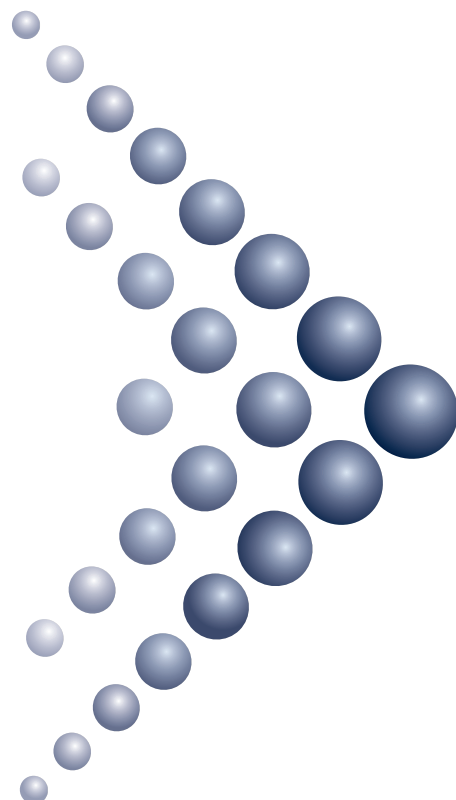




Cancer in Norway 2009

Cancer incidence, mortality,
survival and prevalence in Norway

Special issue:
Cancer screening in Norway



Cancer in Norway 2009

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General requests for cancer information, data or possible research collaborations are welcome, and should be sent to datautlevering@kreftregisteret.no

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Foreword

The Cancer Registry of Norway has collected and compiled data on cancer occurrence since the early 1950s. Up to date statistics as well as trends over time are presented annually in this Cancer in Norway (CiN) publication. CiN represents a coordinated effort by dedicated staff consisting of cancer coders and an editorial team which ensures that statistics are clearly presented. I would like to thank all of our coders, their leaders, members of the IT staff and all of the physicians who have contributed admirably to this achievement. A special thank you goes to Inger Kristin Larsen, Bjørn Møller, Inger Johanne Rein, Bjarke Sæther and Bjarte Aagnes who have compiled the final report, and to all other staff members at the Cancer Registry who have proofread the report or contributed in some other way.

Cancer coding is a complex task which requires a substantial amount of knowledge, not only about cancer codes and coding rules, but also about the natural history of cancer. The Cancer Registry receives reports not only from pathology laboratories, but also from clinicians, the National Cause of Death Registry and, since 2008, the National Patient Registry (NPR). More than 200 000 notifications are received annually. The redundancy in reporting ensures that the Registry's records become more complete. The coders' knowledge and efforts ensure that the records are as accurate as possible.

In 2010 the Cancer Registry changed a number of routines relating to the coding process. Although the Registry still receives case notifications by post, these paper forms are scanned and the patients' identities masked upon receipt. Further in house management and coding is electronic. Another change in 2010 was related to the clinical registries. These were originally set up as independent databases, but several of them have now become electronically integrated with the incidence registry. This reorganization will ultimately improve efficiency, but has caused a delay in publication of CiN 2009.

Every year there is a demand on the Cancer Registry to code additional variables and provide more information, also on the treatment and follow-up of cancer, i.e. by expanding the number of clinical registries. This is important, and our staff members and clinical colleagues throughout the country who participate in the various expert groups do a tremendous job in further developing these clinical registries. However, to satisfy this growing demand, the reporting will need to become increasingly electronic.

Every year CiN includes a Special Issue. This year's special issue focuses on screening for cancer. My thanks goes to everyone who contributed to these articles, and in particular to the special issue editor, Tor Haldorsen. The Cancer Registry runs two national screening programmes, the breast cancer programme and the cervical cancer screening programme. Both of these programmes are described, as well as the rationale for initiating a screening programme for colorectal cancer. The special issue also discusses screening for other types of cancers, and in particular for prostate cancer. These issues have considerable public health implications. The question is not just whether the government should implement new national screening programmes, but whether the effort will save lives and reduce suffering from cancer. Having no national screening programme does not imply that no screening takes place. It simply means that only some individuals will be screened, typically those with higher education or high income, and those who are particularly health conscious. The individuals who undergo screening

will then not necessarily be those who develop cancer. Consequently, opportunistic screening without a national screening programme can be inefficient and not very cost-effective. The cervical cancer screening programme is a good example of the benefits of organized screening. The total number of cytological smears was reduced considerably in Norway after the cervical cancer screening programme was introduced.

The breast cancer and the cervical cancer screening programmes have yet to be formally evaluated. Such evaluations should be done on individual based data, as studies based on aggregate data have been shown to underestimate the beneficial effects of screening. Preliminary results from both programmes suggest that they are indeed on target, but formal evaluations will be useful. As we learn more about the effects these two established screening programmes have had on incidence (of cervical cancer) and mortality (of both cancers), the main question that should be kept in mind is not whether we should screen or not, but how we can improve the screening programmes. How can we use the screening programmes to better identify and differentially treat the aggressive cancers, and at the same time minimize treatment for cancers that grow slowly? To answer this question, a rethinking of the screening programmes based on available scientific evidence is needed. We will also need to conduct further research in collaboration with our clinical and basic science colleagues as well as the dedicated screening programme staff throughout the country, in order to make our screening programmes even better.

On behalf of all the staff at the Cancer Registry, I would like to sincerely thank Dr. Frøydis Langmark, who retired on January 4, 2011, for her continued influence and leadership during 27 years as director of the Cancer Registry. During this period, the Registry developed from a small group of 20-30 physicians, coders and researchers to an institution with more than 130 employees. Dr. Langmark has been a front figure in the Norwegian cancer arena, securing the Registry's national and international reputation, and for that we are all grateful.

Since the beginning of the Cancer Registry, cancer incidence has increased substantially. Because of advances in diagnostics, screening and treatment, survival from cancer has improved, but cancer will remain an important public health problem in the foreseeable future. We hope that this publication will be useful for everyone working towards improvements in cancer prevention and treatment.

Oslo, June 2011

Giske Ursin
Director

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Sammendrag

I denne årlige rapport leverer Kreftregisteret forekomstdata for de ulike kreftsykdommene, og de nyeste data for overlevelse.

Nye tilfeller

I 2009 ble det registrert 27 520 nye krefttilfeller:

54 prosent av tilfellene var blant menn og 46 prosent var blant kvinner. De fem vanligste kreftformene i synkende rekkefølge er for menn; prostata-, lunge-, tykktarms-, blære- og hudkreft, og for kvinner; bryst-, tykktarms-, lunge-, hud- og livmorkreft.

Det kan være tilfeldige årsvariasjoner fra det ene året til det andre, og i tillegg vil siste års tall alltid øke noe på grunn av sent innrapporterte meldinger om krefttilfeller. Ved tolking av krefttall, bør man derfor se på kreftutviklingen over flere år.

Fra forrige femårsperiode (2000-04) til siste periode (2005-09), har risikoen for kreft (insidensraten) økt med 7 prosent for menn, og 3 prosent for kvinner.

For menn ses det størst økning i risikoen for prostatakreft (23 prosent) og føflekkreft (15 prosent). På den positive siden viser ratene for endetarmskreft og lungekreft en liten nedgang på henholdsvis 5 og 4 prosent. Ratene for tykktarmskreft og blærekreft har flatet ut, og de er kun ubetydelig endret i perioden 2005-09 sammenlignet med 2000-04.

For kvinner ser vi den sterkeste økningen i risikoen for lungekreft (13 prosent) og føflekkreft (9 prosent). For første gang siden Kreftregisteret startet registreringene av brystkreft, så vi i 2006 starten på en nedgang i ratene. Femårsperioden 2005-09 viser en nedgang på 4 prosent i ratene sammenlignet med forrige femårsperiode.

Norske kvinner har en av verdens høyeste forekomster av tykk- og endetarmskreft. For disse kreftformene ser vi endelig en utflating. Her er det ingen endring i ratene i siste femårsperiode sammenlignet med den foregående perioden.

Blant barn (0-14 år) er kreft i sentralnervesystemet og leukemi de hyppigste kreftformene, og står for 56 og 59 prosent av alle krefttilfellene hos henholdsvis gutter og jenter. I aldersgruppen 15-49 år er testikkelkreft den hyppigste kreftformen hos menn, mens prostatakreft er den hyppigste kreftform hos middelaldrende og eldre menn.

Kreft i sentralnervesystemet er den hyppigste kreftformen hos jenter i alderen 15-24 år. I aldersgruppen 25-69 år er brystkreft hyppigst, og blant de eldste kvinnene (70+) er tykktarmskreft noe hyppigere enn brystkreft.

Overlevelse

Årets tall bekrefter en trend vi har sett tidligere: Stadig flere overlever kreft. Ved utgangen av 2009 var nær 200 000 nordmenn i live etter å ha fått minst én kreftdiagnose. Det er en økning på over 60 000 personer siden 1999.

En bedret overlevelse ses for alle de fire store kreftformene: Brystkreft, prostatakreft, lungekreft og tykk- og endetarmskreft. Denne økningen er i stor grad et resultat av økt oppmerksomhet rundt kreft både fra pasient og behandlers side og screening i befolkningen. I tillegg kan det være sammenheng med økt kvalitet i behandling.

Relativ overlevelse

Relativ overlevelse er sannsynligheten for at en kreftpasient overlever hvis man ser bort fra andre dødsårsaker.

Fra perioden 2000-04 til 2005-09 økte fem års relativ overlevelse fra

- 79 til 87 prosent for prostatakreft
- 85 til 88 prosent for brystkreft for kvinner
- 13 til 15 prosent for lungekreft for kvinner
- 9 til 12 prosent for lungekreft for menn
- 63 til 66 prosent for endetarmskreft for kvinner
- 57 til 63 prosent for endetarmskreft for menn
- 57 til 62 prosent for tykktarmskreft for kvinner
- 54 til 60 prosent for tykktarmskreft for menn

Sannsynligheten for å utvikle kreft før 75 år er 35 prosent for menn og 28 prosent for kvinner.

Summary

In this annual report the Cancer Registry of Norway delivers incidence data on the different cancer diseases and the latest survival data.

New Cases

There were 27 520 new cancer cases registered in 2009: 54 per cent were among men and 46 per cent among women. The five most common cancer types, in descending order, are for men: prostate, lunge, colon, bladder, skin, and for women: breast, colon, lunge, skin and uterus cancer.

Incidental annual variations may occur from one year to the next. In addition, previous year's numbers will always increase due to delayed notification of cancer cases. When interpreting the cancer statistics, one should look at the cancer development over the past several years.

The incidence rate has increased by 7 per cent in men and three per cent in women from the past five-year period (2000-2004) until the last (2005-2009).

In men one sees the largest incidence increase in cancer of the prostate (23 per cent) and malignant melanoma (15 per cent). On the positive side, the rates for rectum and lung cancer show a small reduction of 5 and 4 per cent, respectively. The rates for colon and bladder cancer have levelled off and are only slightly changed in the period 2005-2009, compared to 2000-2004.

In women we see the strongest increase in incidence of lung cancer (13 per cent) and malignant melanoma (9 per cent). For the first time since the Cancer Registry started registering breast cancer, we saw in 2006 the beginning of a reduction in incidence. The five year period 2005-2009 shows a rate reduction of 4 percent compared to the previous five year period.

Norwegian women have one of the world's highest cancer incidence of the colon and rectum. However, we are finally seeing a levelling off regarding these types of cancer as there is no increase in the rates the last five years compared to the preceding period.

Among children (0-14years of age) cancer in the central nervous system and leukaemia are the most common. They represent 56 and 59 per cent of all cancer cases in boys and girls, respectively. In males aged 15-49 years testicular cancer is most common, but prostate cancer is most common in middle aged and older men.

Cancer in the central nervous system is the most common cancer type in young women 15-24 years old. In the age group 25-69 years breast cancer is most common, and among the oldest women (70+) colon cancer is more common than breast cancer.

Survival

This year's statistics confirm a trend we have seen earlier: Survival continues to increase. At the end of 2009 nearly 200 000 Norwegians are alive after, at one point in time, having had at least one cancer diagnosis. This is an increase of over 60 000 persons since 1999.

One sees an improved survival in all the major cancers: breast, prostate, lung, and colorectal cancer.

This increase is for a large part a result of increased attention regarding cancer from the patient and the health care system and also from screening in the population. In addition, it may be linked to increased quality of treatment.

Relative Survival

Relative survival is the probability of a cancer patient's survival if other causes of death are excluded.

From the period 2000-2004 to 2005-2009 the relative survival increased from:

- 79 to 87 per cent for prostate cancer
- 85 to 88 per cent for breast cancer in women
- 13 to 15 per cent for lung cancer in women
- 9 to 12 per cent for lung cancer in men
- 63 to 66 per cent for rectum cancer in women
- 57 to 63 per cent for rectum cancer in men
- 57 to 62 per cent for colon cancer in women
- 54 to 60 per cent for colon cancer in men

The probability of developing cancer before the age of 75 is 35 per cent in men and 28 per cent in women.

Definitions[❖]

Incidence

The number of new cases (of disease) in a defined population within a specific period of time.

Incidence rate

The number of new cases that arise in a population (incidence) divided by the number of people who are at risk of getting cancer in the same period. The rate is expressed per 100 000 person-years. Person-years is a measurement that combines persons and time (in years) as the denominator in rates.

Crude rate

Rates estimated for the entire population ignoring possible stratifications, such as by age group.

Age-specific rate

A rate calculated on stratifying by age, often based on a five-year interval.

Age-standardised incidence rate

Age-standardised (or age-adjusted) incidence rates are summary rates which would have been observed, given the schedule of age-specific rates, in a population with the age composition of a given standard population. The world standard population (Doll *et al*, 1966) is used in this report.

Prevalence

Prevalence is the number or proportion of a population that has the disease at a given point in time.

Relative survival

The observed survival in a patient group divided by the expected survival of a comparable group in the general population with respect to key factors affecting survival such as age, sex and calendar year of investigation. Relative survival is thus a measure of the excess mortality experienced by the patients regardless of whether the excess mortality may be directly or indirectly attributable to the disease under investigation. A key advantage is that it does not require cause of death information.

Conditional relative survival

The probability of surviving an additional number of years given that the person has already survived X years. As the duration from diagnosis lengthens, the statistic becomes more informative to survivors than the conventional relative survival estimate. A 5-year conditional relative survival that reaches close to 100% X number of years after diagnosis indicates that from thereon in, there is little or no excess mortality among the patient group.

* Based on "A Dictionary of Epidemiology, 4th Ed." (Last, 2001).

Data sources and Methods

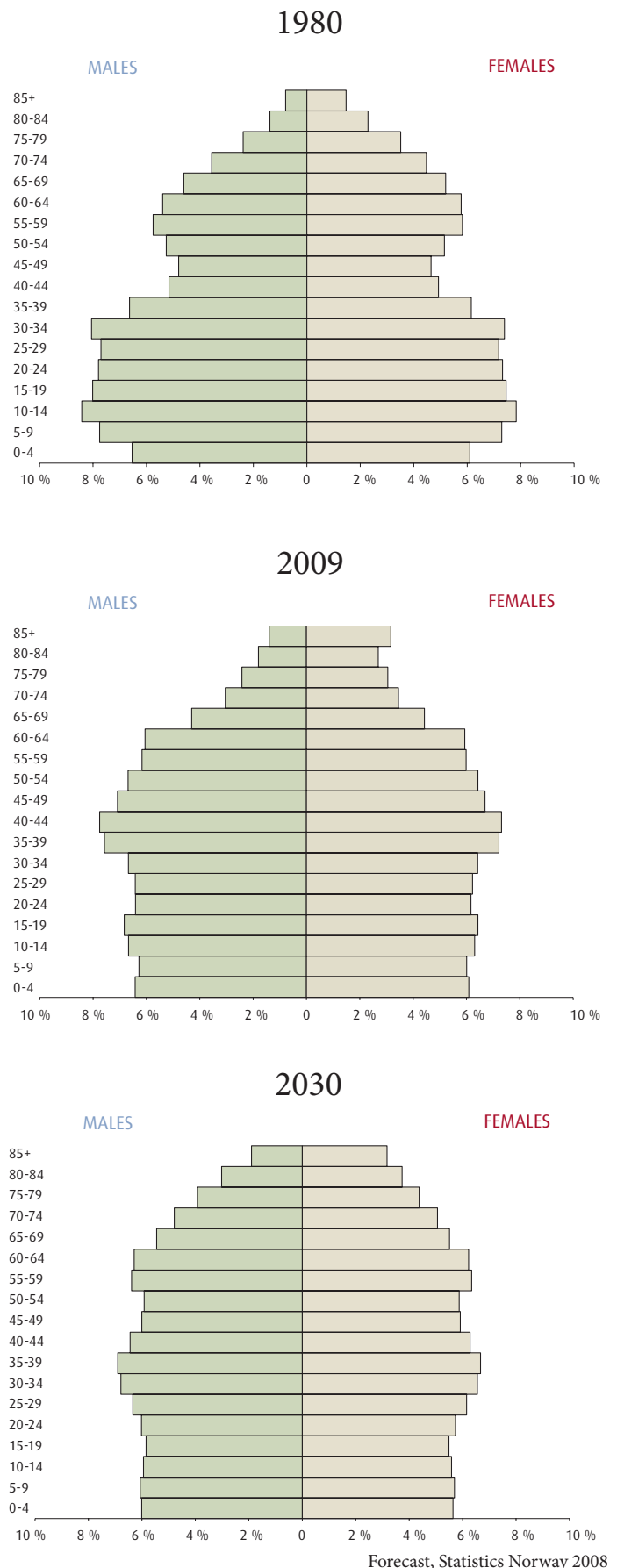
The population of Norway

The Norwegian population is mainly Caucasian. The immigrant population (from over 200 countries) comprised 10.6% of the total population of 4.9 million in 2009 (Table 1). Figure 1 illustrates the changing age structure over time, comparing population estimates from 1980 and 2009 with projections for 2030 (Statistics Norway, 2011). The population of Norway has increased since recording began, and this growth is expected to continue the next few decades. The total number of inhabitants in Norway has increased by 12% during the last 25 years, largely as a result of rising life expectancy and, more recently due to increases in net immigration. By 2030, the size of the population is expected to increase a further 23% to about 5.8 million (Statistics Norway, 2011). The elderly will represent an increasingly large proportion of the population of Norway in the next quarter century. It is projected that by 2030 over one million inhabitants or one-fifth of the population will be aged 65 or over.

Table1: Number of inhabitants in Norway 31.12.2009

Age group	Males	Females
00-04	155882	148046
05-09	152416	146057
10-14	161955	153369
15-19	165748	156284
20-24	155602	149912
25-29	155740	151363
30-34	162005	156153
35-39	183832	175471
40-44	188180	177839
45-49	171934	162742
50-54	162279	156320
55-59	149665	145550
60-64	146836	144346
65-69	104467	107594
70-74	73833	83901
75-79	58738	74118
80-84	43727	65424
85+	33913	76958
TOTAL	2426752	2431447

Figure 1: Age structure of the Norwegian population, 1980, 2009 and 2030



Data sources and registration routines

The Cancer Registry of Norway has, since 1952, systematically collected notifications on cancer occurrence for the Norwegian population. This total number of registrations has from 1953 been considered to be very close to complete. The reporting of neoplasms has been compulsory since the implementation of a directive from the Ministry of Health and Social Affairs in 1951. The Cancer Registry Regulations came into force in 2002 (Regulations for the collection and processing of data in the Cancer Registry of Norway). The main objectives of the Cancer Registry can be summarised as follows:

- Collect data on cancer occurrence and describe the distribution of cancer and changes over time,
- Provide a basis for research to develop new knowledge on the etiology, diagnostic procedures, the natural course of the disease, and the effects of treatment in order to develop appropriate preventive measures as well as to improve the quality of medical care,
- Provide advice and information to public authorities and the general public on preventive measures.

Data items registered in the Cancer Registry of Norway

The following are reportable by law to the Cancer Registry:

- All definite malignant neoplasms (e.g. carcinoma, sarcoma, malignant lymphoma, leukaemia and malignant teratoma).
- All precancerous disorders.
- All histologically benign tumours of the central nervous system and meninges.
- All histologically benign transitional cell papillomas of the urinary tract.
- All tumours of the endocrine glands within the central nervous system.

Registries

The incidence registry

The incidence registry contains the basic data items collected from clinicians and pathologists, as well as data from administrative patient discharge records and mortality sources. From 1953 to June 2011 the incidence registry has recorded 1 469 487 individuals with invasive cancer and 1 183 452 individuals with premalignant conditions.

A total of 3 571 575 notifications have been received since 1969. The incidence registry is updated continuously with information on both new cases, as well as cases diagnosed in previous years.

The present report is based on data from the incidence registry.

Clinical registries

In addition to the basic incidence registry, cancer specific/clinical registries have been established during the last

years. These registries have an extended registration of diagnostic, treatment, clinical, and follow-up data. As of June 2011, registries are established with extended data registration for the following diagnoses:

- Colorectal cancer
- Malignant melanoma
- Breast cancer
- Prostate cancer
- Lymphoma
- Lung cancer
- Childhood cancer
- Ovarian cancer

The section “Research activities at the Registry” provides a more detailed overview of clinical registries.

Notifications and sources of information

The sources of information and the notification process are illustrated in Figure 2. Hospitals, laboratories, general practitioners and Statistics Norway provide the key information that enables the Registry to collect, code and store data on cancer patients in Norway. Information from clinical notifications, pathological notifications and death certificates are the main reporting sources, and these are processed and registered in the incidence registry. Since 1998, information from the Patient Administrative Data (PAD) system in the hospitals has proven an important additional source for identifying patients.

Clinical and pathological notifications

The Cancer Registry Regulations, as issued by the Ministry of Health and Social Affairs, require all hospitals, laboratories and general practitioners in Norway to report all new cases of cancer, irrespective of whether the patient is treated, admitted, or seen only as an outpatient to the Registry within two months. The Registry also receives mandatory reports from individual physicians, and from pathology and cytology laboratories. There are two generic paper-based forms for reporting of solid or non-solid tumours, respectively. Some specific cancers (colorectal cancer, malignant melanoma, breast cancer, prostate cancer, lymphoma, childhood cancer, ovarian cancer) are reported on separate forms with extended information on case history and treatment. Notifications of pathological information are received from hospitals and individual laboratories. These notifications may provide either histological, cytological or autopsy information. The information is identified and linked by the personal identifier number system, established in Norway in 1964.

Death certificates

Records held in the Registry are supplemented with relevant information on vital status from the National Population Registry, and are regularly matched with the Cause of Death Registry run by the Statistics Norway. The Registry receives and registers the death certificates in one or several batches every year. The automated procedure

that matches registered patients to death certificates is important for maintaining quality control, facilitating a high level of completeness and ensuring validity of the Registry data items.

Death certificates also represent a complementary source of information on new cancer cases; those inconsistently specified or unmatched to registry files are subject to further scrutiny. Cancer cases first identified from death certificates are traced back to the certifying hospital or physician. The Registry needs to ascertain from the registrar completing the certificate whether the patient had been investigated and diagnosed when alive, or whether the diagnosis was made following death. A reminder is sent to the physician or institution responsible for the treatment of the patient before death, as indicated on the death certificate. In many cases, a nursing home is the point of contact, and they refer the Registry to the treating physician or hospital where the cancer was diagnosed.

The Patient Administrative Database (PAD) and the Norwegian Patient Register (NPR)

Since 2002, the Registry has received data files from PAD used in all Norwegian hospitals. These files contain information about all patients treated for premalignant and malignant conditions since 1998, and therefore PAD has been a key source in ascertaining information on

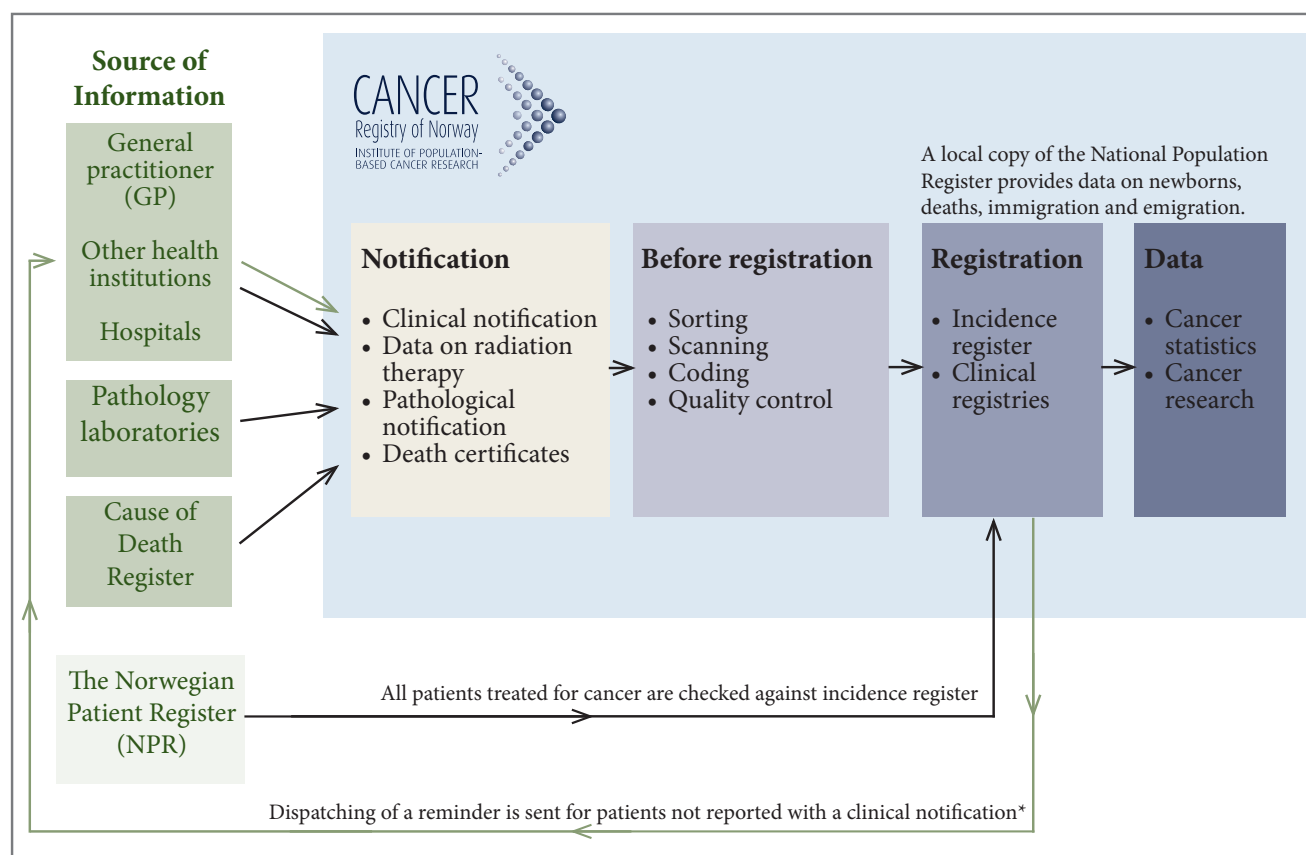
unreported cases. As information from PAD is also sent to NPR, the routine has been changed. Now the Cancer Registry receives PAD information from NPR instead of the hospitals.

Dispatching of reminders

It is mandatory to report clinical information on new cases of cancer within two months of the diagnosis. Reminders are sent to all hospitals and physicians failing to initially report new cases or in cases where the received forms do not yield adequate information. About 40 000 reminders are sent annually, including, in some instances, repeat requests for information. There are two types of reminders:

Pathology and cytology laboratories regularly send copies of pathology reports and autopsies to the Registry. Death certificates are received from the Cause of Death Register at Statistics Norway. In those cases where the clinical report for the cancer case notified from these sources is missing, the hospital/ward/physician responsible for the diagnosis and treatment of the patient is sent a reminder. The NPR captures all C- and some D-diagnoses (ICD-10) and these can be matched with the current information in the Registry database. Reminders are sent to clinical facilities for those cases where no information about the specific diagnosis exists in the Registry (Figure 2).

Figure 2: Sources of information and the processes of cancer registration at the Registry



* Dispatching of reminders for clinical notifications are sent for unregistered cases (notified from the NPR) or cases that are only registered with a pathological notification/death certificate/data on radiation therapy in the registry.

Incidence and mortality data

The incidence data presented in the first part of this report are based on an extraction from the incidence registry on 14 June 2011. The tables and figures in general represent either the latest year of complete incidence (2009) or the latest five-year period (2005-9), the latter grouping used when the stratified numbers are too small to warrant presentation for a single year.

In the urinary tract benign papillomas and atypical epithelial lesions are included as well as invasive cancers. Further in the central nervous system both benign and malignant neoplasms are included. Ovarian borderline tumours and basal cell carcinomas of the skin are excluded.

Codes are translated from ICD-7 to ICD-10 using a combination of topography and morphology. Population data, stratified by year, sex and age, are provided by Statistics Norway. The main cancer forms are tabulated according to their ICD-10 three digit categories. The “all sites” figure comprises all malignant neoplasms (ICD-10 C00-96) plus several benign or precancerous conditions. A commentary on the inclusion and exclusion criteria applied to several sites with respect to morphology is shown below. Corresponding mortality data coded in ICD-10 were obtained from Statistics Norway and are presented in the same ICD-10 categories as incidence.

Follow-up data

To estimate long-term survival patterns and trends, vital statistics of patients diagnosed with cancer during 1960-2009 were obtained by matching to the Cause of Death Registry at Statistics Norway through 31 December 2009. The 23 most common cancers were selected for analysis, and grouped according to their respective ICD-10 categories. About 3.7% of the cases were excluded as they were either registered as DCO cases (Death Certificate Only) or cases diagnosed at autopsy, their survival time could not be estimated (as event dates were missing), or the cases had erroneous event dates (survival time < 0) or zero survival time (survival time = 0). It has been shown that exclusion of patients with a prior cancer diagnosis, which often is associated with an inferior prognosis, may give rise to artificially elevated estimates of survival (Brenner and Hakulinen, 2007). Therefore patients with previous cancer diagnoses were included in each site-specific analysis.

On the other hand, to provide an estimate of “all sites” survival (ICD-10 codes defined as above), analysis was restricted to first primary tumours. While the inclusion of multiple primaries has been recommended for comparative purposes, the corresponding reduction in the overall survival estimates has been shown to be rather negligible; the effect of their inclusion has been shown to reduce 5-year survival in Norway (for diagnoses 1995-9) by less than a percentage point (Rosso *et al.*, 2009). Results should be interpreted with caution. Survival of the most frequent cancers in men and women, prostate and breast cancer, may have been artificially inflated due to the impact of PSA testing and mammographic screening, respectively.

ICD10-codes where specific morphologies are excluded or included

ICD-10	Site	Comments
C38	Mediastinum, pleura	Excludes mesotheliomas of pleura
C44	Skin, non-melanoma	Excludes basal cell carcinoma
C56	Ovary	Excludes borderline tumours
C64	Kidney except renal pelvis	Excludes non-invasive papillary tumours
C65	Renal pelvis	Includes non-invasive papillary tumours
C66	Ureter	Includes non-invasive papillary tumours
C67	Bladder	Includes non-invasive papillary tumours
C68	Other and unspecified urinary organs	Includes non-invasive papillary tumours
C70	Meninges	Includes benign tumours (ICD10, D32-33, D42-43)
C71	Brain	Includes benign tumours (ICD10, D32-33, D35.2-35.4, D42-43, D44.3-44.5)
C72	Spinal cord, cranial nerves and other parts of central nervous system	Includes benign tumours (ICD10, D32-33, D42-43)
C75	Other endocrine glands and related structures	Includes benign tumours (ICD10 D44.3-44.5)
C92	Myeloid leukaemia	Includes myelodysplastic syndrome (ICD10 D46)
C95	Leukaemia of unspecified cell type	Includes polycythemia vera (ICD10 D45) and other, and unspecified tumours in lymphatic or hemopoietic tissue (ICD10 D47)

Statistical methods used in this report

Four measures are used in this report to describe the burden and risk of disease: incidence, mortality, survival and prevalence.

Incidence and mortality

Incidence and mortality refer to the number of new cases and deaths occurring, respectively. The latter is the product of incidence and the fatality of a given cancer. Both measures can be expressed as the absolute number of cases (or deaths), or as the incidence (or mortality) rate, taking into account the size of the population at risk. Rates are essential in the comparisons between groups, and within groups over time. The denominator is the underlying person-time at risk in which the cases or deaths in the numerator arose. Cancer incidence and mortality are presented in this report as both numbers and rates. Several types of rates are used in this report.

Age-specific rates

There are compelling reasons for adjusting for the effect of age when comparing cancer risk in populations. Age is a very strong determinant of cancer risk. The *crude rate*, a rate based on the frequency of cancer in the entire population, is calculated ignoring possible stratifications by age. Although the measure can be useful as an indicator of the total cancer burden, its utility in comparing cancer risk between groups is severely limited when the age distributing differs between groups, or where demographic changes have impacted on the size and age structure of a population over time.

To obtain a more accurate picture of the true risk of cancer, rates are calculated for each age strata, usually grouped in five-year intervals. The age-specific rate for age class i , denoted as r_i is obtained by dividing the number of events in each age class d_i by the corresponding person-years of observation Y_i and multiplying by 100 000:

$$r_i = d_i / Y_i \times 100\,000$$

Rates are provided separately for males and females, because of the often very different cancer patterns by sex. Age and sex-specific incidence and mortality rates are the foundation of epidemiological analysis of cancer frequency data.

Age-standardised rates

To facilitate comparisons however, a summary rate is required that absorbs the schedule of age-specific rates in each comparison group. The summary measure that appears in this report is the age-standardised rate (ASR), a statistic that is independent of the effects of age, thus allowing comparisons of cancer risk between different groups. The calculation of the ASR is an example of direct standardisation, whereby the observed age-specific rates are applied to a standard population. The populations in each age class of the Standard Population are known as the *weights* to be used in the standardisation process. Many possible sets of weights, w_i , can be used. The *world* standard population, a commonly-used reference, is utilised in this report (Segi, 1960; Doll *et al.*, 1966). Although the weights of the world standard fail to resemble those of the Norwegian population in 2009 (Figure 3), this observation is of relatively little importance, since it is the ratio of ASRs, an estimate of the age-adjusted relative risk between populations or within a population over time, that is the focus of interest. This characteristic has been shown to be rather insensitive to the choice of standard (Bray *et al.*, 2002).

For weights w_i in the i th age class of the world standard and for A age classes with $i = 1, 2, \dots, A$, as before, r_i is the age-specific rate in the i th age class. The ASR is calculated as:

$$ASR = \frac{\sum_i r_i w_i}{\sum_i w_i} \times 100\,000$$

Cumulative Risk

The *cumulative risk* is the probability that an individual will develop the cancer under study during a certain age span, in the absence of other competing causes of death (Day, 1982). The age span over which the risk is accumulated must be specified, and in this report, the range 0–74 years is used and provides an approximation of the risk of developing cancer. If before the age of 75 the cumulative risk is less than 10%, as is the case for most cancer forms, it is reasonably approximated by the *cumulative rate*.

The cumulative rate is the summation of the age-specific rates over each year of age from birth to a defined upper age limit. As age-specific incidence rates are computed according to five-year age groups, the cumulative rate

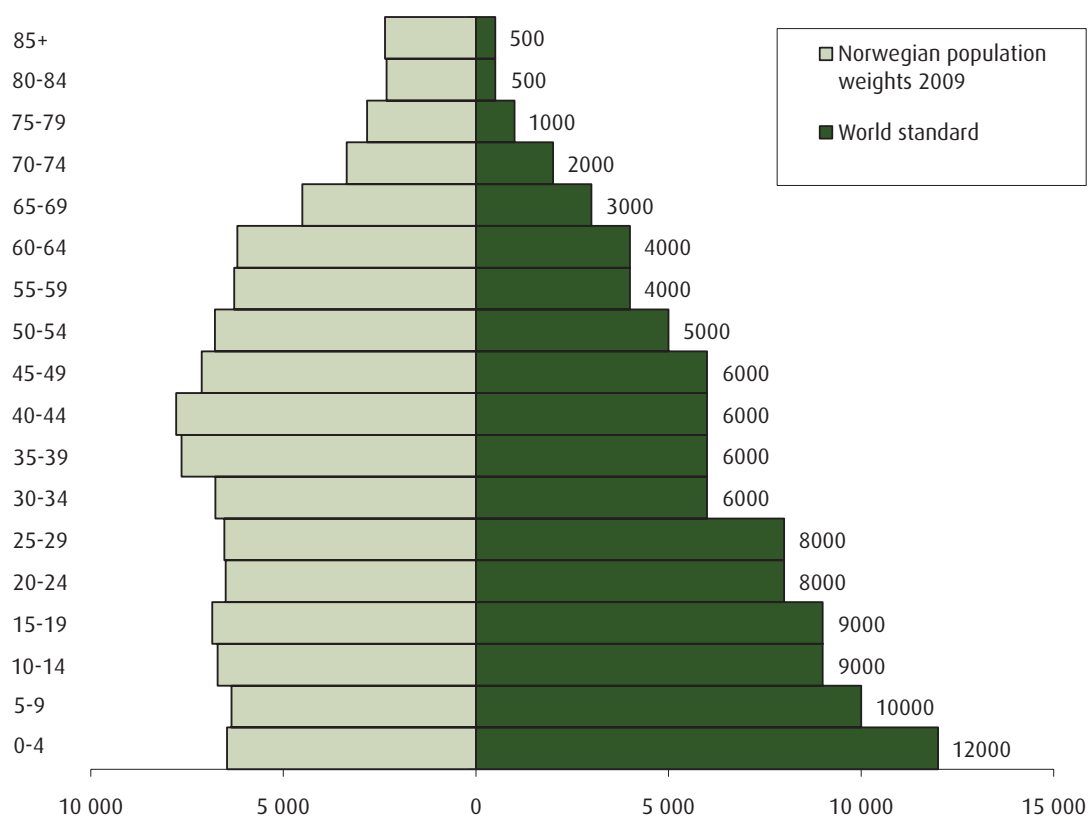
is five times the sum of the age-specific rates calculated over the five-year age groups, assuming the age-specific rates are the same for all ages within the five-year age stratum:

$$5 \sum_i r_i$$

The cumulative rate has several advantages over age-standardised rates. Firstly, as a form of direct standardization, the problem of choosing an arbitrary reference population is eliminated. Secondly, as an approximation to the cumulative risk, it has a greater intuitive appeal, and is more directly interpretable as a measurement of lifetime risk, assuming no other causes of death are in operation. The precise mathematical relationship between the two is:

$$\text{cumulative risk} = 1 - \exp(-\text{cumulative rate})$$

Figure 3: Comparison of population weights



Prevalence

Prevalence is the number or proportion of a population that has the disease at a given point in time. It is a rather complex measure of cancer incidence, mortality, and other factors affecting individuals after diagnosis and treatment.

Prevalence is a useful measure of the number of individuals requiring care for chronic conditions such as hypertension and diabetes. For cancer, on the other hand, many patients diagnosed in the past may now be considered cured, that is to say they no longer have a greater risk of death. However, some residual disability may be present subsequent to for example a specific treatment intervention, thus it is likely that the number of prevalent cancer cases also represents a useful measure. Lifetime cancer prevalence can be defined as the number of living individuals having ever been diagnosed with cancer. Such a measure can easily be derived from the Registry's data, given the very long-term registration of cases and complete follow up over many years. We provide additional estimates that may be useful for quantifying resource requirements; therefore we have incorporated into this report the numbers of persons who were alive on 31 December 2009, and who were previously diagnosed with cancer within one year, one to four years, five to nine years, and 10 or more years.

Survival

The survival time of a cancer patient is defined as the time interval that has elapsed between a cancer diagnosis and subsequent death. The most basic measure of survival is 5-year survival, which represents the percentage of patients still alive 5 years after the date of diagnosis.

Relative Survival

Not all deaths among cancer patients are due to the primary cancer under study. Deaths resulting from other causes will lower the survival and possibly invalidate comparisons between populations. Relative survival is calculated to circumvent this problem by providing an estimate of net survival, and is defined as the observed survival proportion in a patient group divided by the expected survival of a comparable group in the general population with respect to age, sex and calendar year of investigation. At each time t (year) since diagnosis, the relative survival from the cancer, $R(t)$, is defined as follows:

$$R(t) = So(t) / Se(t)$$

where $So(t)$ is the observed survival of cancer patients while the calculation of expected survival $Se(t)$ is based on matching the major demographic characteristics of the patients to the general population. This requires the Norwegian population life tables from Statistics Norway by 1-year age group, sex, and 1-year calendar period. The

method of Hakulinen (Hakulinen, 1982) was used for estimating expected survival.

With traditional cohort-based analyses, the most up-to-date estimates of longer-term survival would have pertained to patients diagnosed in the distant past, with corresponding profiles of prognosis. In contrast, period-based analyses consider the survival experience in recent years, and the survival that would have been observed in a hypothetical cohort of patients who experienced the same interval-specific survival as the patients who were actually at risk during a specific calendar period. Brenner and Hakulinen (Brenner and Hakulinen, 2002) have concluded that period analysis should be used for routine purposes so as to advance the detection of progress in long-term cancer patient survival. Both clinicians and patients are primarily interested in up-to-date estimates of survival, and its incorporation into Cancer in Norway aims to reflect the most recent developments in cancer care.

In this report, we have used a three-year period window (2007-2009) to estimate relative survival up to 15 years, thus patients diagnosed in 2006-2009 contribute with (part of) their survival experience the first year of follow up (part of the first year if they were diagnosed in 2006 or 2009), patients diagnosed in 2005-2008 contribute to the second year of follow up, patients diagnosed in 2004-2007 contribute to the third year of follow up etc. Thus, the period approach consists of the pieces of survival experience in 2007-2009 for all patients who have been diagnosed 15 years ago or less. The same approach is used to analyse time trends, using a three-year moving period window from 1965 to 2009. To increase stability in the estimates, stage-specific survival is presented using a five-year period window.

A more thorough review of, and rationale for, the utilisation of these survival methods was provided in the Special Issue of Cancer in Norway 2007.

Conditional relative survival

The majority of cancer survivors wish to obtain information on their current prognosis, once they have survived a certain period of time after diagnosis. Conditional survival is a key indicator in this respect, estimating survival proportions given that patients have already survived a certain duration of time (Hankey and Steinhorn, 1982; Janssen-Heijnen et al., 2007). The point at which conditional 5-year relative survival reaches 100% is the point where there is no excess mortality among the cancer patients, and prognosis is equivalent to that experienced in the general population. As with the 15-year relative survival analyses, a three-year period window (2007-2009) is used in this report, and we present estimates of sex-specific 5-year relative survival conditional on being alive 1 to 10 years after diagnosis. Estimates were not plotted when there were too few cancer survivors ($n < 20$), or where the conditional relative survival exceeded 100%.

Data quality, completeness and timeliness

Data quality

Cancer in Norway 2006 included as a Special Issue an overview and comprehensive assessment of the data quality at the Cancer Registry of Norway. The report is available at www.kreftregisteret.no. Subsequently there have been several reports on data quality and completeness. Larsen et al. (Larsen et al., 2009) reported that the coding and classification systems, in general, follow international standards. Estimated overall completeness was 98.8% for the registration period 2001-2005, a lower completeness was observed for haematological malignancies and cancers of the central nervous system. Practical aspects and techniques for addressing the data quality at a cancer registry, including the documentation of comparability, validity and timeliness has recently been reviewed (Bray and Parkin, 2009). Methods for the evaluation of registry completeness have also been assessed recently (Parkin and Bray, 2009).

Two indicators of accuracy are included in Table 2, namely the percentage histologically verified (HV%), and the percentage of death certificate only registrations (%DCO). See the above references for further details. The Registry has implemented the rules for registration and reporting of multiple neoplasms as defined jointly by the International Association of Cancer Registries (IACR) and the International Agency for Research on Cancer (IARC) (International Association of Cancer Registries, 2004).

Completeness and timeliness of incidence

Table 3 shows the number of cancer cases diagnosed in 2008 as enumerated on 27 November 2009 (for CiN 2008), and 14 June 2011 (the time of extraction for this report). The number of cancer cases diagnosed in 2008

reported and appearing in this issue (CiN 2009) are 999 (3.8%) more than those registered one and a half years ago (in CiN 2008), with the differences varying by site. The largest apparent deficits of 35.3% and 28.1% were for malignant immunoproliferative diseases and other endocrine glands, respectively. The main reason for this is that there is an increased awareness among clinicians that these diseases should be classified as cancer and reported. Especially reporting of tumours of the sellar region has increased. A large proportion of these tumours are only diagnosed by radiological methods. Because the diagnosis are received from the PAD this has led to an increased number of reminders sent out resulting in an increased number of cases. Common cancers such as melanoma of the skin, and breast cancers, however, appear to have been almost complete when CiN 2008 was published. One pathology laboratory had technical difficulties with their reporting system, resulting in delayed submission of notifications for part of the year 2008. This deficit constitutes 31% (310 of the 999) of the late registrations.

In the last few years, prostate cancer incidence has been increasing, but the specific number of cases is somewhat unstable, being subject to year-to-year variation in connection with PSA testing in Norway. It is easier to explain the deficit in 2008 in the incidence of certain cancers associated with poorer prognosis where registration relies on death certificates to initiate registrations, such as pancreatic cancer. The shortfall may be explained by the backlog in the processing death certificates. The fact that the current DCO proportion for this cancer is above 7% for registrations in 2009 would tend to support this explanation.

Table 2 Percentage distribution of HV (histologically verified) and DCO (death certificate only) by primary site 2005-2009

ICD10	Site	Cases	HV %	DCO %
C00-96	All sites	133290	88.8	1.7
C00-14	Mouth, pharynx	2353	97.4	0.3
C00	Lip	581	99.3	0.3
C01-02	Tongue	442	98.0	0.2
C03-06	Mouth, other	463	98.9	0.2
C07-08	Salivary glands	207	86.5	0.0
C09-14	Pharynx	660	97.6	0.3
C15-26	Digestive organs	27451	89.1	2.8
C15	Oesophagus	995	95.9	1.1
C16	Stomach	2589	95.2	1.4
C17	Small intestine	589	96.1	1.2
C18	Colon	11816	95.1	2.0
C19-21	Rectum, rectosigmoid, anus	6125	97.4	0.8
C22	Liver	733	73.8	6.1
C23-24	Gallbladder, bile ducts	724	65.5	6.9
C25	Pancreas	3388	57.8	7.2
C26	Other digestive organs	492	61.0	15.9
C30-34, C38	Respiratory organs	13591	77.7	2.0
C30-31	Nose, sinuses	215	98.6	0.5
C32	Larynx, epiglottis	583	97.6	0.7
C33-34	Lung, trachea	12695	76.6	2.0
C38	Mediastinum, pleura (non-mesothelioma)	98	61.2	6.1
C40-41	Bone	237	96.6	0.4
C43	Melanoma of the skin	6297	99.1	0.2
C44	Skin, non-melanoma	7245	98.7	0.1
C45	Mesothelioma	377	88.3	0.3
C46	Kaposi's sarcoma	48	95.8	2.1
C47	Autonomic nervous system	63	100.0	0.0
C48-49	Soft tissues	723	95.7	0.1
C50	Breast	13882	98.0	0.2
C51-58	Female genital organs	7832	95.2	1.1
C53	Cervix uteri	1488	98.3	0.2
C54	Corpus uteri	3420	98.9	0.2
C55	Uterus, other	42	54.8	21.4
C56	Ovary	2205	88.4	2.3
C51-52, C57	Other female genital	664	95.0	2.4
C58	Placenta	13	53.8	0.0
C60-63	Male genital organs	22407	96.1	1.2
C61	Prostate	20723	95.9	1.3
C62	Testis	1454	99.2	0.3
C60, C63	Other male genital	230	97.8	0.4
C64-68	Urinary organs	9993	93.6	1.4
C64	Kidney excl. renal pelvis	3138	87.4	2.8
C65	Renal pelvis	366	92.3	0.8
C66-68	Bladder, ureter, urethra	6489	96.7	0.7
C69	Eye	303	44.6	0.3
C70-72, D32-33	Central nervous system	5090	61.7	1.4
C73	Thyroid gland	1177	94.3	0.7
C37, C74-75	Other endocrine glands	1110	58.1	1.8
C39, C76, C80	Other or unspecified	2145	52.6	12.7
C81-96	Lymphoid and haematopoietic tissue	10966	74.6	2.3
C81	Hodgkin lymphoma	584	99.3	0.2
C82-85, C96	Non-Hodgkin lymphoma	4128	96.7	0.4
C88	Malignant immunoproliferative diseases	240	72.1	2.1
C90	Multiple myeloma	1780	55.1	4.0
C91-95, D45-47	Leukaemia	4234	58.0	3.7

Table 3 Registered cancer cases in Norway, 2008 as obtained from the incidence registry extracted 27th November 2009 and 10th June 2011

ICD10	Site	Cases diagnosed 2008 as of			
		27.11.2009	10.06.2011	Difference	%
C00-96	All sites	26121	27120	999	3.8
C00-14	Mouth, pharynx	451	468	17	3.8
C00	Lip	104	108	4	3.8
C01-02	Tongue	94	95	1	1.1
C03-06	Mouth, other	87	88	1	1.1
C07-08	Salivary glands	38	42	4	10.5
C09-14	Pharynx	128	135	7	5.5
C15-26	Digestive organs	5329	5568	239	4.5
C15	Oesophagus	213	221	8	3.8
C16	Stomach	483	506	23	4.8
C17	Small intestine	112	114	2	1.8
C18	Colon	2371	2428	57	2.4
C19-21	Rectum, rectosigmoid, anus	1173	1239	66	5.6
C22	Liver	148	155	7	4.7
C23-24	Gallbladder, bile ducts	127	139	12	9.4
C25	Pancreas	611	666	55	9.0
C26	Other digestive organs	91	100	9	9.9
C30-34, C38	Respiratory organs	2715	2782	67	2.5
C30-31	Nose, sinuses	37	39	2	5.4
C32	Larynx, epiglottis	134	135	1	0.7
C33-34	Lung, trachea	2529	2591	62	2.5
C38	Mediastinum, pleura (non-mesothelioma)	15	17	2	13.3
C40-41	Bone	46	46	0	0.0
C43	Melanoma of the skin	1285	1294	9	0.7
C44	Skin, non-melanoma	1450	1464	14	1.0
C45	Mesothelioma	66	68	2	3.0
C46	Kaposi's sarcoma	7	8	1	14.3
C47	Autonomic nervous system	13	15	2	15.4
C48-49	Soft tissues	128	130	2	1.6
C50	Breast	2774	2779	5	0.2
C51-58	Female genital organs	1565	1591	26	1.7
C53	Cervix uteri	270	293	23	8.5
C54	Corpus uteri	716	718	2	0.3
C55	Uterus, other	8	7	-1	-12.5
C56	Ovary	457	451	-6	-1.3
C51-52, C57	Other female genital	114	122	8	7.0
C58	Placenta			0	0.0
C60-63	Male genital organs	4515	4765	250	5.5
C61	Prostate	4168	4409	241	5.8
C62	Testis	296	306	10	3.4
C60, C63	Other male genital	51	50	-1	-2.0
C64-68	Urinary organs	1902	2045	143	7.5
C64	Kidney excl. renal pelvis	597	659	62	10.4
C65	Renal pelvis	87	89	2	2.3
C66-68	Bladder, ureter, urethra	1218	1297	79	6.5
C69	Eye	60	64	4	6.7
C70-72, D32-33	Central nervous system	882	953	71	8.0
C73	Thyroid gland	229	233	4	1.7
C37, C74-75	Other endocrine glands	196	251	55	28.1
C39, C76, C80	Other or unspecified	376	368	-8	-2.1
C81-96	Lymphoid and haematopoietic tissue	2132	2228	96	4.5
C81	Hodgkin lymphoma	118	120	2	1.7
C82-85, C96	Non-Hodgkin lymphoma	837	837	0	0.0
C88	Malignant immunoproliferative diseases	34	46	12	35.3
C90	Multiple myeloma	351	362	11	3.1
C91-95, D45-47	Leukaemia	792	863	71	9.0

Cancer incidence, mortality, survival and prevalence in Norway 2009

Incidence

In 2009, 27 520 new cases of cancer were recorded in Norway, for which 14 792 occurred among men and 12 728 among women (Table 4). Cancers of the prostate, female breast, colon and lung are the most common cancers and comprise almost half of the total cancer burden.

In men, prostate cancer continues to be the most frequent cancer in men (4299), followed by colorectal (1785) and lung cancer (1519).

Breast cancer remains the most frequent neoplasm in women, with 2745 new cases in 2009, followed by colorectal and lung cancer, with 1839 and 1129 incident cases, respectively.

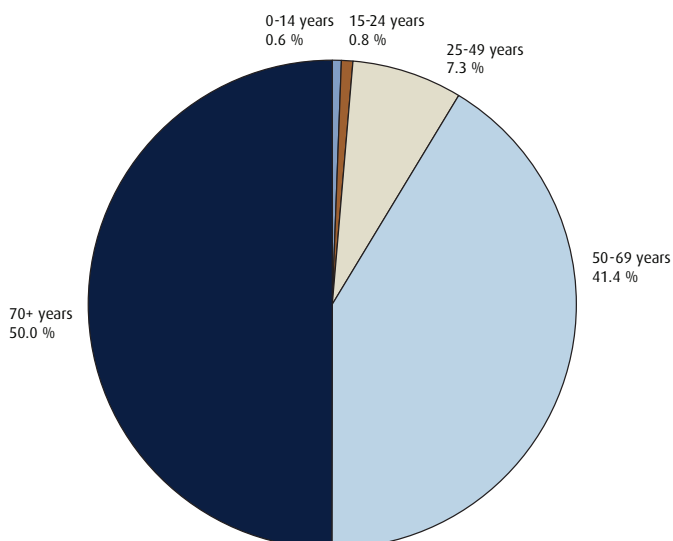
The vast majority of cancers in Norway - over 90% in men and 85% in women are diagnosed in persons over the age of 50 (Figure 4). About half are diagnosed at ages 70 or greater, while 40% of all new cases occur between the ages

50 and 69, in men and women alike. A larger proportion of cancers are diagnosed in women than men at the ages of 25 to 49, while similar proportions, constituting slightly over 1% of the cancer burden, occur in children and young adults.

The relative impact of cancer at different ages varies considerably by cancer site. Figure 5 identifies the cancer types that are the main contributors to the disease burden at different ages. Cancers of the central nervous system are most frequent in children and young female adults, while testicular cancer is by far the most common cancer diagnosed in young men. Prostate cancer is the most frequent cancer in men aged over 50, while breast cancer is the most common cancer diagnosis in women from the ages 25 through to 69.

Figure 4: Percentage distribution of cancer incidence by age, 2005-2009

MALE



FEMALE

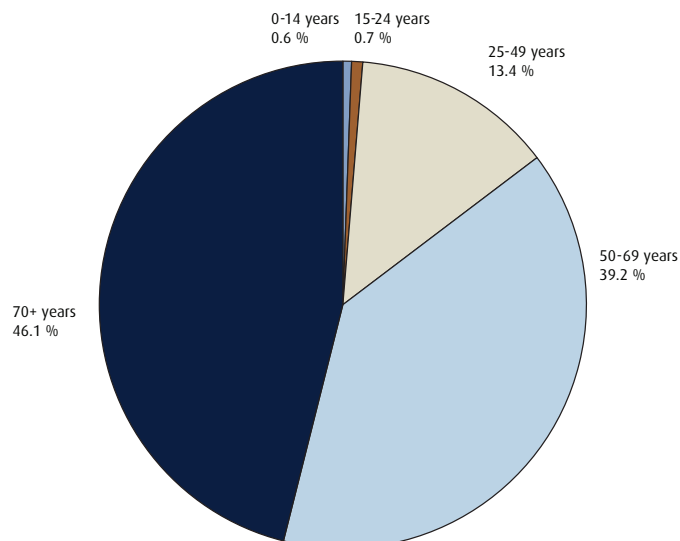
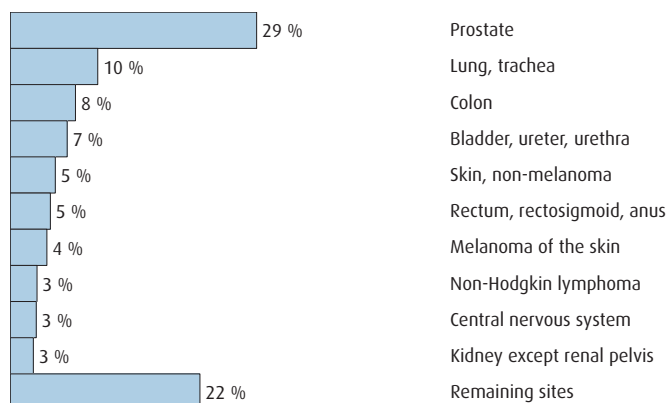


Table 4 Number of new cases by primary site and sex - 2009

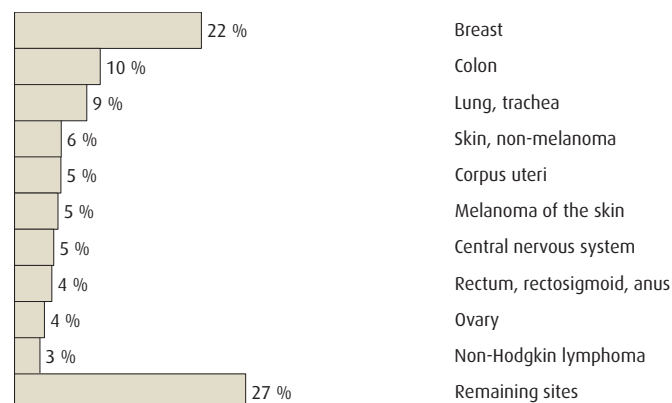
ICD10	Site	Males	Females	Total
C00-96	All sites	14792	12728	27520
C00-14	Mouth, pharynx	338	171	509
C00	Lip	83	39	122
C01-02	Tongue	74	33	107
C03-06	Mouth, other	63	46	109
C07-08	Salivary glands	20	16	36
C09-14	Pharynx	98	37	135
C15-26	Digestive organs	2849	2734	5583
C15	Oesophagus	146	53	199
C16	Stomach	261	214	475
C17	Small intestine	80	72	152
C18	Colon	1086	1319	2405
C19-21	Rectum, rectosigmoid, anus	699	520	1219
C22	Liver	101	63	164
C23-24	Gallbladder, bile ducts	73	74	147
C25	Pancreas	343	348	691
C26	Other digestive organs	60	71	131
C30-34, C38	Respiratory organs	1639	1170	2809
C30-31	Nose, sinuses	21	12	33
C32	Larynx, epiglottis	87	21	108
C33-34	Lung, trachea	1519	1129	2648
C38	Mediastinum, pleura (non-mesothelioma)	12	8	20
C40-41	Bone	35	27	62
C43	Melanoma of the skin	692	721	1413
C44	Skin, non-melanoma	847	741	1588
C45	Mesothelioma	69	12	81
C46	Kaposi's sarcoma	5	4	9
C47	Autonomic nervous system	6	6	12
C48-49	Soft tissues	67	99	166
C50	Breast	15	2745	2760
C51-58	Female genital organs		1558	1558
C53	Cervix uteri		296	296
C54	Corpus uteri		696	696
C55	Uterus, other		16	16
C56	Ovary		419	419
C51-52, C57	Other female genital		130	130
C58	Placenta		1	1
C60-63	Male genital organs	4664		4664
C61	Prostate	4299		4299
C62	Testis	320		320
C60, C63	Other male genital	45		45
C64-68	Urinary organs	1448	632	2080
C64	Kidney excl. renal pelvis	423	240	663
C65	Renal pelvis	48	34	82
C66-68	Bladder, ureter, urethra	977	358	1335
C69	Eye	27	37	64
C70-72, D42-43	Central nervous system	399	562	961
C73	Thyroid gland	74	179	253
C37, C74-75	Other endocrine glands	127	110	237
C39, C76, C80	Other or unspecified	190	226	416
C81-96	Lymphoid and haematopoietic tissue	1301	994	2295
C81	Hodgkin lymphoma	78	44	122
C82-85, C96	Non-Hodgkin lymphoma	483	404	887
C88	Malignant immunoproliferative diseases	22	17	39
C90	Multiple myeloma	213	148	361
C91-95, D45-47	Leukaemia	505	381	886

Figure 5: The most frequent incident cancers by age and sex, 2005-2009

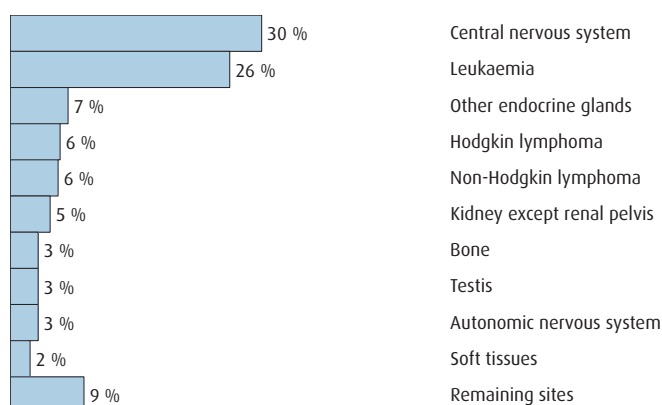
MALES all ages (70 979 cases)



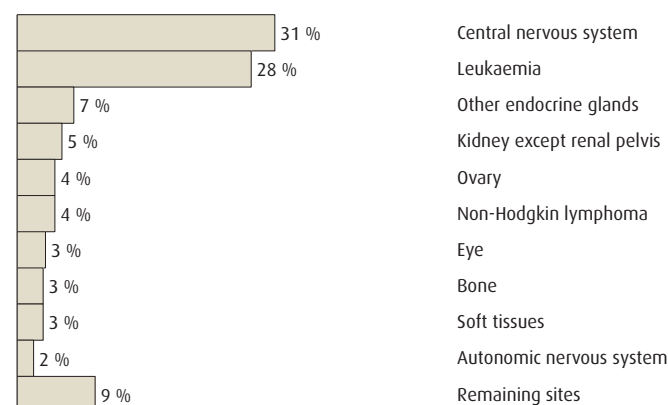
FEMALE all ages (62 311 cases)



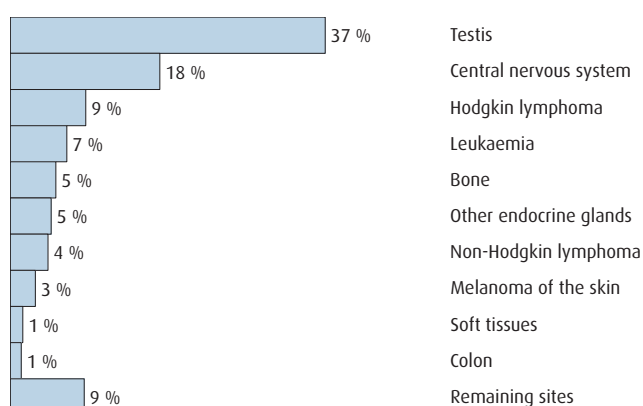
MALES 0-14 years (423 cases)



FEMALE 0-14 years (357 cases)



MALES 15-24 years (536 cases)



FEMALE 15-24 years (458 cases)

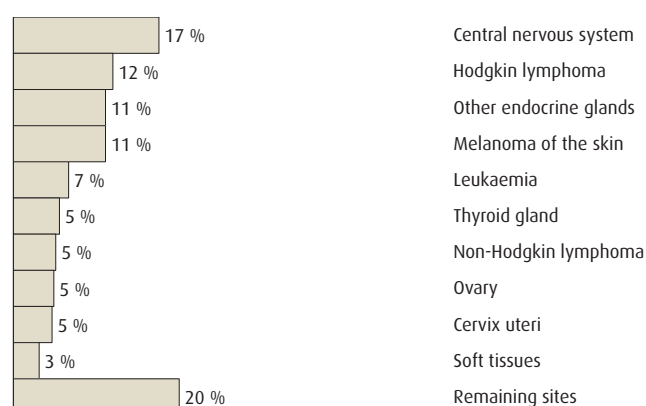
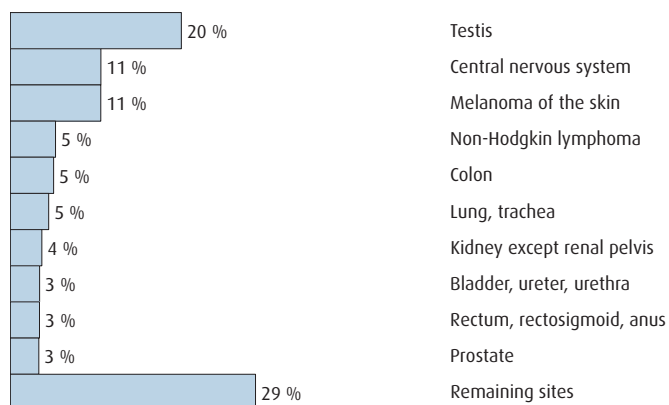
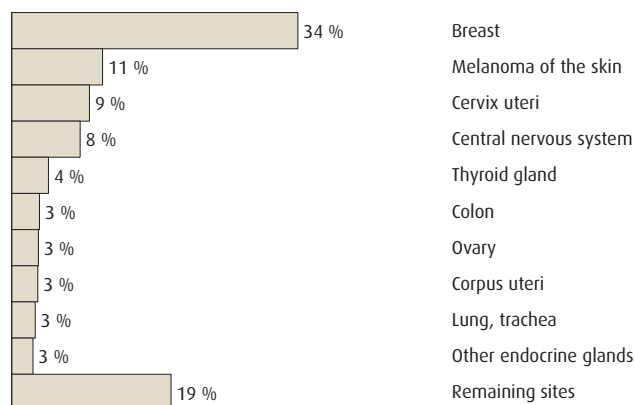


Figure 5 cont.

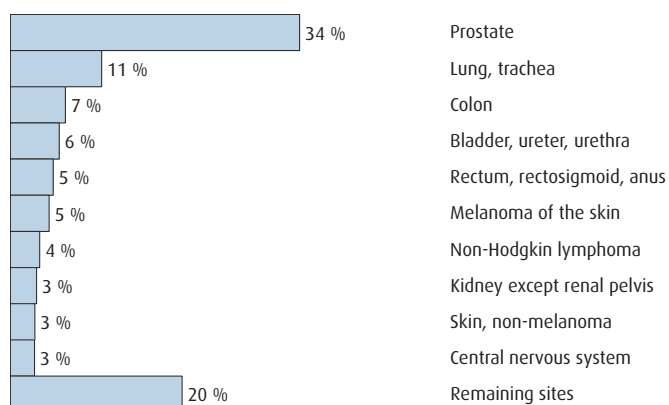
MALES 25-49 years (5 192 cases)



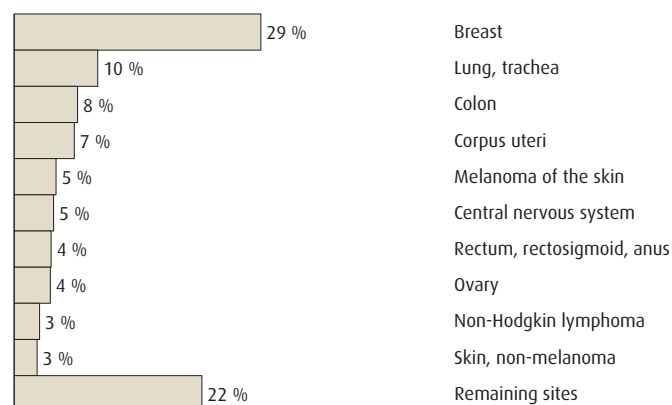
FEMALE 25-49 years (8 334 cases)



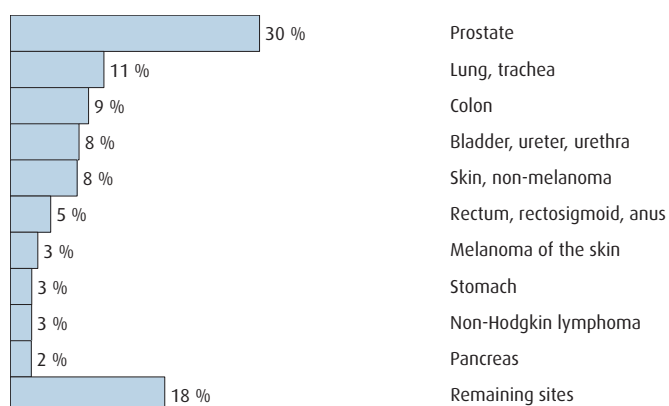
MALES 50-69 years (29 357 cases)



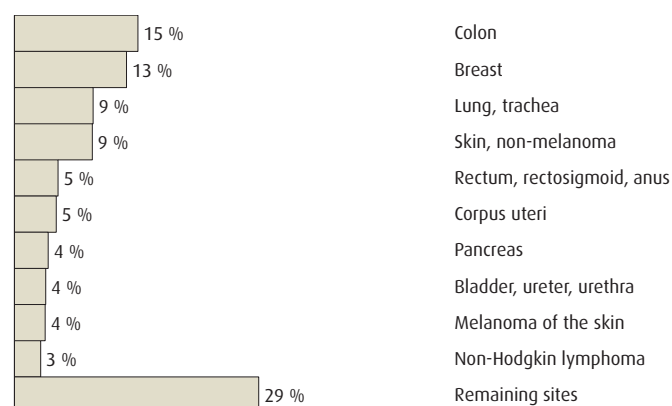
FEMALE 50-69 years (24 451 cases)



MALES 70+ years (35 471 cases)



FEMALE 70+ years (28 711 cases)



The age-standardised rates and male:female (M:F) ratios for selected cancer types in 1978-1982 and 2005-2009 are compared in Table 5. Men tend to have higher rates of incidence for most cancer types in both time periods, with the exceptions of gallbladder and bile ducts, melanoma of the skin and thyroid cancer. The highest M:F ratios are observed for several head and neck cancers, although a number of the most frequent cancer forms - including cancers of the lung, bladder, stomach and rectum - are consistently more common among men. The declines in

the M:F ratios for several neoplasms over the last 25 years may largely be the result of decreasing incidence trends in men and increasing incidence trends in women for a number of cancer types. For lung cancer, the reduction of the M:F ratios over the last two to three decades points to a differential in sex-specific trends with the rapidly increasing trends in lung cancer rates among women contrasting with the recent declines in the last decade among men.

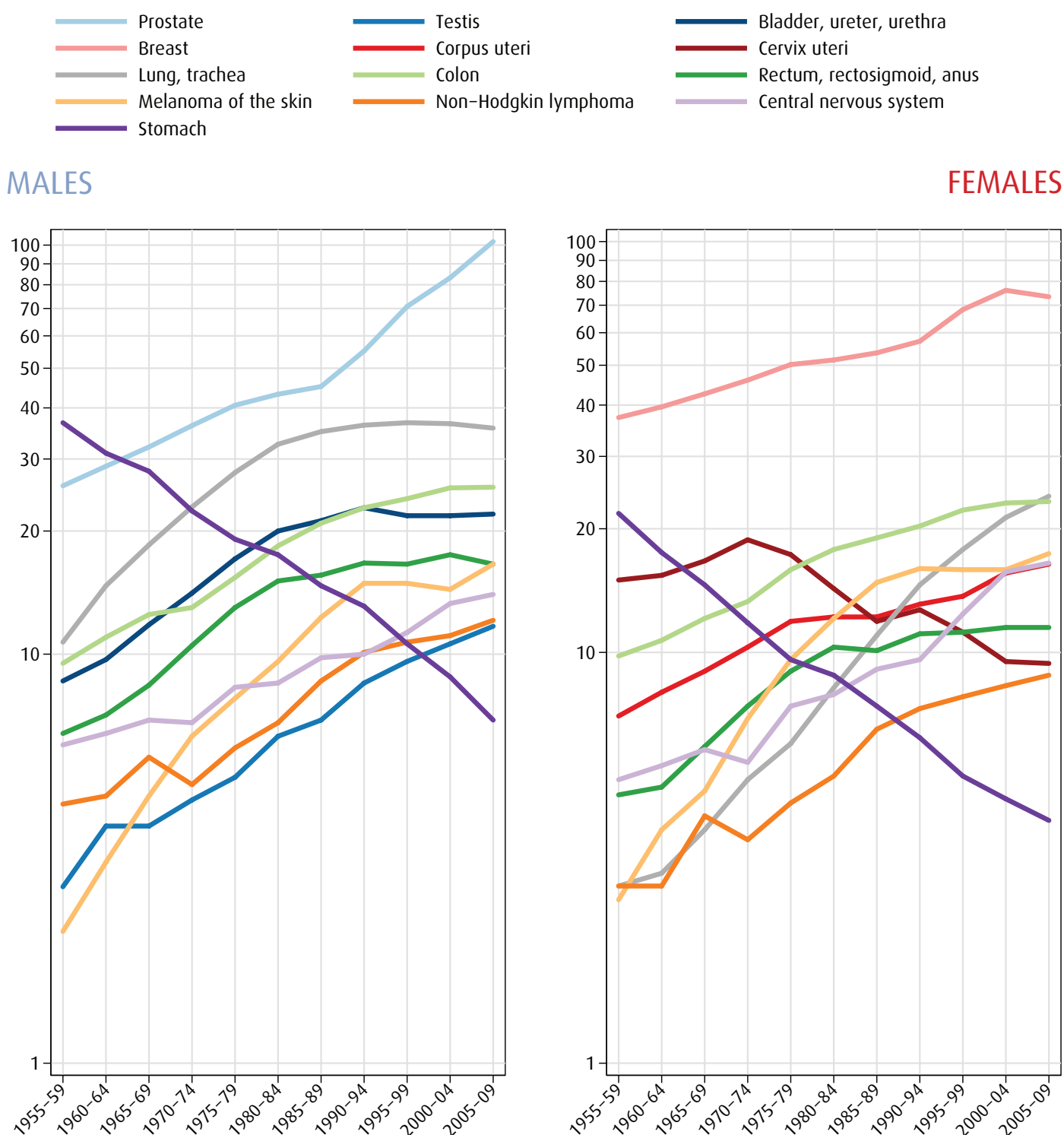
Table 5: Sex ratios (male:female) of age-adjusted rates (world) in 1978-82 and 2005-2009 by primary site, sorted in descending order in last period

ICD10	Site	1978-1982			2005-2009		
		M	F	M/F ratio	M	F	M/F ratio
C32	Larynx, epiglottis	3.1	0.3	10.3	2.5	0.4	5.7
C15	Oesophagus	2.7	0.7	3.8	3.7	1.0	3.6
C66-68	Bladder, ureter, urethra	18.2	5.5	3.3	22.0	6.5	3.4
C09-14	Pharynx	1.6	0.5	3.2	2.7	1.0	2.7
C65	Renal pelvis	1.0	0.4	2.2	1.1	0.5	2.2
C01-02	Tongue	1.0	0.4	2.7	1.6	0.7	2.2
C22	Liver	1.8	1.0	1.8	2.4	1.1	2.1
C64	Kidney excl. renal pelvis	7.5	4.0	1.9	10.3	5.5	1.9
C16	Stomach	18.0	9.2	2.0	6.9	3.9	1.8
C00	Lip	3.4	0.4	7.9	1.6	0.9	1.8
C90	Multiple myeloma	4.7	3.0	1.5	4.9	3.1	1.6
C33-34	Lung, trachea	30.9	7.3	4.2	35.7	24.0	1.5
C81	Hodgkin lymphoma	2.6	1.6	1.6	2.7	1.8	1.4
C91-95, D45-47	Leukaemia	8.1	5.4	1.5	9.1	6.3	1.4
C19-21	Rectum, rectosigmoid, anus	14.7	10.1	1.5	16.6	11.5	1.4
C82-85, C96	Non-Hodgkin lymphoma	6.2	4.5	1.4	12.1	8.8	1.4
C25	Pancreas	8.4	5.3	1.6	7.9	6.3	1.3
C18	Colon	17.1	17.4	1.0	25.6	23.3	1.1
C23-24	Gallbladder, bile ducts	1.1	1.6	0.7	1.6	1.5	1.0
C43	Melanoma of the skin	8.9	10.4	0.9	16.6	17.4	1.0
C73	Thyroid gland	1.6	5.1	0.3	2.0	5.2	0.4

Figure 6 depicts time trends in incidence for a number of common cancers. Of note are:

1. the continuing upsurge in prostate cancer incidence since 1990, largely the result of an increasing use of the Prostate Specific Antigen (PSA) test and subsequent biopsies to detect prostate cancer in Norway
2. yearly declines in incidence rates have been observed for breast cancer since 2005. The latest five-year period (2005-09) is however the first full period reflecting the declining trends
3. the increasing rates of melanoma for both sexes
4. the contrasting lung cancer trends in men and women, with a peak and recent flattening observed in men, but rapid increases in women, largely reflecting the respective phases of the smoking epidemic
5. the continuing increase in colon cancer now seems to be stabilising, and thus following the trends that have been observed for rectal cancer in both sexes, these trends possibly reflecting changing lifestyle
6. the continuing declines in stomach cancer in both sexes, reflecting the joint impact of refrigeration and control of H. Pylori infection
7. the rapid increases in a number of cancers for which the underlying determinants remain enigmatic, amongst them testicular cancer in men and non-Hodgkin lymphoma in both sexes

Figure 6: Time trends in age-standardised incidence rates (world) in Norway for selected cancers (semi-log scale)



The incidence rates of cancer in Norway has been increasing in the last decade (Table 7), as it has been since the Registry began reporting in 1953. While this observation certainly reflects a genuine increase in risk of common cancers such as breast cancer in women, and colorectal and lung cancer in both sexes, an increasing ability to diagnose a number of cancer types with time has also contributed.

Such trends are only partially compensated by decreasing incidence trends of stomach cancer and cervical cancer

in women (Figure 6). More detailed trends of incidence, mortality and survival for 23 cancers are provided in a later section of this report.

Even if rates were to remain stable over the next 15 years, the number of new cases would certainly increase as a result of the joint demographic effects of population growth and ageing (see the special issue of CiN 2005 for predictions of cancer in Norway up to 2020, by Health Region.)

The cumulative risk is shown in Table 6 and in Figure 7, for the most common 15 cancers in men and women, respectively. The cumulative risk of 12.7 for prostate cancer ranks highest in males and indicates that, in the absence of competing causes of death, approximately one in eight men will develop this cancer before the age of 75. The corresponding risk of developing lung cancer is considerably lower in comparison, with about one in 25 men estimated to be diagnosed with the disease before the age of 75.

The cumulative risk of breast cancer ranks highest in women, with the figure of 8.0 indicating that about one in 12 Norwegian women develop this disease before the age of 75, in the absence of competing causes. As with men,

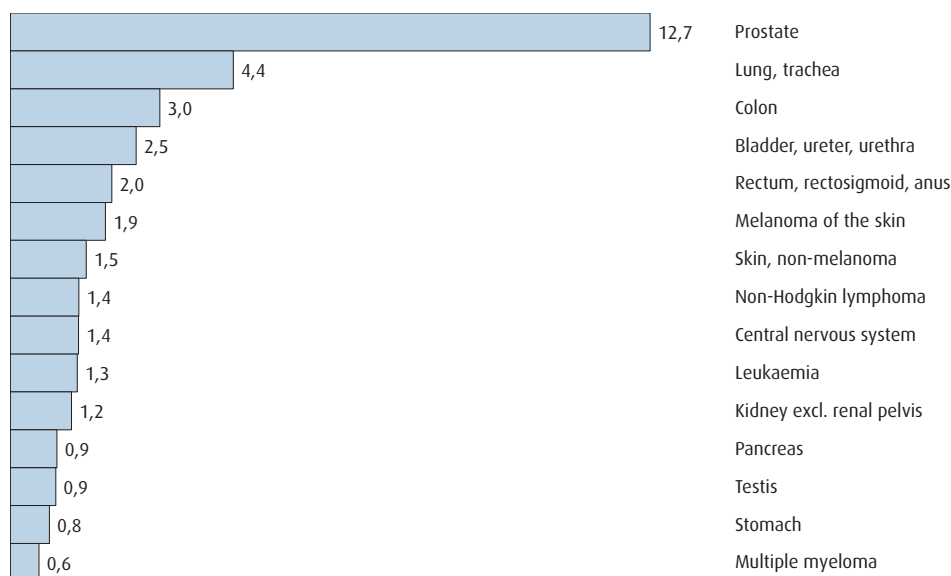
colorectal and lung cancers rank second and third. Tables 7-16 provide further information on the distribution of cancer incidence in Norway. The number of incident cases and rates are tabulated according to year of diagnosis, age group, county of residence, and stage.

Further information

The descriptions in this report can be downloaded from the Cancer Registry of Norway website in various formats. The previous Special Issues on regional predictions, data quality, long-term survival, The Janus Serum Bank in CiN 2005-8, respectively are also available online: www.kreftregisteret.no

Figure 7: Cumulative risk of developing cancer by the age of 75 for selected cancers by sex - 2005-2009 (%)

MALES



FEMALES

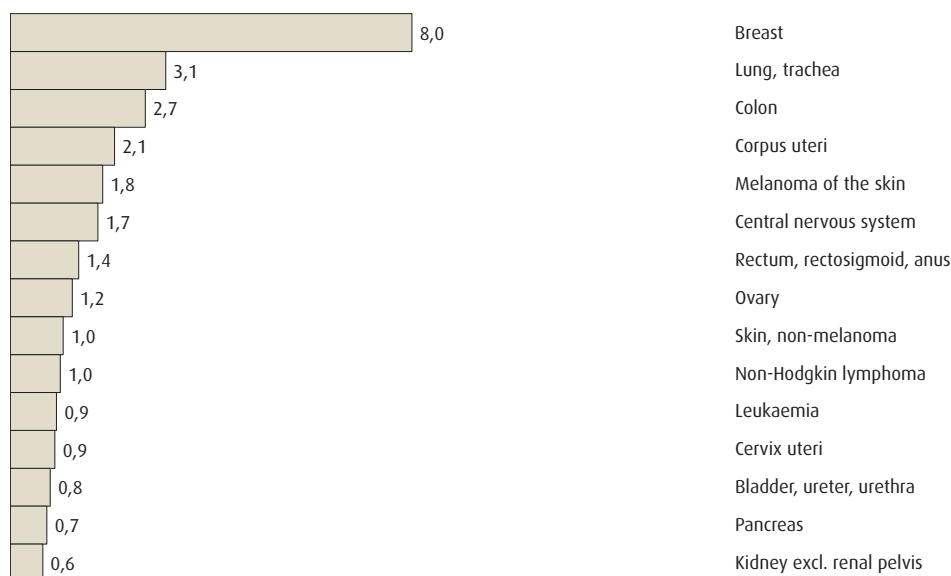


Table 6 Cumulative risk of developing cancer by the age of 75 by primary site and sex - 2005-2009 (%)

ICD10	Site	Males	Females
C00-96	All sites	34.5	27.9
C00-14	Mouth, pharynx	0.9	0.5
C00	Lip	0.2	0.1
C01-02	Tongue	0.2	0.1
C03-06	Mouth, other	0.2	0.1
C07-08	Salivary glands	0.1	0.1
C09-14	Pharynx	0.3	0.1
C15-26	Digestive organs	7.7	5.7
C15	Oesophagus	0.5	0.1
C16	Stomach	0.8	0.4
C17	Small intestine	0.2	0.1
C18	Colon	3.0	2.7
C19-21	Rectum, rectosigmoid, anus	2.0	1.4
C22	Liver	0.3	0.1
C23-24	Gallbladder, bile ducts	0.2	0.2
C25	Pancreas	0.9	0.7
C26	Other digestive organs	0.1	0.1
C30-34, C38	Respiratory organs	4.8	3.2
C30-31	Nose, sinuses	0.1	0.0
C32	Larynx, epiglottis	0.3	0.1
C33-34	Lung, trachea	4.4	3.1
C38	Mediastinum, pleura (non-mesothelioma)	0.0	0.0
C40-41	Bone	0.1	0.1
C43	Melanoma of the skin	1.9	1.8
C44	Skin, non-melanoma	1.5	1.0
C45	Mesothelioma	0.2	0.0
C46	Kaposi's sarcoma	0.0	0.0
C47	Autonomic nervous system	0.0	0.0
C48-49	Soft tissues	0.2	0.3
C50	Breast	0.1	8.0
C51-58	Female genital organs		4.4
C53	Cervix uteri		0.9
C54	Corpus uteri		2.1
C55	Uterus, other		0.0
C56	Ovary		1.2
C51-52, C57	Other female genital		0.3
C58	Placenta		0.0
C60-63	Male genital organs	13.6	
C61	Prostate	12.7	
C62	Testis	0.9	
C60, C63	Other male genital	0.1	
C64-68	Urinary organs	3.8	1.5
C64	Kidney excl. renal pelvis	1.2	0.6
C65	Renal pelvis	0.1	0.1
C66-68	Bladder, ureter, urethra	2.5	0.8
C69	Eye	0.1	0.1
C70-72, D42-43	Central nervous system	1.4	1.7
C73	Thyroid gland	0.2	0.5
C37, C74-75	Other endocrine glands	0.4	0.4
C39, C76, C80	Other or unspecified	0.5	0.4
C81-96	Lymphoid and haematopoietic tissue	3.5	2.4
C81	Hodgkin lymphoma	0.2	0.1
C82-85, C96	Non-Hodgkin lymphoma	1.4	1.0
C88	Malignant immunoproliferative diseases	0.1	0.0
C90	Multiple myeloma	0.6	0.4
C91-95, D45-47	Leukaemia	1.3	0.9

Table 7a Number of new cases by primary site and year - 2000-2009

MALES

ICD10	Site	Year									
		2000	01	02	03	04	05	06	07	08	2009
C00-96	All sites	11621	11759	11841	12756	13409	13352	13669	14539	14627	14792
C00-14	Mouth, pharynx	280	242	258	254	257	249	288	284	275	338
C00	Lip	65	52	61	42	37	49	79	71	57	83
C01-02	Tongue	43	51	50	52	53	44	46	57	62	74
C03-06	Mouth, other	56	36	47	56	52	39	53	40	44	63
C07-08	Salivary glands	28	21	23	17	17	26	15	17	19	20
C09-14	Pharynx	88	82	77	87	98	91	95	99	93	98
C15-26	Digestive organs	2550	2675	2635	2687	2797	2761	2724	2846	2883	2849
C15	Oesophagus	103	122	123	138	149	133	149	133	163	146
C16	Stomach	367	372	336	345	349	302	303	333	300	261
C17	Small intestine	45	67	46	58	44	51	65	66	62	80
C18	Colon	986	1000	972	992	1072	1066	1074	1101	1165	1086
C19-21	Rectum, rectosigmoid, anus	618	633	684	676	693	692	657	653	677	699
C22	Liver	71	80	83	76	80	75	89	95	96	101
C23-24	Gallbladder, bile ducts	54	70	52	55	67	82	55	60	63	73
C25	Pancreas	270	292	306	309	304	324	301	365	319	343
C26	Other digestive organs	36	39	33	38	39	36	31	40	38	60
C30-34, C38	Respiratory organs	1455	1504	1520	1566	1552	1555	1609	1620	1610	1639
C30-31	Nose, sinuses	26	23	28	17	25	24	18	28	24	21
C32	Larynx, epiglottis	112	120	115	94	100	101	115	77	113	87
C33-34	Lung, trachea	1303	1345	1365	1438	1416	1419	1463	1496	1463	1519
C38	Mediastinum, pleura (non-mesothelioma)	14	16	12	17	11	11	13	19	10	12
C40-41	Bone	20	22	28	21	28	25	24	21	23	35
C43	Melanoma of the skin	466	486	475	479	488	590	560	574	673	692
C44	Skin, non-melanoma	591	598	667	656	693	666	762	749	773	847
C45	Mesothelioma	51	61	51	66	74	72	50	63	58	69
C46	Kaposi's sarcoma	3	6	6	5	9	9	9	3	5	5
C47	Autonomic nervous system	7	4	5	7	3	7	6	6	7	6
C48-49	Soft tissues	51	50	57	49	51	47	61	65	50	67
C50	Breast	17	13	14	20	14	18	14	19	21	15
C60-63	Male genital organs	3360	3212	3050	3728	4158	4011	4184	4783	4765	4664
C61	Prostate	3081	2910	2770	3418	3845	3700	3879	4436	4409	4299
C62	Testis	251	271	239	257	268	261	263	304	306	320
C60, C63	Other male genital	28	31	41	53	45	50	42	43	50	45
C64-68	Urinary organs	1130	1183	1244	1254	1416	1301	1333	1455	1434	1448
C64	Kidney excl. renal pelvis	272	322	328	334	394	359	358	399	409	423
C65	Renal pelvis	38	36	37	32	51	28	47	54	58	48
C66-68	Bladder, ureter, urethra	820	825	879	888	971	914	928	1002	967	977
C69	Eye	35	23	31	41	31	27	37	29	36	27
C70-72, D42-43	Central nervous system	347	380	381	424	394	459	422	488	427	399
C73	Thyroid gland	53	53	54	53	50	68	80	66	61	74
C37, C74-75	Other endocrine glands	72	62	86	93	70	92	94	122	119	127
C39, C76, C80	Other or unspecified	262	238	233	247	206	220	205	178	178	190
C81-96	Lymphoid and haematopoietic tissue	871	947	1046	1106	1118	1175	1207	1168	1229	1301
C81	Hodgkin lymphoma	64	53	53	84	73	64	67	66	77	78
C82-85, C96	Non-Hodgkin lymphoma	385	354	341	378	408	420	464	419	469	483
C88	Malignant immunoproliferative diseases	15	28	30	36	28	31	31	32	31	22
C90	Multiple myeloma	151	182	165	167	178	221	185	186	202	213
C91-95, D45-47	Leukaemia	256	330	457	441	431	439	460	465	450	505

Table 7b Number of new cases by primary site and year - 2000-2009

FEMALES

ICD10	Site	Year									
		2000	01	02	03	04	05	06	07	08	2009
C00-96	All sites	10892	11016	11525	11596	12014	12180	12427	12483	12493	12728
C00-14	Mouth, pharynx	127	140	132	130	132	182	205	168	193	171
C00	Lip	23	32	25	25	25	41	55	56	51	39
C01-02	Tongue	29	27	27	25	26	32	38	23	33	33
C03-06	Mouth, other	29	34	35	28	40	43	54	37	44	46
C07-08	Salivary glands	23	24	17	20	11	26	22	23	23	16
C09-14	Pharynx	23	23	28	32	30	40	36	29	42	37
C15-26	Digestive organs	2566	2468	2548	2547	2564	2624	2670	2675	2685	2734
C15	Oesophagus	56	52	48	56	54	60	45	55	58	53
C16	Stomach	240	210	258	223	217	236	218	216	206	214
C17	Small intestine	48	47	62	46	50	43	45	53	52	72
C18	Colon	1156	1138	1136	1234	1184	1198	1278	1266	1263	1319
C19-21	Rectum, rectosigmoid, anus	535	513	520	505	573	566	556	543	562	520
C22	Liver	52	47	46	41	41	59	43	53	59	63
C23-24	Gallbladder, bile ducts	89	62	80	83	64	80	78	83	76	74
C25	Pancreas	334	344	351	317	333	323	369	349	347	348
C26	Other digestive organs	56	55	47	42	48	59	38	57	62	71
C30-34, C38	Respiratory organs	828	846	862	936	978	990	1075	1151	1172	1170
C30-31	Nose, sinuses	13	17	16	12	27	17	22	34	15	12
C32	Larynx, epiglottis	20	22	18	18	13	17	12	18	22	21
C33-34	Lung, trachea	787	799	824	904	926	950	1036	1092	1128	1129
C38	Mediastinum, pleura (non-mesothelioma)	8	8	4	2	12	6	5	7	7	8
C40-41	Bone	22	20	21	19	15	17	19	23	23	27
C43	Melanoma of the skin	535	532	556	550	560	573	659	634	621	721
C44	Skin, non-melanoma	511	485	522	566	578	676	656	684	691	741
C45	Mesothelioma	10	5	8	11	10	9	20	14	10	12
C46	Kaposi's sarcoma	8	0	3	2	3	2	5	3	3	4
C47	Autonomic nervous system	3	5	4	3	7	4	8	5	8	6
C48-49	Soft tissues	75	69	64	69	88	85	82	87	80	99
C50	Breast	2536	2639	2714	2741	2805	2818	2726	2748	2758	2745
C51-58	Female genital organs	1428	1497	1537	1497	1571	1566	1566	1551	1591	1558
C53	Cervix uteri	286	302	312	296	269	306	312	281	293	296
C54	Corpus uteri	564	594	588	629	686	677	657	672	718	696
C55	Uterus, other	15	6	10	13	8	6	9	4	7	16
C56	Ovary	456	449	521	428	466	425	457	453	451	419
C51-52, C57	Other female genital	105	143	103	127	138	146	127	139	122	130
C58	Placenta	2	3	3	4	4	6	4	2	0	1
C64-68	Urinary organs	518	518	585	565	577	596	588	595	611	632
C64	Kidney excl. renal pelvis	181	188	214	202	211	239	210	251	250	240
C65	Renal pelvis	18	26	30	37	27	18	26	22	31	34
C66-68	Bladder, ureter, urethra	319	304	341	326	339	339	352	322	330	358
C69	Eye	20	28	34	34	38	24	29	29	28	37
C70-72, D42-43	Central nervous system	422	479	525	527	589	590	611	606	526	562
C73	Thyroid gland	148	130	144	133	172	164	151	162	172	179
C37, C74-75	Other endocrine glands	49	66	82	90	90	96	107	111	132	110
C39, C76, C80	Other or unspecified	321	287	308	300	283	269	246	243	190	226
C81-96	Lymphoid and haematopoietic tissue	765	802	876	876	954	895	1004	994	999	994
C81	Hodgkin lymphoma	64	33	42	53	46	49	48	48	43	44
C82-85, C96	Non-Hodgkin lymphoma	323	334	343	334	369	334	387	380	368	404
C88	Malignant immunoproliferative diseases	11	17	20	15	21	20	24	17	15	17
C90	Multiple myeloma	123	174	161	151	153	156	143	166	160	148
C91-95, D45-47	Leukaemia	244	244	310	323	365	336	402	383	413	381

Table 8a Age-adjusted (world) incidence rates per 100 000 person-years by primary site and year - 2000-2009

MALES

ICD10	Site	Year									
		2000	01	02	03	04	05	06	07	08	2009
C00-96	All sites	324.2	323.4	322.5	342.9	353.5	346.7	350.2	367.7	363.4	360.0
C00-14	Mouth, pharynx	8.5	7.2	7.8	7.7	7.6	7.0	7.8	7.7	7.4	8.7
C00	Lip	1.8	1.4	1.7	1.1	1.0	1.2	1.9	1.7	1.3	1.9
C01-02	Tongue	1.3	1.6	1.6	1.7	1.6	1.3	1.2	1.6	1.7	2.1
C03-06	Mouth, other	1.7	1.1	1.4	1.7	1.5	1.1	1.5	1.1	1.2	1.6
C07-08	Salivary glands	0.8	0.6	0.7	0.5	0.5	0.7	0.4	0.5	0.5	0.5
C09-14	Pharynx	2.9	2.5	2.4	2.7	2.9	2.7	2.8	2.8	2.6	2.6
C15-26	Digestive organs	67.0	69.7	68.5	68.7	70.2	68.2	66.0	68.2	68.2	65.5
C15	Oesophagus	2.8	3.2	3.5	3.8	4.0	3.5	3.9	3.3	4.1	3.6
C16	Stomach	9.3	9.1	8.6	8.5	8.2	7.1	7.0	7.8	7.0	5.7
C17	Small intestine	1.3	2.0	1.3	1.7	1.2	1.3	1.8	1.7	1.5	2.1
C18	Colon	25.8	25.5	24.8	24.7	26.5	26.2	25.2	25.7	26.9	24.3
C19-21	Rectum, rectosigmoid, anus	16.5	17.3	18.0	17.8	17.8	17.4	16.2	16.4	16.2	16.8
C22	Liver	1.9	2.0	2.3	2.1	1.8	2.1	2.4	2.5	2.6	2.4
C23-24	Gallbladder, bile ducts	1.4	1.9	1.3	1.4	1.7	2.1	1.3	1.4	1.5	1.6
C25	Pancreas	7.0	7.7	7.9	7.9	8.0	7.9	7.5	8.6	7.6	7.6
C26	Other digestive organs	1.0	0.9	0.8	0.9	1.1	0.8	0.7	0.8	0.9	1.5
C30-34, C38	Respiratory organs	39.8	40.7	41.2	41.7	39.9	39.0	40.7	39.4	38.7	38.4
C30-31	Nose, sinuses	0.8	0.6	0.9	0.5	0.7	0.7	0.4	0.8	0.7	0.5
C32	Larynx, epiglottis	3.3	3.1	3.3	2.8	2.8	2.7	3.1	2.0	2.8	2.1
C33-34	Lung, trachea	35.4	36.5	36.8	38.0	36.2	35.3	36.8	36.1	35.0	35.5
C38	Mediastinum, pleura (non-meso-thelioma)	0.4	0.5	0.3	0.4	0.3	0.3	0.3	0.4	0.3	0.3
C40-41	Bone	0.9	0.9	1.2	0.8	1.1	0.9	1.1	0.7	1.0	1.2
C43	Melanoma of the skin	14.1	14.8	14.3	14.3	14.5	16.7	15.3	15.6	17.6	17.9
C44	Skin, non-melanoma	14.5	14.3	15.6	14.8	15.0	14.4	16.2	15.3	15.5	16.8
C45	Mesothelioma	1.3	1.6	1.4	1.7	1.9	1.7	1.2	1.5	1.4	1.5
C46	Kaposi's sarcoma	0.1	0.2	0.1	0.1	0.3	0.2	0.2	0.1	0.1	0.2
C47	Autonomic nervous system	0.3	0.2	0.3	0.4	0.1	0.4	0.2	0.3	0.3	0.4
C48-49	Soft tissues	1.7	1.6	1.8	1.5	1.6	1.4	1.9	1.9	1.5	1.8
C50	Breast	0.5	0.4	0.3	0.5	0.3	0.5	0.3	0.5	0.5	0.4
C60-63	Male genital organs	94.0	88.5	82.3	99.1	110.6	105.7	108.3	123.8	120.1	116.7
C61	Prostate	82.6	76.5	71.2	87.2	98.6	93.4	96.5	110.3	106.8	103.2
C62	Testis	10.6	11.1	10.0	10.4	11.0	10.9	10.8	12.4	12.0	12.4
C60, C63	Other male genital	0.8	0.9	1.2	1.5	1.0	1.4	1.0	1.1	1.2	1.1
C64-68	Urinary organs	29.9	31.0	32.4	32.4	35.2	32.2	32.3	34.9	34.4	33.5
C64	Kidney excl. renal pelvis	8.0	9.4	9.5	9.4	10.9	9.6	9.7	10.3	10.8	11.0
C65	Renal pelvis	0.9	0.9	0.9	0.7	1.3	0.8	1.1	1.3	1.4	1.0
C66-68	Bladder, ureter, urethra	20.9	20.7	22.0	22.3	23.0	21.8	21.4	23.3	22.1	21.5
C69	Eye	1.0	0.7	1.0	1.2	1.1	0.8	1.1	0.8	1.1	0.8
C70-72, D42-43	Central nervous system	12.0	13.0	13.6	15.1	13.0	15.1	13.5	15.9	13.4	12.0
C73	Thyroid gland	1.8	1.8	1.7	1.7	1.5	2.1	2.4	1.8	1.7	2.1
C37, C74-75	Other endocrine glands	2.7	2.3	2.8	3.2	2.5	2.7	3.2	3.8	3.8	4.1
C39, C76, C80	Other or unspecified	6.6	5.5	5.7	5.6	4.6	4.9	4.7	3.9	3.8	3.9
C81-96	Lymphoid and haematopoietic tissue	27.3	28.9	30.4	32.3	32.6	32.7	33.8	31.5	32.8	34.0
C81	Hodgkin lymphoma	2.7	2.1	2.2	3.4	3.0	2.7	2.5	2.3	2.9	2.9
C82-85, C96	Non-Hodgkin lymphoma	12.0	10.6	9.8	11.1	11.9	11.5	12.6	11.4	12.3	12.5
C88	Malignant immunoproliferative diseases	0.5	0.8	0.8	0.8	0.7	0.8	0.7	0.8	0.6	0.5
C90	Multiple myeloma	3.9	5.1	4.3	4.3	4.5	5.4	4.7	4.5	4.8	4.9
C91-95, D45-47	Leukaemia	8.3	10.3	13.2	12.7	12.5	12.4	13.2	12.6	12.2	13.2

Table 8b Age-adjusted (world) incidence rates per 100 000 person-years by primary site and year - 2000-2009

FEMALES

ICD10	Site	Year									
		2000	01	02	03	04	05	06	07	08	2009
C00-96	All sites	272.2	276.8	286.4	283.4	291.6	290.6	295.7	291.6	288.7	288.6
C00-14	Mouth, pharynx	3.1	3.1	3.3	3.2	3.1	4.1	4.9	3.6	4.2	3.8
C00	Lip	0.5	0.7	0.6	0.5	0.5	0.7	1.2	1.0	1.0	0.7
C01-02	Tongue	0.7	0.5	0.7	0.6	0.7	0.7	0.9	0.5	0.8	0.8
C03-06	Mouth, other	0.7	0.6	0.9	0.7	0.9	0.9	1.2	0.7	0.8	0.9
C07-08	Salivary glands	0.6	0.7	0.5	0.6	0.2	0.7	0.5	0.6	0.6	0.4
C09-14	Pharynx	0.6	0.6	0.8	0.9	0.8	1.1	1.1	0.7	1.1	1.0
C15-26	Digestive organs	50.8	50.0	50.7	49.8	51.5	50.5	51.9	50.7	50.1	50.4
C15	Oesophagus	1.0	1.1	0.9	1.1	1.1	1.1	0.9	0.9	1.1	1.0
C16	Stomach	4.7	3.9	4.8	4.0	4.5	4.4	4.1	4.0	3.5	3.6
C17	Small intestine	1.3	1.1	1.5	1.0	1.2	1.0	1.1	1.2	1.2	1.5
C18	Colon	22.8	22.8	22.5	23.8	23.3	22.6	24.1	23.7	22.9	23.1
C19-21	Rectum, rectosigmoid, anus	11.6	11.3	11.5	10.9	12.0	11.8	11.9	11.6	11.4	10.9
C22	Liver	1.1	1.0	1.0	0.9	1.0	1.3	0.8	1.0	1.2	1.3
C23-24	Gallbladder, bile ducts	1.7	1.4	1.4	1.4	1.2	1.5	1.5	1.6	1.5	1.4
C25	Pancreas	5.9	6.4	6.4	6.2	6.3	5.7	6.9	5.9	6.3	6.4
C26	Other digestive organs	0.7	0.8	0.7	0.6	0.9	1.0	0.6	0.8	0.9	1.1
C30-34, C38	Respiratory organs	21.7	21.7	21.5	23.1	23.4	23.4	24.8	26.0	26.1	25.1
C30-31	Nose, sinuses	0.3	0.4	0.5	0.3	0.5	0.4	0.5	0.8	0.3	0.3
C32	Larynx, epiglottis	0.5	0.6	0.5	0.5	0.3	0.5	0.3	0.5	0.5	0.5
C33-34	Lung, trachea	20.8	20.5	20.5	22.4	22.5	22.4	24.0	24.6	25.1	24.1
C38	Mediastinum, pleura (non-mesothelioma)	0.2	0.2	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.2
C40-41	Bone	0.9	0.8	1.0	0.8	0.6	0.6	0.7	0.8	0.7	1.0
C43	Melanoma of the skin	15.7	15.7	16.3	15.8	15.8	16.0	18.7	16.8	16.5	18.9
C44	Skin, non-melanoma	8.4	8.6	8.5	9.1	9.6	10.2	10.3	10.4	10.9	10.9
C45	Mesothelioma	0.2	0.1	0.2	0.2	0.1	0.2	0.4	0.3	0.2	0.3
C46	Kaposi's sarcoma	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1
C47	Autonomic nervous system	0.2	0.2	0.3	0.1	0.3	0.2	0.3	0.3	0.4	0.2
C48-49	Soft tissues	2.0	2.1	1.6	1.9	2.5	2.6	2.2	2.4	2.1	2.5
C50	Breast	73.2	75.7	77.3	77.1	77.4	76.6	73.8	73.1	72.8	70.7
C51-58	Female genital organs	39.2	40.8	41.7	39.9	41.1	40.7	39.6	39.6	39.8	38.6
C53	Cervix uteri	9.3	9.8	10.3	9.5	8.7	9.9	9.7	9.0	9.1	9.5
C54	Corpus uteri	14.8	15.0	15.1	16.1	17.0	16.5	15.5	16.5	17.4	16.0
C55	Uterus, other	0.3	0.1	0.2	0.2	0.2	0.1	0.1	0.0	0.1	0.2
C56	Ovary	12.3	12.5	13.8	11.1	12.3	10.8	11.2	11.2	10.9	10.2
C51-52, C57	Other female genital	2.3	3.1	2.2	2.8	2.7	3.2	2.8	2.9	2.3	2.7
C58	Placenta	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.1	0.0	0.0
C64-68	Urinary organs	11.0	11.2	12.3	11.7	11.3	12.6	12.3	12.4	12.6	12.8
C64	Kidney excl. renal pelvis	4.2	4.2	4.8	4.8	4.8	5.5	5.0	5.8	5.6	5.5
C65	Renal pelvis	0.4	0.6	0.6	0.8	0.4	0.3	0.5	0.4	0.6	0.7
C66-68	Bladder, ureter, urethra	6.3	6.4	6.9	6.0	6.0	6.7	6.8	6.2	6.4	6.6
C69	Eye	0.4	0.7	1.0	0.8	1.0	0.8	0.8	0.8	0.8	1.1
C70-72, D42-43	Central nervous system	13.2	14.7	17.1	16.0	17.4	18.0	17.4	17.8	15.6	16.0
C73	Thyroid gland	5.1	4.3	4.6	4.3	5.4	5.1	4.8	5.0	5.3	5.7
C37, C74-75	Other endocrine glands	1.9	2.5	2.8	3.4	2.9	3.6	3.7	3.8	4.4	4.1
C39, C76, C80	Other or unspecified	5.5	4.5	5.1	4.5	4.8	4.4	4.1	3.8	3.2	3.4
C81-96	Lymphoid and haematopoietic tissue	19.7	19.9	21.2	21.6	23.3	20.9	24.8	24.1	23.1	23.0
C81	Hodgkin lymphoma	2.7	1.4	1.5	2.1	1.7	2.0	2.1	1.9	1.5	1.8
C82-85, C96	Non-Hodgkin lymphoma	8.0	8.3	8.2	7.9	9.1	7.8	9.2	9.2	8.5	9.2
C88	Malignant immunoproliferative diseases	0.2	0.4	0.4	0.3	0.4	0.3	0.6	0.3	0.3	0.3
C90	Multiple myeloma	2.5	3.5	3.3	2.8	3.1	3.2	2.7	3.4	3.2	3.0
C91-95, D45-47	Leukaemia	6.4	6.4	7.8	8.5	8.9	7.5	10.3	9.4	9.7	8.6

Table 9a Average annual number of new cases by primary site and five-year age group - 2005-2009

ICD10	Site	0-4	5-9	10-14	15-19	20-24	25-29
C00-96	All sites	39	18	28	42	65	101
C00-14	Mouth, pharynx	0	0	0	0	1	1
C00	Lip	0	0	0	0	0	0
C01-02	Tongue	0	0	0	0	0	0
C03-06	Mouth, other	0	0	0	0	0	0
C07-08	Salivary glands	0	0	0	0	0	0
C09-14	Pharynx	0	0	0	0	0	0
C15-26	Digestive organs	1	1	1	1	1	4
C15	Oesophagus	0	0	0	0	0	0
C16	Stomach	0	0	0	0	0	0
C17	Small intestine	0	0	0	0	0	0
C18	Colon	0	0	1	0	1	2
C19-21	Rectum, rectosigmoid, anus	0	0	0	0	0	1
C22	Liver	1	1	0	0	0	1
C23-24	Gallbladder, bile ducts	0	0	0	0	0	0
C25	Pancreas	0	0	0	0	0	0
C26	Other digestive organs	0	0	0	0	0	0
C30-34, C38	Respiratory organs	0	0	0	1	1	1
C30-31	Nose, sinuses	0	0	0	0	0	0
C32	Larynx, epiglottis	0	0	0	0	0	0
C33-34	Lung, trachea	0	0	0	0	0	1
C38	Mediastinum, pleura (non-mesothelioma)	0	0	0	0	0	0
C40-41	Bone	0	1	2	3	3	1
C43	Melanoma of the skin	0	0	0	1	2	7
C44	Skin, non-melanoma	0	0	0	0	1	1
C45	Mesothelioma	0	0	0	0	0	0
C46	Kaposi's sarcoma	0	0	0	0	0	0
C47	Autonomic nervous system	2	0	0	0	0	0
C48-49	Soft tissues	1	0	0	1	1	1
C50	Breast	0	0	0	0	0	0
C60-63	Male genital organs	1	0	2	8	33	54
C61	Prostate	0	0	0	0	0	0
C62	Testis	1	0	2	7	33	53
C60, C63	Other male genital	0	0	0	0	0	0
C64-68	Urinary organs	3	1	0	1	2	2
C64	Kidney excl. renal pelvis	3	1	0	0	1	1
C65	Renal pelvis	0	0	0	0	0	0
C66-68	Bladder, ureter, urethra	1	0	0	0	1	1
C69	Eye	2	0	0	0	0	0
C70-72, D42-43	Central nervous system	10	7	8	10	9	11
C73	Thyroid gland	0	0	0	0	1	1
C37, C74-75	Other endocrine glands	2	1	2	3	2	3
C39, C76, C80	Other or unspecified	0	0	0	0	0	0
C81-96	Lymphoid and haematopoietic tissue	16	6	10	13	9	13
C81	Hodgkin lymphoma	0	1	4	5	5	7
C82-85, C96	Non-Hodgkin lymphoma	2	1	2	4	1	3
C88	Malignant immunoproliferative diseases	0	0	0	0	0	0
C90	Multiple myeloma	0	0	0	0	0	0
C91-95, D45-47	Leukaemia	13	5	5	5	3	3

Age											
30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
144	178	247	368	670	1242	1935	2026	2039	2099	1716	1240
1	3	9	15	29	40	47	42	32	30	19	16
0	0	2	2	4	5	7	10	9	12	8	9
0	0	2	5	5	7	11	10	7	4	4	2
0	1	1	1	4	8	9	8	6	5	3	1
1	1	1	1	1	2	2	2	2	2	2	3
0	1	3	6	14	18	18	12	8	8	4	2
14	21	43	72	135	233	349	381	419	451	390	297
0	0	3	6	9	16	22	23	21	21	13	10
1	2	5	8	14	20	34	35	44	51	45	42
1	2	2	2	4	7	9	8	10	9	6	3
6	7	15	23	48	77	121	139	176	190	167	126
3	5	10	17	35	69	97	97	100	100	82	59
1	1	3	6	8	7	11	9	12	11	12	8
0	0	1	2	3	5	10	9	9	10	9	9
1	2	3	9	14	29	42	54	43	53	48	33
0	0	1	1	2	3	2	6	6	5	6	8
2	5	13	33	72	151	245	239	263	274	203	104
0	0	1	1	1	2	4	3	3	2	2	2
0	0	1	2	7	15	16	17	12	13	10	4
2	5	10	30	64	133	223	217	247	256	189	96
0	0	0	0	0	1	2	2	1	2	2	2
1	1	2	2	1	2	1	1	1	3	1	0
12	22	34	37	52	68	82	70	72	68	53	39
4	3	5	9	15	34	49	73	100	134	162	167
0	0	0	0	2	3	10	9	12	12	8	6
1	0	0	0	0	0	0	1	0	1	1	1
0	0	0	0	0	0	1	0	0	0	0	0
1	2	3	5	4	6	5	5	8	7	4	3
0	0	0	2	1	2	3	3	2	2	1	2
54	48	41	55	148	386	720	811	702	630	471	318
0	0	4	31	132	372	708	801	694	624	464	314
53	47	35	22	14	8	5	4	2	1	2	1
1	1	1	2	2	5	6	6	5	6	5	4
4	11	22	39	70	122	175	177	201	244	192	129
2	6	11	19	33	44	58	49	52	49	41	20
0	0	0	2	2	4	6	7	8	8	6	4
2	4	11	18	34	74	110	122	141	186	146	105
0	0	1	2	3	3	6	3	4	3	2	2
19	23	27	31	34	48	48	41	32	31	29	20
5	4	6	6	8	8	8	4	5	7	4	3
4	6	5	9	10	10	18	6	11	10	6	2
0	1	2	6	9	11	15	22	27	29	36	38
23	28	33	45	75	115	154	138	149	163	133	93
9	6	6	3	5	4	4	4	2	3	2	1
7	11	13	22	33	51	65	56	51	57	42	30
0	0	0	0	2	2	5	4	3	4	6	2
1	2	4	6	12	17	23	28	28	36	28	17
7	8	10	14	23	41	56	46	64	63	56	43

Table 9b Average annual number of new cases by primary site and five-year age group - 2005-2009

ICD10	Site	0-4	5-9	10-14	15-19	20-24	25-29
C00-96	All sites	33	20	18	35	57	97
C00-14	Mouth, pharynx	0	0	0	0	1	1
C00	Lip	0	0	0	0	0	0
C01-02	Tongue	0	0	0	0	0	0
C03-06	Mouth, other	0	0	0	0	0	0
C07-08	Salivary glands	0	0	0	0	1	0
C09-14	Pharynx	0	0	0	0	0	0
C15-26	Digestive organs	0	1	1	1	3	4
C15	Oesophagus	0	0	0	0	0	0
C16	Stomach	0	0	0	0	0	0
C17	Small intestine	0	0	0	0	0	0
C18	Colon	0	0	0	1	2	2
C19-21	Rectum, rectosigmoid, anus	0	0	0	0	1	1
C22	Liver	0	0	0	1	0	0
C23-24	Gallbladder, bile ducts	0	0	0	0	0	0
C25	Pancreas	0	0	0	0	0	0
C26	Other digestive organs	0	0	0	0	0	0
C30-34, C38	Respiratory organs	0	1	0	0	0	1
C30-31	Nose, sinuses	0	0	0	0	0	0
C32	Larynx, epiglottis	0	0	0	0	0	0
C33-34	Lung, trachea	0	0	0	0	0	1
C38	Mediastinum, pleura (non-mesothelioma)	0	0	0	0	0	0
C40-41	Bone	0	1	1	2	1	1
C43	Melanoma of the skin	0	0	0	2	8	16
C44	Skin, non-melanoma	0	0	0	1	2	1
C45	Mesothelioma	0	0	0	0	0	0
C46	Kaposi's sarcoma	0	0	0	0	0	0
C47	Autonomic nervous system	1	0	0	1	0	0
C48-49	Soft tissues	0	1	1	2	1	1
C50	Breast	0	0	0	0	2	7
C51-58	Female genital organs	1	1	2	2	8	21
C53	Cervix uteri	0	0	0	0	4	17
C54	Corpus uteri	0	0	0	0	0	1
C55	Uterus, other	0	0	0	0	0	0
C56	Ovary	1	1	2	2	2	2
C51-52, C57	Other female genital	0	0	0	0	0	1
C58	Placenta	0	0	0	0	1	0
C64-68	Urinary organs	3	1	0	0	1	1
C64	Kidney excl. renal pelvis	3	1	0	0	0	1
C65	Renal pelvis	0	0	0	0	0	0
C66-68	Bladder, ureter, urethra	0	0	0	0	0	0
C69	Eye	2	0	0	0	0	1
C70-72, D42-43	Central nervous system	10	6	6	8	8	12
C73	Thyroid gland	0	0	0	2	3	10
C37, C74-75	Other endocrine glands	2	2	1	3	7	8
C39, C76, C80	Other or unspecified	0	0	0	0	0	1
C81-96	Lymphoid and haematopoietic tissue	13	7	5	11	11	11
C81	Hodgkin lymphoma	0	0	1	5	6	5
C82-85, C96	Non-Hodgkin lymphoma	1	1	1	2	3	4
C88	Malignant immunoproliferative diseases	0	0	0	0	0	0
C90	Multiple myeloma	0	0	0	0	0	0
C91-95, D45-47	Leukaemia	12	5	3	4	3	2

FEMALES

Age											
30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
174	291	436	669	940	1166	1476	1307	1284	1450	1449	1559
2	2	3	9	15	16	21	21	21	23	22	24
1	0	0	1	3	3	4	5	6	8	7	10
0	0	1	2	2	3	4	4	3	4	4	4
0	0	1	1	3	4	5	5	7	5	7	7
1	1	1	2	1	1	3	2	2	3	2	2
1	0	1	3	6	6	5	5	3	2	2	2
10	19	36	64	118	175	259	286	333	412	467	489
0	0	1	1	3	4	5	4	8	10	7	11
1	2	3	7	10	11	17	20	26	30	43	48
1	1	1	1	4	5	7	6	8	8	6	5
4	7	17	24	47	72	110	138	165	203	235	237
3	6	8	20	35	46	68	65	63	78	78	78
0	0	1	2	2	3	6	4	7	11	10	8
0	1	1	2	3	7	8	9	8	13	16	10
1	2	3	6	13	23	33	36	42	52	61	75
0	0	1	1	1	3	4	4	5	7	12	18
2	5	11	31	68	111	169	155	174	181	125	77
0	0	0	1	2	2	2	2	2	2	3	3
0	0	0	0	3	2	3	2	2	2	1	1
1	5	10	29	64	107	163	151	168	175	120	72
0	0	0	1	0	1	1	0	1	1	1	1
1	1	1	2	1	3	2	1	1	1	1	1
24	40	49	51	55	63	72	53	54	51	49	54
2	3	8	9	19	28	38	49	69	96	126	239
0	0	1	0	1	1	1	2	2	2	4	1
0	0	0	0	0	0	0	0	0	0	1	1
0	0	1	1	0	0	1	0	0	0	0	0
1	3	3	4	6	9	13	10	9	9	7	6
35	79	165	279	354	370	398	307	177	184	203	199
40	59	67	85	144	176	205	171	155	160	139	131
35	42	33	27	30	22	23	12	13	17	13	9
1	8	15	27	61	88	104	95	91	80	61	52
0	0	0	0	0	0	2	0	0	1	1	4
2	7	16	24	41	54	64	50	39	49	45	40
1	2	4	6	11	12	11	13	12	14	19	26
1	0	0	0	0	0	0	0	0	0	0	0
2	4	11	16	26	43	79	68	84	95	85	85
1	2	6	10	13	20	33	26	34	38	27	24
0	0	0	0	1	2	4	3	3	5	4	3
1	1	4	6	13	21	42	39	47	52	55	59
0	1	1	1	1	4	4	2	3	3	2	2
20	27	30	46	52	58	67	52	53	47	40	38
14	16	14	18	12	17	16	9	9	10	7	8
7	9	8	10	8	8	11	7	7	5	5	3
1	1	2	5	7	11	18	17	20	36	42	72
13	20	25	37	53	73	103	97	112	134	124	130
5	5	3	2	2	3	1	2	3	2	1	1
3	6	10	18	27	32	45	43	42	52	44	40
0	0	1	0	1	1	2	2	1	5	2	3
0	1	3	5	8	12	20	13	21	29	23	20
5	8	8	13	14	24	36	37	44	46	53	67

Table 10a Age-specific incidence rates per 100 000 person-years by primary site and five-year age group - 2005-2009

ICD10	Site	0-4	5-9	10-14	15-19	20-24	25-29
C00-96	All sites	25.7	11.8	17.1	26.4	44.1	67.3
C00-14	Mouth, pharynx	0.0	0.0	0.1	0.1	0.7	0.5
C00	Lip	0.0	0.0	0.0	0.0	0.0	0.0
C01-02	Tongue	0.0	0.0	0.0	0.0	0.1	0.1
C03-06	Mouth, other	0.0	0.0	0.0	0.0	0.0	0.1
C07-08	Salivary glands	0.0	0.0	0.1	0.1	0.3	0.3
C09-14	Pharynx	0.0	0.0	0.0	0.0	0.3	0.0
C15-26	Digestive organs	0.8	0.5	0.5	0.6	1.0	2.5
C15	Oesophagus	0.0	0.0	0.0	0.0	0.0	0.0
C16	Stomach	0.0	0.0	0.0	0.1	0.1	0.0
C17	Small intestine	0.0	0.0	0.0	0.0	0.0	0.3
C18	Colon	0.0	0.0	0.4	0.1	0.8	1.2
C19-21	Rectum, rectosigmoid, anus	0.0	0.0	0.0	0.0	0.0	0.7
C22	Liver	0.8	0.5	0.0	0.3	0.0	0.4
C23-24	Gallbladder, bile ducts	0.0	0.0	0.0	0.0	0.0	0.0
C25	Pancreas	0.0	0.0	0.0	0.1	0.0	0.0
C26	Other digestive organs	0.0	0.0	0.1	0.0	0.0	0.0
C30-34, C38	Respiratory organs	0.0	0.1	0.2	0.5	0.4	0.8
C30-31	Nose, sinuses	0.0	0.1	0.1	0.2	0.1	0.0
C32	Larynx, epiglottis	0.0	0.0	0.0	0.0	0.0	0.0
C33-34	Lung, trachea	0.0	0.0	0.0	0.2	0.3	0.8
C38	Mediastinum, pleura (non-mesothelioma)	0.0	0.0	0.1	0.0	0.0	0.0
C40-41	Bone	0.0	0.5	1.2	1.9	1.9	0.8
C43	Melanoma of the skin	0.0	0.0	0.1	0.9	1.2	4.7
C44	Skin, non-melanoma	0.0	0.0	0.2	0.2	0.4	0.9
C45	Mesothelioma	0.0	0.0	0.0	0.0	0.0	0.0
C46	Kaposi's sarcoma	0.0	0.0	0.0	0.0	0.0	0.1
C47	Autonomic nervous system	1.6	0.1	0.1	0.1	0.1	0.1
C48-49	Soft tissues	0.9	0.1	0.2	0.6	0.4	0.9
C50	Breast	0.0	0.0	0.1	0.0	0.0	0.0
C60-63	Male genital organs	0.4	0.1	1.2	4.9	22.2	35.9
C61	Prostate	0.0	0.0	0.0	0.1	0.0	0.0
C62	Testis	0.4	0.1	1.2	4.6	22.2	35.6
C60, C63	Other male genital	0.0	0.0	0.0	0.1	0.0	0.3
C64-68	Urinary organs	2.1	0.9	0.0	0.4	1.1	1.2
C64	Kidney excl. renal pelvis	1.7	0.9	0.0	0.2	0.7	0.7
C65	Renal pelvis	0.0	0.0	0.0	0.0	0.0	0.0
C66-68	Bladder, ureter, urethra	0.4	0.0	0.0	0.1	0.4	0.5
C69	Eye	1.1	0.0	0.0	0.0	0.1	0.1
C70-72, D42-43	Central nervous system	6.8	4.4	5.1	6.2	6.2	7.4
C73	Thyroid gland	0.0	0.0	0.0	0.1	0.5	0.7
C37, C74-75	Other endocrine glands	1.6	0.8	1.4	1.7	1.6	1.8
C39, C76, C80	Other or unspecified	0.0	0.0	0.0	0.0	0.0	0.0
C81-96	Lymphoid and haematopoietic tissue	10.5	4.2	6.4	8.1	6.2	8.7
C81	Hodgkin lymphoma	0.0	0.8	2.4	2.9	3.4	4.4
C82-85, C96	Non-Hodgkin lymphoma	1.6	0.4	1.1	2.2	0.8	1.7
C88	Malignant immunoproliferative diseases	0.0	0.0	0.0	0.0	0.0	0.0
C90	Multiple myeloma	0.0	0.0	0.0	0.0	0.0	0.3
C91-95, D45-47	Leukaemia	8.9	3.0	3.0	3.0	2.0	2.3

Age											
30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
87.7	97.1	137.1	221.0	423.9	827.6	1412.0	2169.0	2897.8	3515.8	3884.5	3912.2
0.7	1.5	5.1	9.1	18.5	26.7	34.5	44.8	44.9	51.0	43.9	51.7
0.0	0.1	0.9	1.1	2.5	3.6	5.3	10.8	13.4	19.8	17.2	27.2
0.0	0.2	1.0	3.0	3.4	4.7	7.9	10.3	9.6	6.0	8.6	5.7
0.1	0.4	0.7	0.6	2.8	5.1	6.8	8.4	8.2	8.4	6.3	4.2
0.5	0.3	0.7	0.6	0.8	1.2	1.3	2.0	2.6	3.3	3.6	8.3
0.1	0.4	1.9	3.8	9.0	12.1	13.2	13.3	11.1	13.4	8.1	6.2
8.2	11.2	23.6	43.3	85.6	155.4	256.0	407.3	596.2	756.0	882.2	938.0
0.1	0.0	1.4	3.6	5.5	10.7	16.4	24.3	30.2	35.5	30.3	33.0
0.5	1.3	2.8	4.6	8.9	13.2	25.1	37.0	62.2	84.7	102.3	132.5
0.9	1.0	1.3	1.5	2.4	4.8	6.5	8.9	13.9	15.4	14.1	8.8
3.9	3.9	8.5	13.7	30.3	51.2	89.0	148.4	250.3	318.2	379.0	395.5
1.9	2.7	5.7	10.0	21.9	46.3	71.5	104.3	141.7	168.2	185.5	186.2
0.4	0.8	1.7	3.4	4.8	4.4	8.0	10.0	16.4	19.1	27.7	24.7
0.1	0.2	0.5	1.1	1.8	3.3	7.2	9.7	12.9	17.1	19.9	27.5
0.4	1.3	1.4	5.2	8.7	19.6	30.4	58.1	60.8	88.7	109.2	104.5
0.1	0.0	0.4	0.4	1.4	2.0	1.7	6.7	7.9	9.1	14.0	25.4
1.2	2.6	7.0	19.9	45.9	100.9	179.5	256.9	373.1	458.7	458.8	327.2
0.0	0.0	0.7	0.5	0.6	1.3	3.2	3.6	4.0	3.7	5.0	6.5
0.0	0.1	0.6	1.4	4.7	10.3	11.8	18.5	17.1	21.7	22.2	13.8
1.1	2.5	5.7	17.8	40.4	88.5	163.1	232.8	350.7	429.3	427.1	301.9
0.1	0.0	0.1	0.1	0.1	0.8	1.4	2.0	1.4	4.0	4.5	5.0
0.6	0.8	0.9	1.0	0.6	1.2	0.9	0.9	1.4	4.4	3.2	1.3
7.4	12.0	18.5	22.0	33.0	45.1	59.7	74.4	101.7	114.7	119.6	122.7
2.3	1.7	3.0	5.6	9.8	22.9	35.8	78.2	142.0	224.8	366.5	523.1
0.0	0.0	0.0	0.2	1.5	1.9	7.4	9.2	17.4	20.5	18.1	17.9
0.4	0.1	0.2	0.0	0.1	0.1	0.1	1.6	0.6	1.0	1.8	3.2
0.2	0.0	0.2	0.2	0.1	0.1	0.4	0.0	0.0	0.3	0.5	1.3
0.6	1.3	1.5	2.9	2.8	3.9	3.4	5.5	11.1	11.4	9.5	9.3
0.0	0.0	0.1	1.0	0.5	1.2	2.2	2.8	2.8	3.0	3.2	6.4
32.7	26.2	22.7	32.9	93.5	257.2	523.3	867.5	997.9	1055.3	1066.6	1004.7
0.0	0.1	2.4	18.4	83.2	248.0	514.8	856.7	986.8	1044.3	1050.7	991.4
32.3	25.5	19.6	13.1	8.9	5.6	3.9	4.6	3.4	1.4	3.6	1.9
0.4	0.7	0.7	1.4	1.4	3.6	4.6	6.2	7.7	9.7	12.2	11.4
2.5	5.8	12.3	23.3	44.3	81.2	127.7	189.6	285.4	407.9	435.7	407.7
1.1	3.4	6.1	11.3	21.0	29.2	42.6	51.7	73.6	81.7	91.9	63.7
0.1	0.1	0.1	1.1	1.5	2.5	4.6	7.0	11.1	14.1	13.2	11.4
1.3	2.3	6.0	11.0	21.8	49.5	80.5	130.9	200.7	312.2	330.6	332.6
0.1	0.2	0.4	1.4	1.9	1.9	4.1	3.6	5.4	5.0	4.5	5.1
11.5	12.8	15.3	18.5	21.3	32.0	34.7	43.9	46.1	52.6	66.1	64.3
2.9	2.3	3.5	3.5	5.0	5.5	6.0	4.1	7.1	11.4	9.1	8.7
2.2	3.3	3.0	5.3	6.5	6.7	12.6	6.8	15.6	16.8	12.7	7.6
0.0	0.3	1.0	3.5	5.6	7.6	11.0	23.6	37.9	47.9	82.0	118.8
14.0	15.0	18.6	27.3	47.5	76.4	112.5	148.2	211.1	273.1	300.8	293.3
5.5	3.3	3.1	1.9	3.3	2.8	2.9	3.8	3.4	5.0	4.1	3.7
4.0	6.2	7.4	13.1	21.0	33.7	47.8	60.2	72.3	95.8	94.7	94.4
0.0	0.1	0.1	0.2	1.0	1.3	3.9	4.2	4.6	7.4	13.1	7.5
0.4	1.0	2.4	3.6	7.7	11.0	16.7	30.9	40.2	59.7	62.5	52.6
4.1	4.5	5.5	8.4	14.4	27.5	41.2	49.1	90.7	105.3	126.4	135.1

Table 10b Age-specific incidence rates per 100 000 person-years by primary site and five-year age group - 2005-2009

ICD10	Site	0-4	5-9	10-14	15-19	20-24	25-29
C00-96	All sites	22.9	13.6	12.0	22.9	40.3	66.0
C00-14	Mouth, pharynx	0.0	0.1	0.3	0.1	0.7	0.7
C00	Lip	0.0	0.0	0.0	0.0	0.0	0.1
C01-02	Tongue	0.0	0.0	0.0	0.0	0.1	0.1
C03-06	Mouth, other	0.0	0.0	0.0	0.0	0.0	0.1
C07-08	Salivary glands	0.0	0.0	0.3	0.1	0.4	0.1
C09-14	Pharynx	0.0	0.1	0.0	0.0	0.1	0.1
C15-26	Digestive organs	0.3	0.4	0.5	0.9	2.1	3.0
C15	Oesophagus	0.0	0.0	0.0	0.0	0.0	0.0
C16	Stomach	0.0	0.0	0.0	0.0	0.1	0.3
C17	Small intestine	0.0	0.0	0.0	0.1	0.0	0.1
C18	Colon	0.0	0.1	0.1	0.4	1.3	1.6
C19-21	Rectum, rectosigmoid, anus	0.0	0.0	0.0	0.0	0.4	0.8
C22	Liver	0.3	0.3	0.3	0.4	0.1	0.0
C23-24	Gallbladder, bile ducts	0.0	0.0	0.0	0.0	0.1	0.1
C25	Pancreas	0.0	0.0	0.0	0.0	0.0	0.0
C26	Other digestive organs	0.0	0.0	0.1	0.0	0.0	0.0
C30-34, C38	Respiratory organs	0.0	0.4	0.1	0.1	0.3	1.0
C30-31	Nose, sinuses	0.0	0.3	0.0	0.0	0.0	0.1
C32	Larynx, epiglottis	0.0	0.0	0.0	0.0	0.0	0.0
C33-34	Lung, trachea	0.0	0.1	0.1	0.1	0.3	0.8
C38	Mediastinum, pleura (non-mesothelioma)	0.0	0.0	0.0	0.0	0.0	0.0
C40-41	Bone	0.1	0.4	0.9	1.0	0.4	0.7
C43	Melanoma of the skin	0.1	0.1	0.1	1.6	5.4	10.6
C44	Skin, non-melanoma	0.1	0.1	0.1	0.8	1.1	0.4
C45	Mesothelioma	0.0	0.0	0.0	0.0	0.0	0.0
C46	Kaposi's sarcoma	0.0	0.0	0.0	0.0	0.0	0.3
C47	Autonomic nervous system	0.7	0.3	0.0	0.4	0.1	0.1
C48-49	Soft tissues	0.3	0.7	0.5	1.1	0.9	1.0
C50	Breast	0.0	0.0	0.0	0.0	1.6	4.9
C51-58	Female genital organs	0.7	0.4	1.0	1.4	5.4	14.2
C53	Cervix uteri	0.0	0.0	0.0	0.0	3.0	11.4
C54	Corpus uteri	0.0	0.0	0.0	0.0	0.0	0.5
C55	Uterus, other	0.0	0.0	0.0	0.0	0.0	0.0
C56	Ovary	0.7	0.4	1.0	1.3	1.7	1.6
C51-52, C57	Other female genital	0.0	0.0	0.0	0.0	0.1	0.4
C58	Placenta	0.0	0.0	0.0	0.1	0.6	0.1
C64-68	Urinary organs	2.0	0.5	0.1	0.0	0.6	1.0
C64	Kidney excl. renal pelvis	2.0	0.5	0.1	0.0	0.3	0.8
C65	Renal pelvis	0.0	0.0	0.0	0.0	0.0	0.0
C66-68	Bladder, ureter, urethra	0.0	0.0	0.0	0.0	0.3	0.1
C69	Eye	1.7	0.0	0.0	0.1	0.0	0.4
C70-72, D42-43	Central nervous system	6.7	4.2	3.9	5.0	5.8	7.9
C73	Thyroid gland	0.0	0.3	0.1	1.1	2.4	6.7
C37, C74-75	Other endocrine glands	1.4	1.1	0.8	1.8	5.0	5.5
C39, C76, C80	Other or unspecified	0.0	0.0	0.0	0.0	0.3	0.4
C81-96	Lymphoid and haematopoietic tissue	8.9	4.5	3.4	7.4	8.1	7.4
C81	Hodgkin lymphoma	0.0	0.3	0.4	3.4	4.0	3.6
C82-85, C96	Non-Hodgkin lymphoma	0.4	0.8	0.9	1.3	1.8	2.6
C88	Malignant immunoproliferative diseases	0.0	0.0	0.0	0.0	0.0	0.0
C90	Multiple myeloma	0.0	0.0	0.0	0.0	0.0	0.0
C91-95, D45-47	Leukaemia	8.5	3.4	2.1	2.6	2.3	1.2

FEMALES

Age												
30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	
108.5	165.3	255.2	421.4	614.1	803.3	1094.6	1333.1	1581.8	1891.0	2109.2	2113.0	
1.5	1.4	1.8	5.4	10.1	11.1	15.7	21.9	26.2	30.0	32.1	33.1	
0.4	0.2	0.0	0.8	2.2	1.9	3.1	5.1	6.9	10.9	10.2	13.0	
0.3	0.1	0.7	1.0	1.6	1.8	3.3	4.1	4.0	5.2	5.6	5.0	
0.1	0.2	0.4	0.4	1.7	2.7	3.7	5.3	8.4	6.6	10.7	9.4	
0.4	0.6	0.4	1.5	0.8	0.5	2.1	1.9	2.7	4.4	2.3	3.0	
0.4	0.2	0.4	1.8	3.8	4.1	3.6	5.5	4.2	2.9	3.2	2.7	
6.1	11.0	21.2	40.4	76.7	120.3	192.3	291.7	410.6	537.7	679.2	661.8	
0.0	0.1	0.3	0.8	1.7	3.0	4.1	4.5	9.3	13.6	9.9	14.4	
0.9	1.1	1.8	4.3	6.3	7.6	13.1	20.1	32.6	38.6	61.9	64.7	
0.4	0.5	0.5	0.9	2.7	3.7	4.9	6.1	9.5	11.0	8.9	6.2	
2.4	4.0	10.1	15.3	30.8	49.4	82.0	141.0	203.6	264.9	341.4	320.5	
1.7	3.4	4.7	12.6	22.7	31.9	50.4	66.2	77.9	101.5	113.7	105.5	
0.0	0.1	0.6	1.0	1.2	2.1	4.8	3.7	9.2	14.4	14.1	10.5	
0.1	0.6	0.6	1.0	2.0	4.7	5.6	9.2	10.4	17.1	23.2	13.5	
0.5	1.0	1.9	4.0	8.5	15.9	24.5	36.9	52.2	67.2	88.5	101.8	
0.1	0.2	0.7	0.5	0.9	2.1	2.9	4.1	5.9	9.4	17.6	24.6	
1.0	2.9	6.2	19.5	44.7	76.8	125.1	157.7	213.9	236.5	182.8	104.2	
0.2	0.0	0.1	0.4	1.3	1.1	1.8	2.5	2.0	3.1	4.1	4.1	
0.1	0.2	0.2	0.3	1.7	1.5	2.4	1.7	2.9	2.9	1.7	1.6	
0.6	2.7	5.9	18.5	41.6	73.6	120.4	153.5	207.2	228.9	175.5	97.4	
0.0	0.0	0.0	0.4	0.1	0.6	0.4	0.0	1.7	1.6	1.4	1.1	
0.6	0.7	0.5	1.1	0.5	1.8	1.8	1.0	1.7	1.6	1.4	1.6	
15.0	22.8	28.7	31.9	35.7	43.3	53.4	53.8	66.8	66.7	71.6	73.4	
1.1	1.9	4.9	5.8	12.2	19.2	27.8	49.6	85.5	125.4	183.2	323.4	
0.0	0.0	0.4	0.1	0.4	0.7	0.4	2.1	2.7	2.1	5.2	0.8	
0.0	0.0	0.1	0.0	0.1	0.0	0.3	0.0	0.0	0.3	1.2	1.6	
0.1	0.0	0.5	0.6	0.3	0.3	0.4	0.0	0.0	0.0	0.3	0.3	
0.7	1.6	1.8	2.8	3.9	6.1	9.4	9.9	11.1	12.3	10.3	8.2	
21.8	45.0	96.6	175.6	231.2	254.8	295.3	313.7	217.6	239.4	295.2	270.0	
25.2	33.7	39.3	53.5	93.8	121.5	151.7	173.8	191.4	208.9	201.3	176.9	
21.6	23.9	19.0	17.2	19.9	15.2	17.2	12.7	16.3	21.5	18.6	12.6	
0.9	4.3	8.5	17.0	39.6	60.4	77.2	96.9	111.9	104.3	89.3	71.0	
0.0	0.0	0.0	0.0	0.1	0.3	1.2	0.0	0.2	1.6	1.7	4.8	
1.5	4.2	9.6	15.1	27.0	37.2	47.7	50.4	47.9	63.4	64.7	53.6	
0.7	1.2	2.2	4.0	7.1	8.5	8.3	13.8	15.0	18.2	27.0	34.9	
0.5	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1.0	2.4	6.2	10.2	17.1	29.4	58.1	69.3	103.4	124.3	124.6	115.8	
0.5	1.4	3.7	6.0	8.3	13.6	24.2	26.6	41.3	48.9	39.4	32.2	
0.1	0.2	0.1	0.2	0.5	1.2	2.8	3.2	4.2	7.0	5.3	3.8	
0.4	0.8	2.3	3.9	8.2	14.6	31.1	39.5	57.9	68.4	79.9	79.8	
0.2	0.8	0.7	0.9	0.6	2.9	3.2	1.8	3.9	3.9	3.2	2.7	
12.4	15.4	17.8	29.0	33.8	39.7	50.0	53.2	65.1	61.1	58.8	51.3	
8.5	9.2	8.4	11.6	8.1	11.8	11.5	9.6	10.6	12.5	10.5	10.4	
4.6	4.9	4.5	6.4	5.4	5.8	8.5	7.5	8.4	6.3	6.7	3.8	
0.6	0.5	1.3	3.0	4.8	7.8	13.4	17.8	25.2	46.7	61.6	97.8	
7.9	11.1	14.3	23.6	34.6	50.1	76.3	98.5	137.5	175.3	180.1	175.8	
2.9	2.6	1.8	1.3	1.6	1.8	0.7	1.8	3.7	2.9	2.1	1.1	
2.1	3.5	5.9	11.1	17.9	21.9	33.1	43.8	52.2	67.8	64.8	53.9	
0.0	0.0	0.3	0.1	0.6	1.0	1.5	2.3	1.7	7.0	2.3	3.8	
0.0	0.5	1.7	3.0	5.1	8.5	14.8	13.4	26.0	37.6	33.9	26.5	
2.9	4.5	4.6	8.1	9.4	16.8	26.2	37.3	54.0	60.0	77.0	90.5	

Table 11a Average annual number of new cases by primary site and 5-year period 1955-2009

ICD10	Site	1955-59	1960-64	1965-69
C00-96	All sites	3841	4472	5228
C00-14	Mouth, pharynx	182	192	194
C00	Lip	100	95	99
C01-02	Tongue	16	21	20
C03-06	Mouth, other	21	24	29
C07-08	Salivary glands	11	12	13
C09-14	Pharynx	34	40	32
C15-26	Digestive organs	1621	1702	1842
C15	Oesophagus	72	80	78
C16	Stomach	858	802	787
C17	Small intestine	12	10	15
C18	Colon	221	282	349
C19-21	Rectum, rectosigmoid, anus	150	182	234
C22	Liver	17	24	32
C23-24	Gallbladder, bile ducts	15	22	25
C25	Pancreas	138	159	214
C26	Other digestive organs	136	142	108
C30-34, C38	Respiratory organs	296	430	588
C30-31	Nose, sinuses	20	20	22
C32	Larynx, epiglottis	27	43	63
C33-34	Lung, trachea	238	356	490
C38	Mediastinum, pleura (non-mesothelioma)	11	11	14
C40-41	Bone	15	14	18
C43	Melanoma of the skin	45	69	101
C44	Skin, non-melanoma	81	76	84
C45	Mesothelioma	0	2	1
C46	Kaposi's sarcoma	2	4	4
C47	Autonomic nervous system	20	16	16
C48-49	Soft tissues	18	25	32
C50	Breast	8	7	9
C60-63	Male genital organs	707	888	1062
C61	Prostate	638	798	971
C62	Testis	51	68	70
C60, C63	Other male genital	18	22	21
C64-68	Urinary organs	293	378	490
C64	Kidney excl. renal pelvis	88	119	149
C65	Renal pelvis	7	11	16
C66-68	Bladder, ureter, urethra	198	248	325
C69	Eye	18	18	22
C70-72, D42-43	Central nervous system	115	131	149
C73	Thyroid gland	17	24	33
C37, C74-75	Other endocrine glands	6	9	13
C39, C76, C80	Other or unspecified	51	82	114
C81-96	Lymphoid and haematopoietic tissue	346	405	455
C81	Hodgkin lymphoma	42	52	56
C82-85, C96	Non-Hodgkin lymphoma	90	104	138
C88	Malignant immunoproliferative diseases	0	0	2
C90	Multiple myeloma	66	79	84
C91-95, D45-47	Leukaemia	147	170	175

Period							
1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
6110	7249	8289	9064	10129	11076	12277	14196
244	239	249	256	255	259	258	287
124	114	104	95	83	64	51	68
25	28	34	38	39	46	50	57
29	32	46	46	52	53	49	48
16	15	14	15	21	18	21	19
50	50	51	62	60	77	86	95
1932	2112	2319	2371	2456	2510	2669	2813
79	91	86	93	104	123	127	145
674	614	598	533	483	409	354	300
15	22	26	26	31	40	52	65
388	492	625	722	827	895	1004	1098
314	409	503	533	581	592	661	676
50	52	61	63	61	65	78	91
27	38	42	48	54	56	60	67
249	258	287	306	275	279	296	330
137	136	90	47	40	50	37	41
755	970	1167	1281	1358	1422	1519	1607
21	24	23	24	22	21	24	23
71	88	98	108	103	106	108	99
647	839	1029	1141	1216	1277	1373	1472
15	19	17	7	17	18	14	13
18	24	22	22	21	22	24	26
145	192	245	328	422	455	479	618
161	205	263	340	443	542	641	759
8	17	20	38	34	48	61	62
6	7	6	12	15	8	6	6
12	9	8	7	7	7	5	6
41	50	47	41	46	47	52	58
8	11	12	11	15	14	16	17
1297	1573	1809	1996	2483	3014	3502	4481
1186	1443	1647	1812	2249	2753	3205	4145
86	101	134	157	201	226	257	291
24	28	28	27	33	35	40	46
604	770	940	1025	1136	1137	1245	1394
165	199	238	249	277	281	330	390
25	29	35	32	39	36	39	47
414	542	667	743	820	821	877	958
19	24	27	23	26	28	32	31
153	189	207	246	260	313	385	439
34	42	48	47	44	47	53	70
24	27	42	44	45	59	77	111
138	179	207	268	288	296	237	194
510	609	650	708	775	848	1018	1216
63	67	56	49	52	56	65	70
127	168	200	256	307	339	373	451
5	7	8	9	14	20	27	29
113	145	151	161	157	167	169	201
202	222	235	232	246	266	383	464

Table 11b Average annual number of new cases by primary site and 5-year period 1955-2009

ICD10	Site	1955-59	1960-64	1965-69
C00-96	All sites	4085	4482	5144
C00-14	Mouth, pharynx	61	60	77
C00	Lip	8	7	12
C01-02	Tongue	12	12	17
C03-06	Mouth, other	12	11	16
C07-08	Salivary glands	8	11	15
C09-14	Pharynx	22	19	17
C15-26	Digestive organs	1393	1423	1529
C15	Oesophagus	23	28	30
C16	Stomach	613	546	508
C17	Small intestine	10	9	12
C18	Colon	267	324	408
C19-21	Rectum, rectosigmoid, anus	121	137	189
C22	Liver	11	14	16
C23-24	Gallbladder, bile ducts	46	50	58
C25	Pancreas	92	117	142
C26	Other digestive organs	210	197	166
C30-34, C38	Respiratory organs	87	106	140
C30-31	Nose, sinuses	14	12	13
C32	Larynx, epiglottis	2	3	6
C33-34	Lung, trachea	68	83	115
C38	Mediastinum, pleura (non-mesothelioma)	4	7	6
C40-41	Bone	10	10	11
C43	Melanoma of the skin	54	82	108
C44	Skin, non-melanoma	56	48	44
C45	Mesothelioma	0	1	1
C46	Kaposi's sarcoma	0	0	2
C47	Autonomic nervous system	18	12	13
C48-49	Soft tissues	17	24	27
C50	Breast	901	1027	1172
C51-58	Female genital organs	837	930	1070
C53	Cervix uteri	333	352	386
C54	Corpus uteri	167	207	250
C55	Uterus, other	23	23	15
C56	Ovary	249	278	349
C51-52, C57	Other female genital	63	68	67
C58	Placenta	2	3	4
C64-68	Urinary organs	189	212	245
C64	Kidney excl. renal pelvis	74	88	100
C65	Renal pelvis	6	5	10
C66-68	Bladder, ureter, urethra	109	119	135
C69	Eye	13	19	16
C70-72, D42-43	Central nervous system	102	116	133
C73	Thyroid gland	52	59	79
C37, C74-75	Other endocrine glands	7	6	9
C39, C76, C80	Other or unspecified	46	63	91
C81-96	Lymphoid and haematopoietic tissue	241	283	378
C81	Hodgkin lymphoma	30	35	48
C82-85, C96	Non-Hodgkin lymphoma	62	71	114
C88	Malignant immunoproliferative diseases	0	0	0
C90	Multiple myeloma	38	50	77
C91-95, D45-47	Leukaemia	111	126	138

FEMALES

Period							
1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
5858	6864	7649	8329	9197	10213	11409	12462
79	82	100	111	118	131	132	184
10	13	20	24	30	27	26	48
17	18	20	25	22	25	27	32
17	18	25	29	32	36	33	45
15	12	14	12	17	19	19	22
20	21	20	20	17	24	27	37
1677	1929	2122	2199	2294	2434	2539	2678
30	32	33	36	42	44	53	54
443	408	401	358	314	267	230	218
18	20	26	26	32	36	51	53
473	627	746	861	947	1086	1170	1265
261	337	420	431	479	506	529	549
31	30	39	44	47	41	45	55
52	65	81	81	72	79	76	78
181	213	253	287	300	312	336	347
187	197	123	75	61	64	50	57
186	231	314	427	562	708	890	1112
14	12	13	16	16	16	17	20
7	8	13	11	17	19	18	18
158	203	283	396	523	665	848	1067
6	7	5	4	6	8	7	7
14	13	13	15	17	18	19	22
161	240	326	411	475	500	547	642
95	143	183	262	362	452	532	690
2	3	4	6	7	9	9	13
4	3	4	7	6	4	3	3
13	7	5	9	8	7	4	6
32	42	46	44	45	52	73	87
1328	1532	1668	1816	1975	2357	2687	2759
1210	1291	1292	1274	1393	1419	1506	1566
438	422	369	328	363	329	293	298
303	361	384	395	444	489	612	684
11	6	7	6	7	8	10	8
339	372	406	438	466	463	464	441
116	127	121	105	107	128	123	133
4	2	4	4	6	3	3	3
306	364	406	458	478	513	553	604
114	134	149	173	190	192	199	238
13	19	17	20	20	27	28	26
178	212	240	265	267	295	326	340
17	22	23	21	28	30	31	29
128	182	206	248	279	378	508	579
99	123	147	135	137	121	145	166
14	24	45	39	44	56	75	111
98	153	208	254	315	308	300	235
397	480	539	593	652	715	855	977
40	44	38	36	33	36	48	46
106	140	181	231	275	302	341	375
3	3	6	7	12	11	17	19
96	123	127	138	137	146	152	155
152	169	187	182	195	221	297	383

Table 12a Age-adjusted (world) incidence rates per 100 000 person-years by primary site and five-year period 1955-2009

ICD10	Site	1955-59	1960-64	1965-69
C00-96	All sites	168.7	179.5	193.5
C00-14	Mouth, pharynx	7.9	7.7	7.3
C00	Lip	4.3	3.8	3.6
C01-02	Tongue	0.7	0.9	0.8
C03-06	Mouth, other	0.9	0.9	1.1
C07-08	Salivary glands	0.5	0.5	0.5
C09-14	Pharynx	1.5	1.6	1.2
C15-26	Digestive organs	69.7	66.2	65.6
C15	Oesophagus	3.1	3.1	2.7
C16	Stomach	36.8	31.0	28.0
C17	Small intestine	0.6	0.4	0.6
C18	Colon	9.5	11.0	12.5
C19-21	Rectum, rectosigmoid, anus	6.4	7.1	8.4
C22	Liver	0.8	1.0	1.2
C23-24	Gallbladder, bile ducts	0.7	0.9	0.9
C25	Pancreas	6.1	6.3	7.6
C26	Other digestive organs	5.8	5.4	3.8
C30-34, C38	Respiratory organs	13.3	17.7	22.2
C30-31	Nose, sinuses	0.9	0.8	0.8
C32	Larynx, epiglottis	1.2	1.8	2.4
C33-34	Lung, trachea	10.7	14.7	18.5
C38	Mediastinum, pleura (non-mesothelioma)	0.5	0.5	0.5
C40-41	Bone	0.9	0.7	0.9
C43	Melanoma of the skin	2.1	3.1	4.5
C44	Skin, non-melanoma	3.4	2.9	2.9
C45	Mesothelioma	0.0	0.1	0.0
C46	Kaposi's sarcoma	0.1	0.1	0.1
C47	Autonomic nervous system	1.0	0.8	0.7
C48-49	Soft tissues	0.9	1.1	1.3
C50	Breast	0.3	0.3	0.3
C60-63	Male genital organs	29.3	33.5	36.7
C61	Prostate	25.8	28.8	32.1
C62	Testis	2.7	3.8	3.8
C60, C63	Other male genital	0.8	0.9	0.8
C64-68	Urinary organs	13.0	15.2	18.0
C64	Kidney excl. renal pelvis	4.0	5.0	5.6
C65	Renal pelvis	0.3	0.5	0.6
C66-68	Bladder, ureter, urethra	8.6	9.7	11.8
C69	Eye	0.9	0.8	1.0
C70-72, D42-43	Central nervous system	6.0	6.4	6.9
C73	Thyroid gland	0.8	1.0	1.3
C37, C74-75	Other endocrine glands	0.3	0.5	0.7
C39, C76, C80	Other or unspecified	2.3	3.3	4.2
C81-96	Lymphoid and haematopoietic tissue	16.7	18.0	18.7
C81	Hodgkin lymphoma	2.2	2.6	2.6
C82-85, C96	Non-Hodgkin lymphoma	4.3	4.5	5.6
C88	Malignant immunoproliferative diseases	0.0	0.0	0.1
C90	Multiple myeloma	2.9	3.1	3.1
C91-95, D45-47	Leukaemia	7.3	7.8	7.3

Period							
1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
212.0	236.0	256.4	270.4	292.5	313.8	333.3	357.6
8.6	8.1	8.1	8.4	8.2	8.2	7.7	7.7
4.3	3.7	3.2	2.8	2.4	1.8	1.4	1.6
0.9	1.0	1.1	1.3	1.3	1.5	1.6	1.6
1.0	1.1	1.5	1.6	1.7	1.7	1.5	1.3
0.6	0.5	0.4	0.5	0.7	0.6	0.6	0.5
1.8	1.7	1.7	2.2	2.1	2.6	2.7	2.7
64.6	66.2	68.5	68.0	68.6	67.8	68.8	67.2
2.6	2.9	2.6	2.9	3.2	3.5	3.5	3.7
22.4	19.1	17.5	14.7	13.1	10.6	8.8	6.9
0.5	0.7	0.8	0.8	0.9	1.2	1.5	1.7
13.0	15.4	18.4	20.9	22.8	24.0	25.5	25.6
10.5	13.0	15.1	15.6	16.7	16.6	17.5	16.6
1.8	1.7	1.9	1.9	1.8	1.9	2.0	2.4
0.9	1.1	1.2	1.4	1.5	1.5	1.5	1.6
8.3	8.1	8.5	8.6	7.7	7.5	7.7	7.9
4.5	4.1	2.4	1.2	1.0	1.2	0.9	0.9
26.8	32.3	37.2	39.5	40.7	41.3	40.7	39.2
0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.6
2.6	3.0	3.3	3.5	3.3	3.3	3.1	2.5
22.9	27.8	32.6	35.0	36.3	36.8	36.6	35.7
0.6	0.7	0.6	0.2	0.5	0.5	0.4	0.3
0.8	1.1	1.0	1.0	0.9	1.0	1.0	1.0
6.3	7.8	9.6	12.3	14.9	14.9	14.4	16.6
5.2	6.1	7.4	9.2	11.1	13.5	14.8	15.6
0.3	0.5	0.6	1.2	1.0	1.4	1.6	1.5
0.2	0.2	0.2	0.3	0.4	0.2	0.2	0.2
0.5	0.5	0.4	0.5	0.3	0.3	0.3	0.3
1.6	1.9	1.8	1.5	1.6	1.6	1.7	1.7
0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5
41.4	46.5	50.4	52.8	64.6	81.4	94.9	114.9
36.2	40.6	43.2	45.1	55.1	70.8	83.2	102.0
4.4	5.0	6.3	6.9	8.5	9.6	10.6	11.7
0.8	0.9	0.9	0.8	0.9	1.0	1.1	1.2
21.0	25.0	29.1	30.0	32.4	31.2	32.2	33.5
6.1	6.9	8.0	7.9	8.4	8.3	9.5	10.3
0.8	1.0	1.1	1.0	1.2	1.0	0.9	1.1
14.1	17.1	20.0	21.2	22.8	21.8	21.8	22.0
0.8	0.9	1.1	0.9	0.9	1.0	1.0	0.9
6.8	8.3	8.5	9.8	10.0	11.3	13.3	14.0
1.4	1.6	1.7	1.7	1.6	1.6	1.7	2.0
1.2	1.2	1.9	1.9	1.8	2.2	2.7	3.5
4.7	5.8	6.2	7.6	7.8	7.6	5.6	4.3
19.6	21.6	22.3	23.4	25.2	26.9	30.3	33.0
2.8	2.7	2.3	2.0	2.1	2.4	2.7	2.7
4.8	5.9	6.8	8.6	10.1	10.7	11.1	12.1
0.2	0.2	0.2	0.3	0.4	0.5	0.7	0.7
3.8	4.7	4.5	4.7	4.4	4.5	4.4	4.9
8.1	8.1	8.4	7.9	8.2	8.8	11.4	12.7

Table 12b Age-adjusted (world) incidence rates per 100 000 person-years by primary site and five-year period 1955-2009

ICD10	Site	1955-59	1960-64	1965-69
C00-96	All sites	164.0	167.1	178.0
C00-14	Mouth, pharynx	2.4	2.1	2.4
C00	Lip	0.3	0.2	0.4
C01-02	Tongue	0.4	0.4	0.5
C03-06	Mouth, other	0.5	0.4	0.5
C07-08	Salivary glands	0.3	0.4	0.5
C09-14	Pharynx	0.9	0.7	0.6
C15-26	Digestive organs	50.1	46.3	44.8
C15	Oesophagus	0.8	0.9	0.8
C16	Stomach	21.8	17.5	14.6
C17	Small intestine	0.4	0.3	0.4
C18	Colon	9.8	10.7	12.1
C19-21	Rectum, rectosigmoid, anus	4.5	4.7	5.9
C22	Liver	0.5	0.6	0.5
C23-24	Gallbladder, bile ducts	1.7	1.6	1.7
C25	Pancreas	3.4	3.9	4.1
C26	Other digestive organs	7.4	6.1	4.6
C30-34, C38	Respiratory organs	3.4	3.7	4.6
C30-31	Nose, sinuses	0.5	0.4	0.4
C32	Larynx, epiglottis	0.1	0.1	0.2
C33-34	Lung, trachea	2.7	2.9	3.7
C38	Mediastinum, pleura (non-mesothelioma)	0.1	0.3	0.2
C40-41	Bone	0.5	0.6	0.5
C43	Melanoma of the skin	2.5	3.7	4.6
C44	Skin, non-melanoma	2.1	1.5	1.3
C45	Mesothelioma	0.0	0.0	0.0
C46	Kaposi's sarcoma	0.0	0.0	0.1
C47	Autonomic nervous system	0.8	0.5	0.6
C48-49	Soft tissues	0.7	1.0	1.0
C50	Breast	37.3	39.6	42.6
C51-58	Female genital organs	36.1	38.0	41.4
C53	Cervix uteri	15.0	15.4	16.7
C54	Corpus uteri	7.0	8.0	9.0
C55	Uterus, other	0.8	0.8	0.4
C56	Ovary	10.7	11.1	13.0
C51-52, C57	Other female genital	2.4	2.4	2.1
C58	Placenta	0.1	0.2	0.2
C64-68	Urinary organs	7.3	7.3	7.6
C64	Kidney excl. renal pelvis	3.1	3.2	3.3
C65	Renal pelvis	0.2	0.2	0.3
C66-68	Bladder, ureter, urethra	4.0	3.9	4.0
C69	Eye	0.6	0.9	0.7
C70-72, D42-43	Central nervous system	4.9	5.3	5.8
C73	Thyroid gland	2.2	2.4	3.2
C37, C74-75	Other endocrine glands	0.4	0.3	0.4
C39, C76, C80	Other or unspecified	1.8	2.3	2.9
C81-96	Lymphoid and haematopoietic tissue	10.7	11.6	13.6
C81	Hodgkin lymphoma	1.5	1.7	2.1
C82-85, C96	Non-Hodgkin lymphoma	2.7	2.7	4.0
C88	Malignant immunoproliferative diseases	0.0	0.0	0.0
C90	Multiple myeloma	1.4	1.7	2.3
C91-95, D45-47	Leukaemia	5.1	5.5	5.2

FEMALES

Period							
1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
191.9	210.5	220.4	227.3	244.3	263.5	282.1	291.0
2.4	2.2	2.7	2.8	3.1	3.4	3.2	4.1
0.3	0.4	0.5	0.5	0.7	0.6	0.6	0.9
0.4	0.4	0.5	0.6	0.6	0.7	0.6	0.7
0.5	0.4	0.6	0.7	0.8	0.9	0.7	0.9
0.5	0.3	0.5	0.4	0.5	0.5	0.5	0.6
0.7	0.6	0.6	0.6	0.5	0.7	0.7	1.0
45.6	47.7	48.9	47.6	48.7	49.6	50.6	50.7
0.7	0.7	0.7	0.8	0.9	0.9	1.1	1.0
11.8	9.6	8.8	7.4	6.2	5.0	4.4	3.9
0.6	0.6	0.7	0.7	0.8	0.9	1.2	1.2
13.3	15.9	17.8	19.0	20.3	22.2	23.1	23.3
7.4	9.0	10.3	10.1	11.1	11.2	11.5	11.5
0.9	0.8	1.0	1.0	1.1	0.9	1.0	1.1
1.3	1.5	1.8	1.6	1.5	1.6	1.4	1.5
4.9	5.2	5.5	6.0	5.9	6.0	6.2	6.3
4.8	4.4	2.3	1.2	1.0	0.9	0.7	0.9
5.8	6.8	9.0	11.9	15.6	18.9	22.3	25.1
0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5
0.2	0.3	0.3	0.3	0.5	0.5	0.4	0.4
4.9	6.0	8.2	11.0	14.6	17.8	21.3	24.0
0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.1
0.6	0.5	0.6	0.7	0.7	0.7	0.8	0.8
6.9	9.6	12.1	14.8	16.0	15.9	15.9	17.4
2.4	3.4	3.9	5.0	6.8	7.9	8.8	10.5
0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1
0.6	0.3	0.3	0.4	0.4	0.3	0.2	0.3
1.3	1.4	1.5	1.4	1.5	1.5	2.0	2.4
46.0	50.2	51.5	53.6	57.2	68.3	76.1	73.4
45.2	46.0	43.4	40.3	42.7	41.2	40.5	39.7
18.8	17.3	14.3	11.9	12.7	11.2	9.5	9.4
10.3	11.9	12.2	12.2	13.1	13.7	15.6	16.4
0.3	0.1	0.2	0.1	0.1	0.2	0.2	0.1
12.4	13.1	13.5	13.4	14.0	13.1	12.4	10.9
3.2	3.4	3.1	2.5	2.5	2.9	2.6	2.8
0.2	0.1	0.2	0.2	0.3	0.2	0.1	0.1
8.7	9.7	10.0	10.7	10.9	11.3	11.5	12.6
3.6	4.0	4.1	4.4	4.7	4.7	4.6	5.5
0.3	0.5	0.4	0.5	0.4	0.5	0.6	0.5
4.8	5.3	5.5	5.9	5.7	6.0	6.3	6.5
0.7	0.7	0.9	0.7	0.9	0.9	0.8	0.9
5.4	7.4	7.9	9.1	9.6	12.4	15.7	16.9
3.9	4.8	5.4	4.8	4.7	4.0	4.7	5.2
0.6	1.1	2.0	1.7	1.8	2.1	2.7	3.9
2.7	3.8	4.7	5.3	6.2	5.9	4.9	3.8
13.0	14.6	15.5	16.3	17.3	18.8	21.1	23.2
1.6	1.7	1.5	1.4	1.4	1.5	1.9	1.8
3.5	4.3	5.0	6.5	7.3	7.8	8.3	8.8
0.1	0.1	0.2	0.2	0.3	0.2	0.3	0.4
2.7	3.2	3.0	3.0	2.8	2.9	3.0	3.1
5.2	5.3	5.9	5.3	5.5	6.3	7.6	9.1

Table 13a Average annual number of new cases by primary site and county - 2005-2009

ICD10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud
C00-96	All sites	14196	860	1415	1337	656	597	820
C00-14	Mouth, pharynx	287	19	28	30	15	9	13
C00	Lip	68	5	6	4	5	2	3
C01-02	Tongue	57	3	6	6	3	2	3
C03-06	Mouth, other	48	4	3	6	2	2	3
C07-08	Salivary glands	19	1	3	1	1	1	0
C09-14	Pharynx	95	6	9	13	4	3	5
C15-26	Digestive organs	2813	167	283	256	129	121	153
C15	Oesophagus	145	8	16	15	7	6	9
C16	Stomach	300	15	26	30	10	13	15
C17	Small intestine	65	3	5	5	3	2	3
C18	Colon	1098	66	106	91	50	48	63
C19-21	Rectum, rectosigmoid, anus	676	47	67	57	31	27	39
C22	Liver	91	5	10	15	5	3	4
C23-24	Gallbladder, bile ducts	67	2	8	7	3	4	3
C25	Pancreas	330	18	39	33	19	15	15
C26	Other digestive organs	41	3	6	4	2	2	3
C30-34, C38	Respiratory organs	1607	100	145	139	78	62	86
C30-31	Nose, sinuses	23	1	3	2	1	1	1
C32	Larynx, epiglottis	99	7	7	9	6	4	5
C33-34	Lung, trachea	1472	91	134	127	71	57	79
C38	Mediastinum, pleura (non-mesothelioma)	13	1	1	1	0	0	0
C40-41	Bone	26	1	2	2	1	1	1
C43	Melanoma of the skin	618	41	78	60	26	23	43
C44	Skin, non-melanoma	759	53	70	68	37	24	69
C45	Mesothelioma	62	3	8	5	2	2	5
C46	Kaposi's sarcoma	6	0	1	1	0	0	0
C47	Autonomic nervous system	6	0	0	1	0	0	1
C48-49	Soft tissues	58	3	8	5	4	2	2
C50	Breast	17	2	2	2	0	0	1
C60-63	Male genital organs	4481	259	420	410	200	218	259
C61	Prostate	4145	239	386	368	190	204	244
C62	Testis	291	17	29	38	8	12	13
C60, C63	Other male genital	46	3	5	5	2	2	2
C64-68	Urinary organs	1394	95	146	131	66	50	71
C64	Kidney excl. renal pelvis	390	29	48	37	19	16	24
C65	Renal pelvis	47	3	5	4	2	2	2
C66-68	Bladder, ureter, urethra	958	63	93	90	45	33	46
C69	Eye	31	3	4	3	1	1	1
C70-72, D42-43	Central nervous system	439	23	42	47	18	17	23
C73	Thyroid gland	70	4	7	9	3	3	5
C37, C74-75	Other endocrine glands	111	6	11	10	5	3	6
C39, C76, C80	Other or unspecified	194	14	19	21	9	9	10
C81-96	Lymphoid and haematopoietic tissue	1216	68	141	137	61	53	72
C81	Hodgkin lymphoma	70	6	7	10	4	3	4
C82-85, C96	Non-Hodgkin lymphoma	451	23	52	53	25	22	18
C88	Malignant immunoproliferative diseases	29	2	4	2	1	1	1
C90	Multiple myeloma	201	10	24	20	8	8	14
C91-95, D45-47	Leukaemia	464	27	54	51	23	18	35

Vestfold	Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finmark
780	577	368	499	1168	1338	389	837	767	395	779	432	182
14	13	8	10	24	25	8	16	17	7	20	8	4
4	2	2	4	9	6	2	3	4	1	5	1	1
3	2	3	2	3	5	1	4	2	1	5	2	1
2	2	1	1	5	5	2	3	2	1	3	2	0
2	2	0	1	2	1	1	1	1	0	1	1	0
4	5	2	3	6	8	2	6	7	2	7	3	1
146	106	59	89	227	300	76	168	158	79	157	98	39
6	6	4	6	11	13	4	9	7	3	8	5	3
15	10	4	7	21	34	10	21	18	9	18	13	9
4	2	1	1	5	7	1	4	7	2	4	2	1
61	41	20	38	95	123	29	66	57	35	67	34	10
32	24	17	22	54	77	22	40	36	15	34	24	11
3	3	3	4	7	8	2	4	6	3	4	4	0
4	3	3	3	5	6	2	2	5	2	3	2	1
19	15	6	8	25	31	6	19	21	9	18	13	4
1	1	1	1	3	2	1	2	2	2	1	1	1
89	63	48	70	123	150	42	99	88	43	90	61	31
1	0	0	1	2	3	0	1	1	0	1	1	1
5	5	4	5	7	8	1	7	5	3	7	5	1
83	56	44	64	112	138	41	90	81	40	81	55	29
1	1	0	0	1	1	0	1	1	0	1	1	0
1	1	1	1	3	3	1	2	1	1	1	1	1
39	27	15	23	66	57	11	26	35	15	17	13	4
50	40	29	40	70	67	14	28	37	15	28	17	4
7	3	1	1	6	8	1	2	4	1	2	1	1
0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	1	0	0	0	0
3	2	2	2	6	6	2	3	2	2	3	2	1
1	0	1	1	1	2	0	2	1	1	1	0	0
239	182	121	158	385	395	150	287	227	123	272	125	50
224	172	113	145	356	358	143	268	208	113	255	114	44
13	8	7	11	26	31	5	16	17	8	15	10	5
2	2	0	2	4	5	1	3	2	1	2	1	1
78	55	32	40	107	136	34	86	78	39	86	43	21
17	15	6	11	29	36	8	24	23	12	20	10	7
5	1	1	1	4	5	2	3	4	1	2	2	0
57	39	25	28	74	95	24	60	52	26	64	31	14
2	1	1	2	3	3	1	1	1	1	2	0	1
21	18	12	14	36	45	10	25	31	14	23	16	5
3	3	1	2	4	5	2	6	6	2	2	2	1
7	4	2	4	8	11	4	9	6	5	5	3	2
10	9	6	4	13	18	6	10	9	7	12	6	3
69	48	29	39	86	106	28	68	62	41	57	36	14
3	2	1	2	6	7	1	3	6	2	2	2	0
26	17	12	17	34	38	13	25	19	15	22	15	7
1	1	0	1	1	3	1	1	2	3	1	1	0
11	9	6	5	15	19	4	10	12	7	9	6	3
28	19	10	15	31	39	10	28	24	15	23	12	3

Table 13b Average annual number of new cases by primary site and county - 2005-2009

ICD10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud
C00-96	All sites	12462	763	1287	1396	560	520	738
C00-14	Mouth, pharynx	184	12	17	23	9	9	11
C00	Lip	48	3	5	3	2	2	2
C01-02	Tongue	32	1	3	5	1	2	3
C03-06	Mouth, other	45	3	4	6	4	2	3
C07-08	Salivary glands	22	1	1	3	1	1	1
C09-14	Pharynx	37	3	3	6	1	2	3
C15-26	Digestive organs	2678	175	251	274	119	111	145
C15	Oesophagus	54	3	7	8	2	3	3
C16	Stomach	218	12	18	22	8	8	12
C17	Small intestine	53	4	6	5	3	1	3
C18	Colon	1265	84	114	127	56	52	72
C19-21	Rectum, rectosigmoid, anus	549	37	58	56	24	24	27
C22	Liver	55	2	6	5	4	2	3
C23-24	Gallbladder, bile ducts	78	5	5	7	4	5	4
C25	Pancreas	347	24	31	39	14	12	19
C26	Other digestive organs	57	4	6	6	3	3	2
C30-34, C38	Respiratory organs	1112	66	119	132	52	40	65
C30-31	Nose, sinuses	20	1	2	2	1	0	1
C32	Larynx, epiglottis	18	0	2	5	1	1	1
C33-34	Lung, trachea	1067	64	114	123	50	39	63
C38	Mediastinum, pleura (non-mesothelioma)	7	0	1	2	0	0	0
C40-41	Bone	22	2	1	3	1	1	1
C43	Melanoma of the skin	642	45	68	69	26	24	42
C44	Skin, non-melanoma	690	51	57	65	28	21	67
C45	Mesothelioma	13	1	2	1	0	1	1
C46	Kaposi's sarcoma	3	0	0	0	0	0	0
C47	Autonomic nervous system	6	1	1	0	0	0	1
C48-49	Soft tissues	87	5	9	8	3	4	3
C50	Breast	2759	158	311	344	121	112	158
C51-58	Female genital organs	1566	87	164	170	81	88	90
C53	Cervix uteri	298	14	36	34	15	14	18
C54	Corpus uteri	684	37	75	72	37	41	36
C55	Uterus, other	8	0	0	0	1	0	0
C56	Ovary	441	29	43	50	22	26	28
C51-52, C57	Other female genital	133	6	9	13	7	7	8
C58	Placenta	3	0	0	0	0	0	0
C64-68	Urinary organs	604	43	57	69	27	23	32
C64	Kidney excl. renal pelvis	238	18	23	25	10	9	12
C65	Renal pelvis	26	2	2	3	2	0	1
C66-68	Bladder, ureter, urethra	340	23	32	41	15	14	18
C69	Eye	29	1	3	4	2	2	2
C70-72, D42-43	Central nervous system	579	31	57	59	24	25	30
C73	Thyroid gland	166	6	21	18	10	6	10
C37, C74-75	Other endocrine glands	111	7	12	16	3	3	5
C39, C76, C80	Other or unspecified	235	16	21	30	12	11	15
C81-96	Lymphoid and haematopoietic tissue	977	58	115	111	44	41	59
C81	Hodgkin lymphoma	46	2	6	5	3	1	3
C82-85, C96	Non-Hodgkin lymphoma	375	20	42	43	18	17	21
C88	Malignant immunoproliferative diseases	19	2	3	3	1	1	1
C90	Multiple myeloma	155	9	17	20	7	7	8
C91-95, D45-47	Leukaemia	383	26	47	40	15	16	26

FEMALES

Vestfold	Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finmark
687	501	295	463	960	1165	267	659	716	353	622	350	160
11	7	5	7	12	13	5	9	10	4	10	7	2
3	1	2	3	7	4	2	3	2	0	1	1	0
2	2	1	1	2	2	1	2	2	0	2	1	0
3	2	1	1	1	2	1	2	3	1	4	2	0
2	1	0	1	1	1	1	2	1	1	1	1	0
2	1	1	1	1	4	0	1	2	1	1	2	1
143	91	60	85	203	282	73	170	164	77	142	79	35
4	2	1	2	4	4	1	1	4	1	2	2	1
12	8	3	6	16	25	8	15	16	6	11	8	5
2	1	1	2	3	5	1	4	5	1	5	1	0
66	43	27	40	96	142	34	84	73	40	66	36	12
32	15	14	17	45	58	16	30	32	14	30	15	6
2	2	1	3	5	5	2	3	3	1	5	2	1
3	4	2	3	5	7	2	6	5	4	3	2	2
19	13	8	11	26	34	8	24	22	9	18	11	7
3	2	2	3	4	3	1	4	3	2	3	2	0
63	43	30	51	73	85	20	56	67	30	66	33	20
1	1	0	1	1	2	0	1	0	0	2	1	1
1	0	0	1	1	1	0	0	1	0	0	1	0
60	41	29	49	71	82	19	54	65	29	64	32	19
0	0	0	0	0	0	0	0	1	0	0	0	1
2	1	1	1	2	3	0	2	1	1	0	0	0
41	28	17	23	69	64	10	31	36	18	15	12	7
35	44	26	41	73	61	12	19	36	20	21	9	4
1	0	0	0	1	1	0	1	1	1	0	0	0
0	0	0	0	0	0	0	1	0	0	1	0	0
0	0	0	0	0	2	0	0	0	0	0	0	0
5	3	2	3	7	6	3	5	6	5	6	3	2
163	103	55	103	214	246	56	149	144	76	134	80	32
77	69	36	59	128	141	29	71	88	40	80	48	22
12	12	5	9	24	31	5	11	15	8	20	11	4
34	33	15	29	57	62	13	28	38	16	32	19	9
0	0	0	0	1	2	0	1	0	1	0	1	0
22	18	12	16	33	36	7	24	25	11	21	12	7
8	6	3	4	12	11	4	8	10	5	7	4	1
0	0	0	0	0	0	0	0	0	0	0	1	0
29	23	18	23	40	51	11	33	41	16	41	21	7
9	10	5	11	15	19	5	13	17	9	16	8	4
2	1	1	1	2	2	1	2	2	0	1	1	0
18	12	12	11	23	30	5	19	22	6	24	12	3
1	1	0	0	3	3	1	2	1	0	2	1	0
33	24	11	21	37	62	16	29	39	24	30	17	10
7	9	2	5	8	18	4	12	10	4	11	5	2
8	3	2	2	5	13	3	7	8	3	6	2	2
12	10	4	6	16	20	6	9	13	8	12	10	3
57	41	25	32	70	93	18	54	50	27	45	25	12
2	1	1	2	4	5	1	3	4	1	2	1	1
23	15	12	13	29	34	6	20	18	9	20	8	7
1	1	0	0	1	2	0	2	1	1	1	0	0
9	7	3	5	10	14	4	10	5	4	7	7	1
22	17	9	12	26	38	8	19	23	12	15	10	3

Table 14a Age-adjusted (world) incidence rates per 100 000 person-years by county and primary site - 2005-2009

ICD10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud
C00-96	All sites	357.6	360.9	347.9	348.5	347.4	331.3	369.1
C00-14	Mouth, pharynx	7.7	8.2	7.2	8.3	9.0	6.2	6.1
C00	Lip	1.6	1.9	1.6	0.9	2.6	1.1	1.2
C01-02	Tongue	1.6	1.2	1.6	1.8	1.5	1.6	1.2
C03-06	Mouth, other	1.3	1.7	0.9	1.5	1.3	0.9	1.2
C07-08	Salivary glands	0.5	0.5	0.8	0.4	0.6	0.7	0.2
C09-14	Pharynx	2.7	2.8	2.3	3.6	3.0	2.0	2.3
C15-26	Digestive organs	67.2	66.6	65.6	64.2	64.2	63.8	66.6
C15	Oesophagus	3.7	3.6	3.7	4.0	3.3	3.4	4.2
C16	Stomach	6.9	5.5	5.8	7.3	4.9	6.7	6.5
C17	Small intestine	1.7	1.5	1.2	1.3	1.8	1.2	1.2
C18	Colon	25.6	25.8	24.4	22.0	23.0	25.0	27.1
C19-21	Rectum, rectosigmoid, anus	16.6	18.6	15.9	14.5	15.8	14.8	16.8
C22	Liver	2.4	2.3	2.5	3.9	2.8	1.3	1.9
C23-24	Gallbladder, bile ducts	1.6	0.9	1.9	1.7	1.8	2.3	1.0
C25	Pancreas	7.9	7.1	8.9	8.4	9.9	7.8	6.8
C26	Other digestive organs	0.9	1.3	1.2	1.1	0.9	1.4	1.0
C30-34, C38	Respiratory organs	39.2	40.9	33.5	35.8	40.2	31.8	38.0
C30-31	Nose, sinuses	0.6	0.4	0.6	0.6	0.3	0.6	0.6
C32	Larynx, epiglottis	2.5	2.9	1.9	2.4	3.0	1.7	2.0
C33-34	Lung, trachea	35.7	37.4	30.7	32.4	36.9	29.1	35.2
C38	Mediastinum, pleura (non-mesothelioma)	0.3	0.2	0.3	0.2	0.0	0.3	0.1
C40-41	Bone	1.0	0.5	0.8	1.0	0.6	0.6	0.9
C43	Melanoma of the skin	16.6	19.0	20.0	15.3	14.9	14.3	19.7
C44	Skin, non-melanoma	15.6	18.3	14.3	14.1	14.4	9.7	26.1
C45	Mesothelioma	1.5	0.9	1.8	1.1	1.1	0.8	2.1
C46	Kaposi's sarcoma	0.2	0.0	0.1	0.4	0.1	0.1	0.1
C47	Autonomic nervous system	0.3	0.4	0.0	0.3	0.0	0.2	0.7
C48-49	Soft tissues	1.7	1.6	2.1	1.4	2.6	1.4	1.4
C50	Breast	0.5	0.8	0.6	0.6	0.1	0.1	0.3
C60-63	Male genital organs	114.9	107.6	107.2	109.8	104.9	122.0	119.1
C61	Prostate	102.0	93.2	94.6	98.1	93.3	107.4	107.6
C62	Testis	11.7	13.0	11.3	10.5	10.2	13.5	10.5
C60, C63	Other male genital	1.2	1.4	1.3	1.3	1.5	1.1	0.9
C64-68	Urinary organs	33.5	39.6	34.4	33.5	32.7	25.8	30.6
C64	Kidney excl. renal pelvis	10.3	13.1	11.8	10.0	10.9	9.1	10.9
C65	Renal pelvis	1.1	1.2	1.4	1.2	0.8	0.7	0.7
C66-68	Bladder, ureter, urethra	22.0	25.3	21.2	22.4	21.0	15.9	19.0
C69	Eye	0.9	1.3	1.0	1.1	0.8	0.9	0.6
C70-72, D42-43	Central nervous system	14.0	13.1	13.0	13.7	12.1	12.1	13.1
C73	Thyroid gland	2.0	1.6	2.1	2.5	2.0	1.9	2.6
C37, C74-75	Other endocrine glands	3.5	3.2	3.1	2.9	4.7	2.8	3.1
C39, C76, C80	Other or unspecified	4.3	5.3	4.2	5.2	4.2	3.7	4.1
C81-96	Lymphoid and haematopoietic tissue	33.0	32.1	37.0	37.4	38.6	33.1	33.9
C81	Hodgkin lymphoma	2.7	3.4	2.6	3.2	4.4	3.2	2.7
C82-85, C96	Non-Hodgkin lymphoma	12.1	10.4	13.0	14.3	14.8	13.2	8.6
C88	Malignant immunoproliferative diseases	0.7	0.9	1.0	0.6	0.6	0.7	0.7
C90	Multiple myeloma	4.9	4.1	5.9	5.3	4.6	4.0	5.5
C91-95, D45-47	Leukaemia	12.7	13.4	14.6	13.9	14.2	12.0	16.5

Vestfold	Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finmark
390.1	364.6	403.1	376.5	383.6	354.2	394.0	371.5	334.8	326.7	356.9	332.8	298.8
7.4	8.6	8.6	7.6	8.1	6.9	8.4	7.9	8.0	5.7	10.0	7.0	6.6
1.7	1.3	2.3	2.5	2.6	1.4	2.1	1.1	1.8	1.0	2.0	0.6	1.5
1.6	1.4	3.0	1.4	1.0	1.4	1.3	2.0	1.3	0.9	2.6	1.7	2.2
0.9	1.2	0.9	1.2	1.7	1.5	2.3	1.4	1.0	1.2	1.2	1.2	0.7
0.8	1.1	0.0	0.4	0.6	0.4	0.5	0.4	0.6	0.3	0.4	0.7	0.5
2.5	3.6	2.4	2.1	2.2	2.2	2.2	3.0	3.4	2.3	3.8	2.8	1.7
69.2	63.6	60.9	64.6	71.6	75.8	74.6	68.1	63.6	60.0	67.6	72.9	62.8
3.4	4.2	3.8	4.6	3.6	3.5	4.2	3.7	2.8	2.4	3.7	4.2	3.8
6.6	6.3	4.1	4.8	6.4	8.3	9.4	9.0	6.8	6.3	7.3	9.7	15.2
2.1	1.4	1.5	0.9	1.9	1.9	0.7	2.0	3.3	1.8	2.1	1.3	1.4
29.0	23.7	19.5	26.4	29.2	30.5	27.3	25.9	21.9	27.1	28.0	24.3	16.5
15.6	14.3	18.4	16.1	17.8	19.9	22.4	17.0	15.2	11.5	15.0	18.2	17.5
1.4	1.8	2.9	3.5	2.3	2.5	1.6	1.5	2.7	2.3	1.9	3.1	0.3
1.7	1.5	2.6	2.1	1.6	1.5	2.3	0.8	2.1	1.1	1.3	1.5	1.2
8.9	9.6	6.5	5.7	7.9	7.3	5.5	7.6	8.0	6.1	7.7	9.5	5.8
0.6	0.8	1.5	0.5	0.9	0.4	1.3	0.5	0.8	1.4	0.6	1.0	1.1
44.0	39.2	51.7	53.1	40.0	39.4	42.3	42.8	35.5	33.5	38.5	44.5	45.8
0.7	0.3	0.3	1.0	0.7	0.9	0.6	0.6	0.7	0.1	0.6	0.5	1.0
2.3	3.4	3.9	3.9	2.6	2.4	0.9	3.3	2.0	2.2	2.9	3.5	1.9
40.5	35.1	47.2	47.9	36.4	35.8	40.6	38.5	32.5	31.2	34.5	39.8	42.5
0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.4	0.3	0.0	0.5	0.6	0.4
0.9	1.4	1.1	1.3	1.2	1.0	1.3	1.3	0.6	0.9	1.0	1.0	2.8
21.0	19.8	17.0	17.2	23.0	16.2	11.1	12.8	16.6	14.0	8.8	10.7	8.2
20.8	20.1	26.2	24.6	20.0	14.4	10.3	9.1	13.7	9.9	10.5	11.2	6.5
3.2	1.5	1.5	0.9	1.6	2.3	1.4	0.7	1.8	0.9	0.8	1.2	1.1
0.2	0.2	0.5	0.3	0.0	0.2	0.1	0.0	0.2	0.0	0.1	0.0	0.0
0.2	0.0	0.5	0.0	0.1	0.8	0.7	0.1	1.1	0.0	0.1	0.1	1.1
1.7	1.9	2.5	1.5	2.3	1.6	1.5	1.3	1.4	2.2	1.4	1.9	1.3
0.6	0.1	0.7	0.9	0.3	0.5	0.0	0.7	0.5	0.5	0.5	0.2	0.7
121.3	115.6	134.3	122.8	128.0	106.7	149.9	131.1	102.9	103.5	127.0	97.9	82.8
108.8	104.9	121.1	109.0	115.6	92.9	139.0	116.3	91.0	89.6	113.0	84.7	67.1
11.2	9.4	12.9	12.8	11.3	12.3	9.7	13.7	10.9	13.1	13.3	12.1	14.4
1.3	1.4	0.4	1.1	1.2	1.5	1.2	1.2	1.0	0.8	0.7	1.0	1.3
36.6	34.3	34.0	28.3	33.5	34.2	32.6	36.2	32.1	29.7	37.4	29.9	33.4
8.9	10.5	6.4	9.0	10.1	10.0	9.6	11.5	10.4	9.7	10.1	7.2	11.4
2.2	0.9	1.1	0.6	1.1	1.3	1.3	1.2	1.6	0.8	0.8	1.3	0.7
25.6	22.8	26.5	18.8	22.3	22.9	21.7	23.5	20.1	19.1	26.6	21.4	21.2
1.2	0.6	1.0	1.4	0.9	0.9	2.2	0.4	0.5	0.7	1.0	0.7	0.8
14.0	14.0	18.1	13.5	14.9	14.4	12.4	15.0	17.1	15.7	13.4	15.3	9.9
1.9	1.6	1.7	2.1	1.3	1.5	2.6	3.7	3.1	1.3	1.0	1.3	1.6
4.1	3.4	3.2	3.6	3.2	3.6	4.7	5.6	3.2	5.4	3.3	2.8	5.2
4.1	4.7	5.6	2.5	3.9	4.0	5.6	3.4	3.0	4.6	4.8	3.9	4.6
37.5	33.9	34.0	30.2	29.4	29.9	32.2	31.3	29.9	38.3	29.8	30.4	23.6
2.1	2.3	1.8	2.4	2.5	2.5	1.9	2.0	3.5	3.2	1.7	2.2	0.8
14.1	12.1	13.6	12.7	11.3	10.9	13.3	11.8	8.6	12.7	11.2	13.1	12.7
0.6	0.4	0.3	0.4	0.4	0.7	0.6	0.4	0.8	2.4	0.5	0.4	0.2
5.6	6.2	6.3	3.6	4.6	4.7	4.3	4.1	4.7	5.0	3.7	4.9	5.3
15.2	12.8	12.0	11.1	10.6	11.1	12.0	13.0	12.2	15.1	12.6	10.0	4.6

Table 14b Age-adjusted (world) incidence rates per 100 000 person-years by county and primary site - 2005-2009

ICD10	Site	Norway	Østfold	Akershus	Oslo	Hedmark	Oppland	Buskerud
C00-96	All sites	291.0	296.4	293.1	296.3	287.8	278.5	309.7
C00-14	Mouth, pharynx	4.1	4.4	3.8	5.4	3.5	4.3	4.1
C00	Lip	0.9	0.8	1.1	0.6	0.5	1.0	0.7
C01-02	Tongue	0.7	0.5	0.7	1.4	0.6	0.9	0.8
C03-06	Mouth, other	0.9	1.2	0.8	1.2	1.3	0.8	0.8
C07-08	Salivary glands	0.6	0.5	0.3	0.5	0.5	0.7	0.4
C09-14	Pharynx	1.0	1.4	0.9	1.7	0.6	0.9	1.3
C15-26	Digestive organs	50.7	55.7	48.9	47.5	47.1	48.9	49.1
C15	Oesophagus	1.0	0.8	1.3	1.5	1.0	1.0	1.0
C16	Stomach	3.9	3.2	3.3	3.8	3.0	3.8	3.5
C17	Small intestine	1.2	1.4	1.3	1.1	1.4	0.4	1.5
C18	Colon	23.3	26.4	21.7	21.2	22.5	22.8	24.3
C19-21	Rectum, rectosigmoid, anus	11.5	13.0	12.4	10.9	9.8	11.2	10.1
C22	Liver	1.1	0.7	0.9	1.2	1.9	1.0	0.9
C23-24	Gallbladder, bile ducts	1.5	1.9	1.0	1.0	1.4	2.2	1.0
C25	Pancreas	6.3	7.4	5.8	5.9	5.2	5.4	6.2
C26	Other digestive organs	0.9	1.0	1.0	0.9	1.0	1.0	0.7
C30-34, C38	Respiratory organs	25.1	24.7	25.4	26.2	26.3	21.2	25.7
C30-31	Nose, sinuses	0.5	0.4	0.6	0.5	0.5	0.2	0.4
C32	Larynx, epiglottis	0.4	0.0	0.4	1.2	0.6	0.4	0.6
C33-34	Lung, trachea	24.0	24.2	24.2	24.3	25.1	20.6	24.8
C38	Mediastinum, pleura (non-mesothelioma)	0.1	0.1	0.1	0.2	0.1	0.1	0.0
C40-41	Bone	0.8	1.2	0.4	0.8	0.6	0.6	1.0
C43	Melanoma of the skin	17.4	20.9	16.6	15.7	15.0	15.3	20.9
C44	Skin, non-melanoma	10.5	13.4	8.8	8.2	7.8	6.1	21.4
C45	Mesothelioma	0.3	0.4	0.4	0.3	0.0	0.2	0.4
C46	Kaposi's sarcoma	0.1	0.0	0.1	0.1	0.0	0.0	0.0
C47	Autonomic nervous system	0.3	0.6	0.2	0.1	0.0	0.0	0.4
C48-49	Soft tissues	2.4	2.5	2.2	1.8	2.1	2.3	1.6
C50	Breast	73.4	70.5	77.6	84.4	71.7	69.0	74.6
C51-58	Female genital organs	39.7	36.8	39.5	39.6	44.7	48.9	42.0
C53	Cervix uteri	9.4	8.1	10.3	9.0	11.0	10.4	11.4
C54	Corpus uteri	16.4	14.9	16.8	17.1	18.0	21.0	15.8
C55	Uterus, other	0.1	0.1	0.0	0.0	0.2	0.1	0.1
C56	Ovary	10.9	11.4	10.4	11.1	12.1	13.8	11.8
C51-52, C57	Other female genital	2.8	2.0	1.9	2.4	3.4	3.7	2.9
C58	Placenta	0.1	0.3	0.0	0.0	0.0	0.0	0.0
C64-68	Urinary organs	12.6	15.1	11.5	13.3	11.7	10.3	12.0
C64	Kidney excl. renal pelvis	5.5	7.2	5.0	5.3	4.6	4.3	5.0
C65	Renal pelvis	0.5	0.4	0.5	0.6	0.9	0.1	0.6
C66-68	Bladder, ureter, urethra	6.5	7.5	6.0	7.5	6.1	5.8	6.4
C69	Eye	0.9	0.8	0.8	1.1	1.8	0.9	0.7
C70-72, D42-43	Central nervous system	16.9	15.7	15.6	15.2	17.6	19.2	17.3
C73	Thyroid gland	5.2	2.5	6.2	4.8	7.2	4.5	5.6
C37, C74-75	Other endocrine glands	3.9	5.2	4.0	4.5	2.4	2.7	3.2
C39, C76, C80	Other or unspecified	3.8	4.2	3.7	4.3	4.3	3.9	4.1
C81-96	Lymphoid and haematopoietic tissue	23.2	21.8	27.6	23.2	23.9	20.4	25.4
C81	Hodgkin lymphoma	1.8	1.3	2.3	1.7	2.6	0.8	2.1
C82-85, C96	Non-Hodgkin lymphoma	8.8	7.2	9.8	8.8	9.8	8.0	9.0
C88	Malignant immunoproliferative diseases	0.4	0.5	0.6	0.5	0.3	0.3	0.3
C90	Multiple myeloma	3.1	2.8	3.4	3.9	3.0	3.7	3.1
C91-95, D45-47	Leukaemia	9.1	10.1	11.4	8.3	8.1	7.6	10.8

FEMALES

Vestfold	Telemark	Aust-Agder	Vest-Agder	Rogaland	Hordaland	Sogn og Fjordane	Møre og Romsdal	Sør-Trøndelag	Nord-Trøndelag	Nordland	Troms	Finmark
316.6	300.3	296.1	309.5	291.8	286.4	263.5	283.8	289.3	283.5	283.6	260.6	273.2
4.6	3.9	5.1	4.9	3.6	3.2	4.1	3.7	4.3	3.6	4.3	4.6	3.1
0.7	0.6	2.1	2.0	1.9	0.8	1.9	1.0	0.5	0.1	0.3	0.8	0.5
0.9	0.7	0.4	0.6	0.6	0.4	0.5	0.6	0.6	0.3	1.1	0.5	0.5
1.1	0.9	0.7	1.0	0.3	0.5	0.6	0.7	1.0	1.3	1.6	1.2	0.3
1.0	0.4	0.6	0.5	0.3	0.2	1.1	0.9	0.9	1.1	0.6	0.5	0.7
0.9	1.3	1.2	0.8	0.4	1.1	0.0	0.6	1.2	0.9	0.7	1.5	1.0
52.5	43.2	51.9	46.7	50.8	56.0	58.1	56.1	53.2	48.9	50.9	46.2	47.2
1.3	0.9	1.4	0.9	0.9	0.7	1.4	0.3	1.5	0.4	0.5	1.5	0.8
3.8	4.7	2.3	3.4	3.9	4.3	6.6	4.6	4.6	2.8	3.7	5.5	7.7
1.1	0.7	1.4	1.2	0.8	1.3	0.8	1.5	1.6	1.4	1.9	0.6	0.0
22.8	20.4	23.2	20.8	23.4	27.4	24.5	27.3	22.6	23.0	22.9	20.6	16.2
12.5	7.0	12.7	10.4	12.4	12.8	15.6	11.0	11.9	11.1	12.1	8.9	9.9
1.2	0.9	1.1	1.3	1.1	1.2	1.8	0.8	1.2	0.9	1.7	1.3	0.6
1.2	2.2	2.3	1.9	1.3	1.4	2.1	2.1	1.5	2.2	1.1	1.3	2.2
7.4	5.6	6.1	5.3	6.4	6.5	5.1	7.5	7.3	5.6	5.9	5.6	9.3
1.1	0.8	1.3	1.5	0.6	0.4	0.2	0.9	1.1	1.4	1.0	0.8	0.5
27.4	24.5	30.8	33.7	23.0	21.0	20.6	22.8	26.1	23.0	27.8	23.0	32.7
0.6	0.5	0.1	0.8	0.1	0.5	0.2	0.5	0.1	0.2	0.7	0.7	0.3
0.6	0.1	0.1	0.5	0.3	0.3	0.2	0.1	0.6	0.1	0.2	0.8	0.2
26.0	23.8	30.5	32.3	22.5	20.1	20.1	22.1	25.0	22.5	26.8	21.4	31.1
0.1	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.4	0.2	0.0	0.0	1.0
1.3	0.7	1.2	0.7	0.8	1.3	0.1	1.1	0.5	1.0	0.3	0.0	0.8
20.8	20.5	16.8	18.8	22.9	18.2	12.4	16.1	17.5	19.8	9.0	10.9	14.6
10.4	16.7	17.0	16.9	14.7	9.8	6.4	5.7	10.0	10.4	6.3	5.2	5.7
0.4	0.4	0.5	0.0	0.1	0.2	0.4	0.4	0.1	0.7	0.1	0.0	0.4
0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.3	0.0	0.1
0.0	0.2	1.0	0.4	0.1	0.8	0.0	0.5	0.4	0.0	0.2	0.0	0.0
3.7	2.5	1.5	2.4	2.2	1.9	2.8	2.4	2.5	3.8	3.1	2.9	3.6
85.5	68.3	62.6	77.4	75.2	70.2	65.6	73.6	66.0	68.8	69.7	66.7	60.2
37.3	45.7	39.2	42.4	41.6	38.4	31.7	33.0	38.8	34.7	40.5	40.2	39.5
7.9	10.0	7.1	8.8	9.7	9.6	6.7	7.4	8.1	9.3	13.2	11.5	8.8
15.7	20.9	15.9	19.2	17.7	16.4	13.8	11.3	15.7	12.0	14.8	14.7	17.1
0.1	0.0	0.2	0.1	0.2	0.3	0.0	0.1	0.0	0.3	0.0	0.5	0.0
9.8	11.6	12.8	11.8	10.7	9.7	7.6	11.0	11.4	9.6	9.6	9.5	11.8
3.5	3.1	3.1	2.5	3.3	2.5	3.5	3.3	3.4	3.5	2.4	2.9	1.9
0.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.4	1.2	0.0
11.5	11.9	16.4	13.4	11.6	10.8	9.2	12.4	15.0	12.4	15.7	14.4	11.4
4.6	5.6	5.8	6.8	4.9	4.8	4.0	5.4	6.7	7.7	6.9	5.8	7.0
0.8	0.2	1.0	0.5	0.5	0.4	1.1	0.4	0.6	0.3	0.5	0.6	0.4
6.1	6.1	9.6	6.1	6.2	5.6	4.2	6.6	7.8	4.4	8.4	8.0	4.0
0.8	0.7	0.3	0.4	1.1	0.9	1.3	1.2	0.7	0.8	0.7	0.5	0.4
19.8	21.3	15.4	17.3	14.0	17.5	19.4	15.6	19.1	22.2	17.6	16.1	20.4
4.3	8.2	2.2	5.6	2.8	6.2	5.0	7.3	5.2	5.0	6.3	4.4	3.0
6.2	3.0	3.1	2.1	2.2	4.4	5.4	5.5	4.7	3.8	5.0	1.8	3.7
3.7	3.8	3.1	2.7	3.2	3.5	4.2	2.6	3.6	4.5	4.1	5.3	3.8
26.4	24.8	28.0	23.8	21.8	22.2	16.8	23.6	21.4	20.2	21.6	18.4	22.6
1.5	0.8	1.6	2.8	2.1	2.2	1.1	2.2	2.2	0.4	2.3	0.9	2.4
10.3	9.0	11.3	8.6	9.0	8.4	6.4	8.6	7.5	8.1	8.8	5.8	13.6
0.2	0.4	0.1	0.4	0.1	0.2	0.2	0.8	0.4	0.5	0.3	0.0	0.4
3.8	3.2	3.3	2.7	2.8	2.7	2.3	3.5	1.7	2.5	2.6	4.0	2.2
10.7	11.3	11.8	9.2	7.7	8.7	6.7	8.5	9.7	8.6	7.6	7.8	3.9

Table 15a Average annual number of new cases for selected primary sites, stage and period of diagnosis 1955-2009

MALES

ICD10	Site	Stage	Period											% 2005-09
			1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	
C00-14	Mouth, pharynx	Total	246	192	194	244	239	249	256	255	259	258	287	100.0
		Localized	171	132	131	160	153	153	161	149	116	84	104	36.4
		Regional	58	46	44	59	70	86	83	88	94	113	132	45.9
		Distant	4	7	8	10	9	5	8	11	11	13	13	4.6
		Unknown	13	7	11	15	7	5	4	7	38	48	38	13.1
C15	Oesophagus	Total	101	80	78	79	91	86	93	104	123	127	145	100.0
		Localized	61	49	45	36	43	43	40	44	37	24	35	24.3
		Regional	13	12	10	17	19	19	24	24	25	31	39	26.8
		Distant	19	15	19	20	24	20	27	28	34	41	39	26.8
		Unknown	8	4	4	6	5	4	2	8	27	32	32	22.1
C16	Stomach	Total	1217	802	787	674	614	598	533	483	409	354	300	100.0
		Localized	340	218	211	164	178	185	178	168	93	62	63	21.0
		Regional	258	174	155	152	141	166	148	136	121	107	83	27.6
		Distant	474	352	342	304	257	217	185	153	138	126	93	31.2
		Unknown	144	58	78	54	39	29	22	25	57	59	61	20.3
C18	Colon	Total	305	282	349	388	492	625	722	827	895	1004	1098	100.0
		Localized	125	114	139	132	156	184	222	272	186	174	180	16.4
		Regional	74	72	80	112	170	256	282	303	428	489	585	53.3
		Distant	86	81	113	127	148	163	194	217	236	261	230	20.9
		Unknown	21	14	17	17	17	22	24	35	45	80	103	9.4
C19-21	Rectum, rectosigmoid, anus	Total	207	182	234	314	409	503	533	581	592	661	676	100.0
		Localized	102	88	109	147	187	231	230	259	208	174	170	25.2
		Regional	45	46	64	85	132	165	201	206	231	270	299	44.3
		Distant	39	39	51	70	82	93	95	101	112	136	109	16.2
		Unknown	21	9	10	12	8	14	8	15	41	81	97	14.4
C22	Liver	Total	22	24	32	50	52	61	63	61	65	78	91	100.0
		Localized	11	11	17	23	24	32	34	38	26	27	30	33.3
		Regional	2	1	1	3	5	5	5	3	4	5	9	9.9
		Distant	8	11	12	19	20	16	15	10	14	19	20	21.9
		Unknown	2	1	1	5	3	8	9	10	21	26	32	34.9
C23-24	Gallbladder, bile ducts	Total	20	22	25	27	38	42	48	54	56	60	67	100.0
		Localized	11	8	8	8	11	14	19	17	9	12	10	15.3
		Regional	2	3	5	5	9	10	10	10	11	17	22	32.7
		Distant	6	9	11	12	17	15	14	16	17	16	18	26.4
		Unknown	1	1	1	2	1	4	5	11	20	15	17	25.5
C25	Pancreas	Total	180	159	214	249	258	287	306	275	279	296	330	100.0
		Localized	53	47	58	50	43	53	68	53	28	21	26	7.7
		Regional	17	18	27	34	34	38	36	27	35	58	71	21.4
		Distant	92	85	117	141	154	163	159	137	129	157	178	53.9
		Unknown	17	9	12	24	28	34	42	58	87	60	56	17.0
C33-34	Lung, trachea	Total	313	356	490	647	839	1029	1141	1216	1277	1373	1472	100.0
		Localized	91	115	168	205	278	338	379	406	270	186	210	14.3
		Regional	64	77	93	127	143	193	241	228	308	372	425	28.9
		Distant	131	140	205	267	359	426	448	469	531	643	675	45.9
		Unknown	27	23	23	48	59	73	73	113	168	172	162	11.0
C43	Melanoma of the skin	Total	61	69	101	145	192	245	328	422	455	479	618	100.0
		Localized	35	43	64	108	157	203	281	360	337	277	279	45.2
		Regional	12	10	13	16	16	17	16	18	13	20	23	3.7
		Distant	9	14	17	14	16	15	20	26	26	35	26	4.2
		Unknown	4	1	7	7	3	9	11	18	79	146	289	46.8
C61	Prostate	Total	846	798	971	1186	1443	1647	1812	2249	2753	3205	4145	100.0
		Localized	498	497	644	771	966	1111	1207	1564	1220	1240	2144	51.7
		Regional	44	33	31	59	75	62	56	85	111	159	301	7.3
		Distant	221	207	219	255	306	386	487	410	416	395	316	7.6
		Unknown	84	61	77	101	96	88	61	191	1007	1411	1383	33.4
C62	Testis	Total	71	68	70	86	101	134	157	201	226	257	291	100.0
		Localized	49	44	48	45	59	70	102	136	138	140	179	61.7
		Regional	3	3	4	14	21	38	31	36	34	45	42	14.4
		Distant	17	18	17	25	21	24	23	24	31	29	31	10.5
		Unknown	2	2	1	3	1	3	2	5	23	43	39	13.4
C64	Kidney except renal pelvis	Total	111	119	149	165	199	238	249	277	281	330	390	100.0
		Localized	60	62	75	69	80	102	111	142	115	142	179	46.0
		Regional	8	16	19	32	50	45	51	38	44	42	37	9.4
		Distant	37	37	51	59	65	81	78	75	74	75	84	21.7
		Unknown	6	4	4	5	3	10	10	22	48	71	89	22.9
C66-68	Bladder, ureter, urethra	Total	261	248	325	414	542	667	743	820	821	877	958	100.0
		Localized	197	207	271	325	451	562	648	735	548	469	542	56.6
		Regional	19	19	30	47	51	60	54	41	40	60	71	7.5
		Distant	28	14	15	25	30	29	28	26	29	36	34	3.6
		Unknown	17	7	9	17	10	15	14	18	203	311	310	32.4
C70-72, D42-43	Central nervous system	Total	156	131	149	153	189	207	246	260	313	385	439	100.0
		Non-malignant	38	40	39	44	56	65	72	101	128	186	217	49.3
		Malignant	118	90	110	108	133	142	174	159	184	199	222	50.7
C73	Thyroid gland	Total	25	24	33	34	42	48	47	44	47	53	70	100.0
		Localized	9	5	10	14	20	21	26	22	20	19	20	28.7
		Regional	9	12	14	13	16	18	13	12	15	21	32	46.4
		Distant	5	7	8	6	5	8	8	8	8	7	9	12.9
		Unknown	1	1	1	1	1	1	1	2	4	6	8	12.0

Table 15b Average annual number of new cases for selected primary sites, stage and period of diagnosis 1955-2009

FEMALES

ICD10	Site	Stage	Period											% 2005-09
			1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09	
C00-14	Mouth, pharynx	Total	85	60	77	79	82	100	111	118	131	132	184	100.0
		Localized	53	35	44	43	46	56	70	78	70	47	78	42.2
		Regional	24	19	29	27	28	37	35	33	39	47	69	37.6
		Distant	3	3	2	5	3	3	4	4	6	5	5	2.9
		Unknown	5	3	2	4	5	3	2	4	17	34	32	17.2
C15	Oesophagus	Total	34	28	30	30	32	33	36	42	44	53	54	100.0
		Localized	22	19	18	15	18	16	20	24	14	12	14	26.2
		Regional	4	4	3	5	6	8	8	7	8	12	11	19.9
		Distant	3	3	6	7	6	7	6	8	9	12	11	20.3
		Unknown	4	2	2	3	2	3	1	3	13	17	18	33.6
C16	Stomach	Total	853	546	508	443	408	401	358	314	267	230	218	100.0
		Localized	247	152	128	102	109	128	138	113	69	44	50	22.8
		Regional	146	98	94	86	96	104	92	78	66	64	49	22.3
		Distant	318	229	221	212	167	135	112	105	85	77	75	34.3
		Unknown	143	67	64	43	36	34	16	18	47	45	45	20.6
C18	Colon	Total	353	324	408	473	627	746	861	947	1086	1170	1265	100.0
		Localized	146	130	166	160	194	223	251	314	225	209	218	17.3
		Regional	78	79	96	145	228	301	360	364	524	577	683	54.0
		Distant	93	97	125	144	182	186	215	216	255	281	247	19.5
		Unknown	36	18	20	24	24	35	36	53	82	103	116	9.2
C19-21	Rectum, rectosigmoid, anus	Total	161	137	189	261	337	420	431	479	506	529	549	100.0
		Localized	79	63	91	120	150	200	194	235	183	150	151	27.4
		Regional	39	36	50	74	108	136	149	148	188	213	229	41.6
		Distant	30	31	40	59	70	71	75	80	89	92	81	14.8
		Unknown	13	8	9	8	10	13	14	16	45	74	89	16.1
C22	Liver	Total	14	14	16	31	30	39	44	47	41	45	55	100.0
		Localized	5	6	7	15	14	18	22	24	12	11	15	27.4
		Regional	1	0	1	1	1	2	2	3	3	5	8	13.7
		Distant	6	6	8	12	13	15	11	10	9	8	11	20.2
		Unknown	2	1	0	3	2	5	8	11	16	21	21	38.6
C23-24	Gallbladder, bile ducts	Total	57	50	58	52	65	81	81	72	79	76	78	100.0
		Localized	15	16	14	14	17	26	28	22	14	12	16	20.2
		Regional	10	8	9	9	11	16	15	13	15	16	18	23.3
		Distant	29	24	34	26	34	33	25	23	24	26	26	33.5
		Unknown	3	2	1	3	4	5	12	14	27	23	18	23.0
C25	Pancreas	Total	125	117	142	181	213	253	287	300	312	336	347	100.0
		Localized	38	36	42	43	45	50	72	72	27	28	35	10.1
		Regional	12	12	14	23	27	33	36	27	36	57	67	19.4
		Distant	63	61	75	95	120	134	138	121	139	163	167	48.2
		Unknown	12	9	11	21	21	36	41	80	111	89	78	22.4
C33-34	Lung, trachea	Total	91	83	115	158	203	283	396	523	665	848	1067	100.0
		Localized	24	25	35	50	62	77	124	158	125	122	190	17.8
		Regional	10	11	17	25	29	46	71	103	148	207	281	26.3
		Distant	44	41	57	72	96	134	173	211	279	422	481	45.1
		Unknown	13	6	6	11	17	25	27	52	113	97	116	10.8
C43	Melanoma of the skin	Total	69	82	108	161	240	326	411	475	500	547	642	100.0
		Localized	51	67	81	132	216	289	380	435	382	339	318	49.6
		Regional	9	6	7	10	8	15	11	12	11	12	16	2.6
		Distant	7	6	12	10	13	12	11	15	20	23	16	2.6
		Unknown	2	3	8	10	3	10	9	14	87	172	290	45.3
C50	Breast	Total	1223	1027	1172	1328	1532	1668	1816	1975	2357	2687	2759	100.0
		I	531	468	569	651	809	914	878	951	1271	1362	1403	50.9
		II	466	356	369	416	440	483	648	736	859	1081	1128	40.9
		III	64	80	83	97	116	92	124	107	81	95	109	4.0
		IV	120	96	115	113	118	107	123	141	124	135	105	3.8
		Unknown	43	28	36	51	50	72	42	40	22	14	13	0.5
C53	Cervix uteri	Total	463	352	386	438	422	369	328	363	329	293	298	100.0
		I	178	147	186	231	239	214	180	223	196	171	168	56.3
		II	142	119	134	117	98	73	75	69	68	54	63	21.2
		III	91	54	40	63	56	52	45	36	34	33	22	7.5
		IV	37	24	20	23	23	23	23	29	27	25	32	10.6
		Unknown	14	7	6	4	7	8	5	5	5	9	13	4.4
C54	Corpus uteri	Total	223	207	250	303	361	384	395	444	489	612	684	100.0
		Localized	176	171	199	250	289	284	304	333	344	380	455	66.5
		Regional	14	11	13	19	37	50	41	50	56	67	74	10.8
		Distant	23	21	35	28	31	37	44	53	65	79	91	13.3
		Unknown	10	4	3	5	3	13	6	8	24	86	65	9.5
C56	Ovary	Total	339	278	349	339	372	406	438	466	463	464	441	100.0
		Localized	105	89	110	139	116	108	117	132	97	85	82	18.5
		Regional	30	17	18	23	25	40	25	16	13	13	13	3.0
		Distant	188	160	215	171	226	246	283	299	308	307	301	68.2
		Unknown	16	13	6	6	5	11	12	20	44	59	45	10.3
C64	Kidney except renal pelvis	Total	94	88	100	114	134	149	173	190	192	199	238	100.0
		Localized	55	52	54	58	65	66	82	104	85	82	115	48.3
		Regional	9	10	11	23	25	34	29	22	22	21	19	8.1
		Distant	25	25	32	29	40	43	51	46	47	47	36	15.3
		Unknown	6	2	3	4	3	7	11	19	38	49	67	28.3
C66-68	Bladder, ureter, urethra	Total	143	119	135	178	212	240	265	267	295	326	340	100.0
		Localized	89	73	93	117	153	185	222	225	172	159	180	52.9
		Regional	15	17	19	27	26	24	21	16	19	27	31	9.1
		Distant	23	19	17	22	21	18	14	15	20	23	20	5.9
		Unknown	16	9	6	12	12	12	8	11	84	117	109	32.1
C70-72, D42-43	Central nervous system	Total	137	116	133	128	182	206	248	279	378	508	579	100.0
		Non-malignant	53	51	62	52	80	90	123	155	225	348	409	70.6
		Malignant	85	65	71	75	102	116	125	124	152	161	170	29.4
C73	Thyroid gland	Total	70	59	79	99	123	147	135	137	121	145	166	100.0
		Localized	32	25	45	55	77	97	91	89	61	71	76	46.1
		Regional	22	22	24	29	30	34	31	34	39	43	52	31.3
		Distant	13	11	9	12	14	11	10	11	9	10	8	5.1
		Unknown	4	2	2	4	2	4	4	4	12	21	29	17.5

Table 16a Age-adjusted (world) incidence rates per 100 000 person-years for selected primary sites, stage and period of diagnosis 1955-2009

MALES

ICD10	Site	Stage	Period										
			1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
C00-14	Mouth, pharynx	Total	10.9	7.7	7.3	8.6	8.1	8.1	8.4	8.2	8.2	7.7	7.7
		Localized	7.6	5.3	4.9	5.6	5.2	4.9	5.2	4.6	3.6	2.4	2.7
		Regional	2.5	1.9	1.6	2.1	2.4	2.9	2.9	3.0	3.1	3.5	3.7
		Distant	0.2	0.3	0.3	0.4	0.3	0.1	0.3	0.4	0.4	0.4	0.4
		Unknown	0.6	0.3	0.4	0.5	0.2	0.1	0.1	0.2	1.1	1.4	0.9
C15	Oesophagus	Total	4.4	3.1	2.7	2.6	2.9	2.6	2.9	3.2	3.5	3.5	3.7
		Localized	2.6	1.9	1.5	1.2	1.3	1.2	1.1	1.2	1.0	0.6	0.9
		Regional	0.6	0.5	0.4	0.6	0.6	0.6	0.8	0.8	0.8	0.9	1.0
		Distant	0.9	0.6	0.7	0.7	0.8	0.6	0.9	0.9	1.0	1.2	1.0
		Unknown	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.7	0.8	0.8
C16	Stomach	Total	53.4	31.0	28.0	22.4	19.1	17.5	14.7	13.1	10.6	8.8	6.9
		Localized	14.4	8.2	7.3	5.3	5.4	5.2	4.7	4.2	2.3	1.5	1.4
		Regional	11.8	6.9	5.7	5.2	4.4	5.1	4.2	4.0	3.3	2.8	2.0
		Distant	21.2	13.8	12.3	10.2	8.2	6.4	5.2	4.3	3.7	3.2	2.2
		Unknown	6.0	2.1	2.7	1.7	1.1	0.8	0.6	0.6	1.3	1.3	1.3
C18	Colon	Total	13.4	11.0	12.5	13.0	15.4	18.4	20.9	22.8	24.0	25.5	25.6
		Localized	5.5	4.4	4.9	4.4	4.9	5.3	6.2	7.3	4.9	4.4	4.2
		Regional	3.3	2.9	2.9	3.8	5.4	7.7	8.4	8.4	11.5	12.2	13.6
		Distant	3.8	3.2	4.1	4.3	4.6	4.8	5.7	6.2	6.5	6.8	5.7
		Unknown	0.9	0.5	0.6	0.5	0.5	0.6	0.6	0.9	1.0	2.0	2.2
C19-21	Rectum, rectosigmoid, anus	Total	9.0	7.1	8.4	10.5	13.0	15.1	15.6	16.7	16.6	17.5	16.6
		Localized	4.4	3.4	3.9	4.8	5.9	6.9	6.5	7.3	5.7	4.6	4.2
		Regional	2.0	1.8	2.3	2.9	4.2	5.0	6.1	6.0	6.5	7.1	7.4
		Distant	1.7	1.5	1.8	2.3	2.6	2.9	2.8	2.9	3.3	3.8	2.8
		Unknown	0.9	0.3	0.3	0.4	0.3	0.4	0.2	0.4	1.1	2.0	2.2
C22	Liver	Total	1.1	1.0	1.2	1.8	1.7	1.9	1.9	1.8	1.9	2.0	2.4
		Localized	0.5	0.4	0.6	0.8	0.8	1.0	1.1	1.1	0.8	0.7	0.8
		Regional	0.1	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2
		Distant	0.4	0.4	0.5	0.7	0.7	0.6	0.5	0.3	0.4	0.5	0.5
		Unknown	0.1	0.1	0.0	0.2	0.1	0.2	0.2	0.3	0.5	0.6	0.8
C23-24	Gallbladder, bile ducts	Total	0.9	0.9	0.9	0.9	1.1	1.2	1.4	1.5	1.5	1.5	1.6
		Localized	0.5	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.2	0.3	0.2
		Regional	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.5	0.6
		Distant	0.3	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.4
		Unknown	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.3	0.4	0.3	0.3
C25	Pancreas	Total	8.1	6.3	7.6	8.3	8.1	8.5	8.6	7.7	7.5	7.7	7.9
		Localized	2.4	1.8	2.0	1.6	1.3	1.5	1.8	1.4	0.7	0.5	0.5
		Regional	0.8	0.7	1.0	1.1	1.1	1.2	1.1	0.8	1.1	1.6	1.7
		Distant	4.2	3.4	4.2	4.8	4.9	4.9	4.6	4.1	3.6	4.3	4.4
		Unknown	0.7	0.3	0.4	0.8	0.8	1.0	1.1	1.4	2.0	1.4	1.2
C33-34	Lung, trachea	Total	14.4	14.7	18.5	22.9	27.8	32.6	35.0	36.3	36.8	36.6	35.7
		Localized	4.2	4.7	6.2	7.2	8.8	10.2	10.9	11.6	7.6	4.9	5.1
		Regional	3.0	3.3	3.6	4.6	5.1	6.6	7.8	7.1	9.0	9.8	10.4
		Distant	6.1	5.8	7.8	9.5	12.1	13.8	14.3	14.7	15.9	17.7	16.7
		Unknown	1.2	0.9	0.8	1.6	1.8	2.0	2.0	2.9	4.2	4.1	3.6
C43	Melanoma of the skin	Total	2.9	3.1	4.5	6.3	7.8	9.6	12.3	14.9	14.9	14.4	16.6
		Localized	1.7	2.0	2.9	4.7	6.5	8.0	10.5	12.8	11.1	8.5	7.7
		Regional	0.6	0.5	0.6	0.7	0.6	0.7	0.6	0.6	0.4	0.6	0.6
		Distant	0.4	0.6	0.7	0.6	0.6	0.6	0.7	0.9	0.8	1.0	0.7
		Unknown	0.2	0.1	0.3	0.3	0.1	0.3	0.4	0.6	2.5	4.3	7.7
C61	Prostate	Total	35.0	28.8	32.1	36.2	40.6	43.2	45.1	55.1	70.8	83.2	102.0
		Localized	20.5	17.8	21.3	23.4	27.1	29.0	29.6	37.9	32.2	34.3	54.5
		Regional	1.8	1.2	1.1	1.9	2.1	1.7	1.6	2.8	3.8	4.6	7.7
		Distant	9.2	7.6	7.3	7.9	8.7	10.3	12.3	10.1	10.0	9.0	6.6
		Unknown	3.5	2.2	2.5	3.1	2.7	2.3	1.5	4.3	24.9	35.3	33.2
C62	Testis	Total	3.8	3.8	3.8	4.4	5.0	6.3	6.9	8.5	9.6	10.6	11.7
		Localized	2.6	2.4	2.6	2.3	2.9	3.3	4.4	5.7	5.8	5.8	7.2
		Regional	0.1	0.2	0.2	0.7	1.0	1.8	1.4	1.6	1.5	1.9	1.7
		Distant	1.0	1.0	1.0	1.3	1.0	1.1	1.0	1.0	1.4	1.2	1.3
		Unknown	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.2	1.0	1.7	1.5
C64	Kidney except renal pelvis	Total	5.2	5.0	5.6	6.1	6.9	8.0	7.9	8.4	8.3	9.5	10.3
		Localized	2.8	2.6	2.9	2.5	2.8	3.5	3.6	4.5	3.6	4.2	4.9
		Regional	0.4	0.7	0.7	1.2	1.8	1.6	1.6	1.2	1.3	1.2	1.0
		Distant	1.7	1.5	1.9	2.2	2.2	2.6	2.5	2.2	2.2	2.1	2.1
		Unknown	0.3	0.2	0.1	0.2	0.1	0.3	0.2	0.5	1.3	2.0	2.3
C66-68	Bladder, ureter, urethra	Total	11.6	9.7	11.8	14.1	17.1	20.0	21.2	22.8	21.8	21.8	22.0
		Localized	8.7	8.2	9.9	11.1	14.3	16.9	18.5	20.5	14.9	11.9	12.5
		Regional	0.8	0.7	1.1	1.6	1.6	1.8	1.5	1.1	1.1	1.6	1.8
		Distant	1.3	0.6	0.5	0.8	0.9	0.9	0.8	0.7	0.8	0.9	0.8
		Unknown	0.7	0.3	0.3	0.5	0.3	0.4	0.4	0.4	5.1	7.5	7.0
C70-72, D42-43	Central nervous system	Total	8.2	6.4	6.9	6.8	8.3	8.5	9.8	10.0	11.3	13.3	14.0
		Non-malignant	2.0	1.9	1.8	1.9	2.3	2.4	2.6	3.6	4.6	6.3	6.7
		Malignant	6.2	4.5	5.2	4.9	5.9	6.0	7.3	6.4	6.7	7.1	7.3
C73	Thyroid gland	Total	1.2	1.0	1.3	1.4	1.6	1.7	1.7	1.6	1.6	1.7	2.0
		Localized	0.4	0.2	0.4	0.6	0.8	0.7	0.9	0.8	0.7	0.6	0.6
		Regional	0.4	0.5	0.6	0.6	0.6	0.7	0.5	0.5	0.5	0.7	1.0
		Distant	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
		Unknown	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2

Table 16b Age-adjusted (world) incidence rates per 100 000 person-years for selected primary sites, stage and period of diagnosis 1955-2009

FEMALES

ICD10	Site	Stage	Period										
			1955-59	1960-64	1965-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
C00-14	Mouth, pharynx	Total	3.3	2.1	2.4	2.4	2.2	2.7	2.8	3.1	3.4	3.2	4.1
		Localized	2.1	1.3	1.4	1.3	1.2	1.6	1.8	2.0	1.8	1.2	1.8
		Regional	0.9	0.6	0.9	0.8	0.8	1.0	0.9	0.9	1.0	1.2	1.6
		Distant	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1
		Unknown	0.2	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.4	0.7	0.7
C15	Oesophagus	Total	1.2	0.9	0.8	0.7	0.7	0.7	0.8	0.9	0.9	1.1	1.0
		Localized	0.8	0.6	0.5	0.3	0.4	0.3	0.4	0.5	0.3	0.2	0.2
		Regional	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3
		Distant	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.3	0.2
		Unknown	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.3	0.3
C16	Stomach	Total	30.9	17.5	14.6	11.8	9.6	8.8	7.4	6.2	5.0	4.4	3.9
		Localized	8.5	4.6	3.5	2.5	2.4	2.7	2.6	2.0	1.2	0.8	0.9
		Regional	5.8	3.4	2.9	2.4	2.4	2.5	2.1	1.6	1.3	1.3	0.9
		Distant	12.0	7.6	6.6	6.0	4.1	3.1	2.5	2.2	1.9	1.6	1.5
		Unknown	4.5	1.9	1.6	0.9	0.7	0.6	0.2	0.3	0.6	0.6	0.7
C18	Colon	Total	13.2	10.7	12.1	13.3	15.9	17.8	19.0	20.3	22.2	23.1	23.3
		Localized	5.5	4.3	4.9	4.5	4.8	5.2	5.4	6.6	4.6	4.1	3.9
		Regional	3.0	2.7	3.0	4.1	5.9	7.4	8.1	8.0	10.9	11.5	12.6
		Distant	3.5	3.2	3.7	4.1	4.7	4.5	5.0	5.0	5.6	5.9	5.1
		Unknown	1.2	0.5	0.5	0.6	0.5	0.6	0.5	0.7	1.2	1.6	1.7
C19-21	Rectum, rectosigmoid, anus	Total	6.1	4.7	5.9	7.4	9.0	10.3	10.1	11.1	11.2	11.5	11.5
		Localized	3.0	2.2	2.9	3.3	4.0	5.0	4.5	5.3	4.1	3.4	3.1
		Regional	1.5	1.3	1.5	2.1	3.0	3.4	3.6	3.7	4.4	4.7	4.9
		Distant	1.1	1.0	1.2	1.7	1.9	1.7	1.8	1.9	2.0	2.0	1.8
		Unknown	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.7	1.3	1.7
C22	Liver	Total	0.6	0.6	0.5	0.9	0.8	1.0	1.0	1.1	0.9	1.0	1.1
		Localized	0.2	0.3	0.2	0.4	0.4	0.5	0.5	0.6	0.3	0.3	0.3
		Regional	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2
		Distant	0.2	0.3	0.2	0.3	0.4	0.4	0.3	0.3	0.2	0.2	0.3
		Unknown	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.4
C23-24	Gallbladder, bile ducts	Total	2.1	1.6	1.7	1.3	1.5	1.8	1.6	1.5	1.6	1.4	1.5
		Localized	0.6	0.5	0.4	0.4	0.4	0.6	0.5	0.4	0.3	0.2	0.3
		Regional	0.4	0.3	0.3	0.2	0.3	0.4	0.3	0.3	0.4	0.4	0.4
		Distant	1.1	0.8	1.0	0.7	0.8	0.7	0.5	0.5	0.5	0.5	0.5
		Unknown	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.4	0.3	0.3
C25	Pancreas	Total	4.7	3.9	4.1	4.9	5.2	5.5	6.0	5.9	6.0	6.2	6.3
		Localized	1.4	1.1	1.2	1.1	1.0	1.0	1.3	1.3	0.5	0.4	0.5
		Regional	0.4	0.4	0.4	0.7	0.7	0.8	0.9	0.7	0.8	1.2	1.3
		Distant	2.4	2.1	2.2	2.6	3.0	3.1	3.1	2.7	3.0	3.3	3.4
		Unknown	0.5	0.3	0.3	0.5	0.5	0.7	0.7	1.2	1.6	1.3	1.0
C33-34	Lung, trachea	Total	3.6	2.9	3.7	4.9	6.0	8.2	11.0	14.6	17.8	21.3	24.0
		Localized	0.9	0.8	1.2	1.5	1.8	2.1	3.2	4.3	3.4	3.0	4.3
		Regional	0.4	0.4	0.5	0.8	0.9	1.5	2.2	3.0	4.2	5.2	6.5
		Distant	1.8	1.5	1.8	2.3	2.9	4.1	5.0	6.3	7.9	11.0	11.1
		Unknown	0.5	0.2	0.2	0.3	0.4	0.5	0.6	1.0	2.4	2.1	2.2
C43	Melanoma of the skin	Total	3.2	3.7	4.6	6.9	9.6	12.1	14.8	16.0	15.9	15.9	17.4
		Localized	2.3	3.0	3.5	5.7	8.8	10.9	13.9	14.8	12.5	10.1	8.8
		Regional	0.4	0.3	0.3	0.4	0.3	0.5	0.3	0.3	0.3	0.3	0.3
		Distant	0.3	0.3	0.5	0.4	0.4	0.4	0.3	0.4	0.5	0.6	0.4
		Unknown	0.1	0.1	0.3	0.3	0.1	0.3	0.3	0.4	2.7	4.8	7.9
C50	Breast	Total	51.6	39.6	42.6	46.0	50.2	51.5	53.6	57.2	68.3	76.1	73.4
		I	22.3	18.0	20.5	22.5	26.3	27.5	25.3	27.0	36.1	38.1	37.0
		II	20.3	14.3	14.2	15.2	15.4	15.9	20.5	22.6	26.5	32.0	31.0
		III	2.4	2.8	2.8	3.0	3.3	2.4	3.4	2.7	2.0	2.4	2.6
		IV	4.8	3.5	3.9	3.6	3.6	3.1	3.4	4.1	3.3	3.3	2.5
C53	Cervix uteri	Unknown	1.7	1.0	1.2	1.8	1.7	2.5	1.1	0.8	0.4	0.3	0.3
		Total	21.1	15.4	16.7	18.8	17.3	14.3	11.9	12.7	11.2	9.5	9.4
		I	8.4	6.9	8.7	11.0	10.9	9.0	7.1	8.3	7.3	6.1	5.8
		II	6.5	5.2	5.5	4.6	3.6	2.6	2.7	2.4	2.1	1.6	1.8
		III	4.1	2.2	1.5	2.3	1.8	1.7	1.3	1.1	1.0	0.9	0.6
C54	Corpus uteri	Distant	1.6	0.9	0.7	0.8	0.7	0.6	0.7	0.9	0.7	0.7	0.8
		Unknown	0.6	0.3	0.2	0.1	0.2	0.3	0.1	0.1	0.1	0.3	0.4
		Total	9.5	8.0	9.0	10.3	11.9	12.2	12.2	13.1	13.7	15.6	16.4
		Localized	7.6	6.7	7.2	8.7	9.8	9.5	9.6	10.1	9.9	10.0	11.2
		Regional	0.6	0.4	0.5	0.6	1.1	1.4	1.2	1.5	1.5	1.6	1.7
C56	Ovary	Distant	1.0	0.8	1.2	0.9	0.9	1.0	1.3	1.4	1.8	2.0	2.1
		Unknown	0.4	0.2	0.1	0.2	0.1	0.4	0.1	0.2	0.5	2.0	1.4
		Total	14.9	11.1	13.0	12.4	13.1	13.5	13.4	14.0	13.1	12.4	10.9
		Localized	4.8	3.8	4.3	5.4	4.3	3.8	3.9	4.4	3.2	2.7	2.4
		Regional	1.3	0.7	0.7	0.9	0.9	1.4	0.8	0.5	0.4	0.3	0.3
C64	Kidney except renal pelvis	Distant	8.1	6.2	7.9	5.9	7.7	8.1	8.5	8.8	8.6	8.0	7.3
		Unknown	0.7	0.5	0.2	0.2	0.2	0.3	0.2	0.4	1.0	1.4	0.9
		Total	4.0	3.2	3.3	3.6	4.0	4.1	4.4	4.7	4.7	4.6	5.5
		Localized	2.3	1.9	1.8	1.9	2.0	1.9	2.1	2.8	2.3	2.2	2.9
		Regional	0.4	0.4	0.3	0.8	0.7	1.0	0.8	0.6	0.5	0.5	0.4
C66-68	Bladder, ureter, urethra	Distant	1.0	0.9	1.0	0.8	1.2	1.1	1.3	1.0	1.1	1.0	0.8
		Unknown	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.7	1.0	1.4
		Total	5.4	3.9	4.0	4.8	5.3	5.5	5.9	5.7	6.0	6.3	6.5
		Localized	3.3	2.4	2.8	3.2	3.8	4.3	5.0	4.9	3.7	3.3	3.5
		Regional	0.6	0.6	0.6	0.7	0.7	0.5	0.5	0.4	0.4	0.5	0.6
C70-72, D42-43	Central nervous system	Distant	0.9	0.7	0.5	0.6	0.6	0.4	0.3	0.3	0.4	0.5	0.4
		Unknown	0.6	0.3	0.2	0.3	0.3	0.2	0.1	0.2	1.5	2.1	2.0
		Total	6.8	5.3	5.8	5.4	7.4	7.9	9.1	9.6	12.4	15.7	16.9
		Non-malignant	2.5	2.2	2.5	2.1	3.1	3.2	4.2	4.9	7.0	10.4	11.5
		Malignant	4.3	3.1	3.3	3.3	4.3	4.7	4.9	4.7	5.4	5.3	5.4
C73	Thyroid gland	Total	2.9	2.4	3.2	3.9	4.8	5.4	4.8	4.7	4.0	4.7	5.2
		Localized	1.3	1.0	1.8	2.3	3.2	3.8	3.4	3.2	2.2	2.5	2.5
		Regional	0.9	1.0	1.0	1.1	1.1	1.2	1.1	1.2	1.3	1.4	1.6
		Distant	0.5	0.4	0.3	0.3	0.4	0.2	0.2	0.3	0.2	0.2	0.2
		Unknown	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.6	0.9

Mortality

There were 10 565 deaths from cancer in Norway in 2009, of which 5636 were among men and 4 929 among women (Table 17). Cancers of the lung, colorectal, prostate and female breast account for half of the total cancer mortality. As previously, lung cancer ranked first in men in terms of cancer mortality numbers, responsible for 1 230 deaths, followed by prostate cancer (1048 deaths) and colorectal cancer (762 deaths).

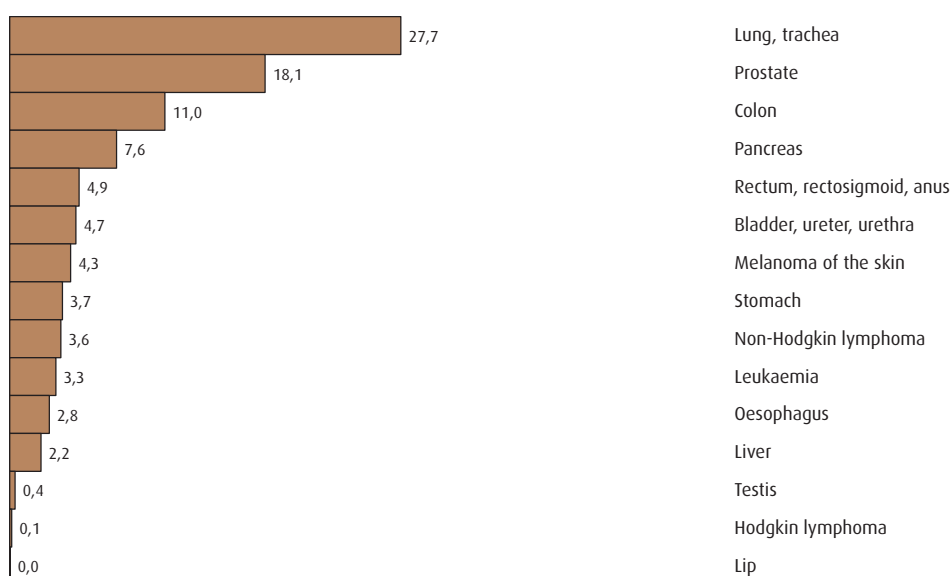
Lung cancer mortality (830 deaths) also rank highest among women. Colorectal cancer (784 deaths) and breast cancer (671 deaths) rank as the second and third most frequent cause of cancer deaths among women, respectively.

Figure 8 shows the distribution of age-standardised mortality rates for selected cancer site. There is at least a 100-fold variation in rates across these cancers, with lung cancer as the leading cause of cancer death in both sexes. Given the very poor prognosis associated with pancreatic cancer, the disease ranks among the top 5 causes of cancer death among both men and women.

The Trends section in this report examines the mortality time trends in relation to those of incidence and survival for selected 23 cancers.

Figure 8: Age-standardised (world) mortality rates in Norway 2009 for selected cancers
(Source : Statistics Norway)

Males



Females

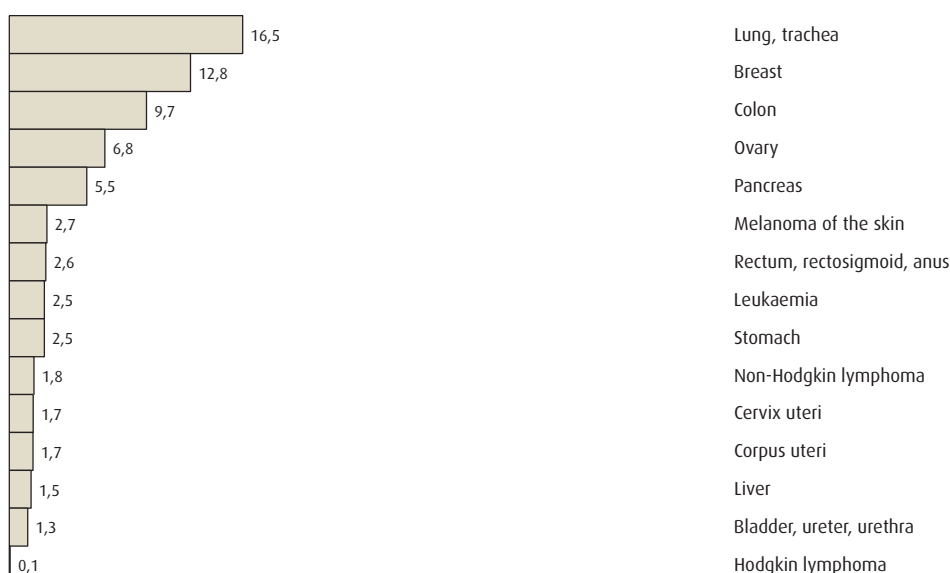


Table 17 Number of cancer deaths in Norway by primary site and sex - 2009 (Source: Statistics Norway)

ICD10	Site	Males	Females	Total
C00-96	All sites	5636	4929	10565
C00-14	Mouth, pharynx	74	43	117
C00	Lip	1	1	2
C01-02	Tongue	20	9	29
C03-06	Mouth, other	16	15	31
C07-08	Salivary glands	8	4	12
C09-14	Pharynx	29	14	43
C15-26	Digestive organs	1564	1501	3065
C15	Oesophagus	117	51	168
C16	Stomach	171	155	326
C17	Small intestine	22	32	54
C18	Colon	534	627	1161
C19-21	Rectum, rectosigmoid, anus	228	157	385
C22	Liver	102	84	186
C23-24	Gallbladder, bile ducts	28	30	58
C25	Pancreas	339	325	664
C26	Other digestive organs	23	40	63
C30-34, C38	Respiratory organs	1273	838	2111
C30-31	Nose, sinuses	7		7
C32	Larynx, epiglottis	29	4	33
C33-34	Lung, trachea	1230	830	2060
C38	Mediastinum, pleura (non-mesothelioma)	7	4	11
C40-41	Bone	14	12	26
C43	Melanoma of the skin	174	122	296
C44	Skin, non-melanoma	19	19	38
C45	Mesothelioma	52	11	63
C46	Kaposi's sarcoma	1		1
C47	Autonomic nervous system		1	1
C48-49	Soft tissues	25	41	66
C50	Breast	7	671	678
C51-58	Female genital organs		614	614
C53	Cervix uteri		73	73
C54	Corpus uteri		95	95
C55	Uterus, other		56	56
C56	Ovary		330	330
C51-52, C57	Other female genital		60	60
C58	Placenta			
C60-63	Male genital organs	1067		1067
C61	Prostate	1048		1048
C62	Testis	13		13
C60, C63	Other male genital	6		6
C64-68	Urinary organs	413	177	590
C64	Kidney excl. renal pelvis	154	84	238
C65	Renal pelvis	6	3	9
C66-68	Bladder, ureter, urethra	253	90	343
C69	Eye	4	1	5
C70-72, D32-33	Central nervous system	200	154	354
C73	Thyroid gland	12	21	33
C37, C74-75	Other endocrine glands	11	8	19
C39, C76, C80	Other or unspecified	216	282	498
C81-96	Lymphoid and haematopoietic tissue	510	413	923
C81	Hodgkin lymphoma	7	4	11
C82-85, C96	Non-Hodgkin lymphoma	171	117	288
C88	Malignant immunoproliferative diseases	5	1	6
C90	Multiple myeloma	132	103	235
C91-95, D45-47	Leukaemia	195	188	383

Survival

Long-term estimates of survival are becoming increasingly relevant as life expectancy amongst cancer patients increases and cancer care continues to advance (Brenner and Hakulinen, 2002). Given that cancer patients survive longer, there is a need to communicate information not only on prognosis at the time of diagnosis, but for a period of time thereafter, among those who survive their cancer diagnosis (Janssen-Heijnen *et al.*, 2007). Figures 9-A to 9-X overleaf aims to depict these two aspects of cancer survival in Norway for all cancers combined and for 23 specific cancer types. Relative survival estimates are presented by sex and age, 1 to 15 years after diagnosis, with age strata determined cancer-specifically according to relevant biological and/or clinical criteria. Table 18 provides the 5-year relative survival estimates (with 95% confidence intervals) over the last four decades by stage, as well as for cancer site and sex. Table 19 gives the 1-, 5-, 10- and 15-year relative survival estimates for the follow-up period 2007-9 by cancer site and sex.

For some sites, these cumulative survival curves tend to level off a certain number of years after diagnosis, indicating that from this point forward, the cancer patient group has a similar mortality to the group without cancer, or in other words, statistical cure is reached (Lambert, 2007). This concept - involving attributes of survival observed among patients as a group - should be distinguished from clinical cure, as is determined on the basis of a lack of specific symptoms in an individual. Estimates of 5-year relative survival conditional on being alive 1 to 10 years after diagnosis are included in the sex-specific figures, and better quantify the prognosis of cancer patients beyond their initial diagnosis (Figure 9-A to 9-X, dotted lines). When conditional 5-year relative survival reaches beyond 90-95%, we commonly say that there is little or no excess mortality among the cancer patients, with mortality equivalent to that experienced in the general population, analogous to the notion of cure that may be observed in the long-term relative survival estimates.

The overall profile of the sex- and age-specific survival of all cancer patients 1 to 15 years after diagnosis in Norway is captured in Figure 9-A. The levelling-off of the 5-year relative survival occurs some 8 to 10 years after diagnosis, while the attainment of 5-year conditional relative survival estimates of 90-95% is reached in patients alive 3-5 years after diagnosis (dotted lines). Cure appears to be attained more rapidly in women than men. As was mentioned in the Trends section, the combined-cancer estimates are an aggregate of many different cancer forms with contrasting diagnostic and treatment capacities. Sex-specific survival estimates will be particularly influenced

by PSA testing for prostate cancer and mammographic screening for breast cancer, respectively.

The cumulative 5-year relative survival described by cancer site, sex and age, and 5-year conditional relative survival by site and age (Figures 9-B to 9-X) are fairly self-explanatory and highlight the wide variations in patient survival according to these three variables. The 90 percentage point difference in 5-year survival among patients with testicular (Figure 9-Q) or pancreatic cancer (Figure 9-I) strikingly illustrates the wide differential in prognosis according to the type of cancer diagnosed. Long-term survival following diagnoses of melanoma and cancers of the oral cavity, bladder, central nervous system and thyroid clearly varies in men and women, and contributing factors may be biological or anatomical, or may relate to sex-specific differences in stage at presentation, subsite or histological distribution, or levels of co-morbidity.

The overall cancer survival tends to diminish with increasing age at diagnosis, yet the age-specific differences are rather narrow for the likes of colon cancer (Figure 9-E) relative to, for example, ovarian cancer (Figure 9-O) or leukaemia (Figure 9-X). For certain cancers including breast and prostate cancer, long-term survival among patients diagnosed aged under the age of 50 is actually lower than for patients diagnosed aged 50-59. This in part represents the diagnosis of more aggressive tumours in the younger age group, but also the impact of screening on the older group.

The figures also illustrate a very positive aspect of cancer survival; cancer patients who are alive for a certain time after diagnosis begin to have very good prospects of surviving their cancer and becoming cured. In fact, for about two-thirds of the cancer types diagnosed in Norway, the 5-year conditional relative survival reaches 90% 2-5 years after diagnosis. This means that in general terms, survivors of these cancers, will, within a few years of diagnosis have mortality rates similar to that of the general population, and would be considered (statistically) cured. The extent to which survivors may be considered cured does however vary; 5-year conditional survival from breast reaches 90% 2 years after diagnosis (Figure 9-L) and slowly increases to 95% 10 years from diagnosis. As is evident from the continual declines in long-term breast cancer survival by age however, the cancer represents a disease for which a proportion may be considered cured long-term, but for which there remains a group of survivors with a persistent excess mortality. There is also a spectrum of cancers associated with particularly poor survival on diagnosis, and for which cure is not indicated, including cancers of the oesophagus (Figure 9-C), liver (Figure 9-G) and pancreas (Figure 9-I).

Table 18a Five-year relative survival (period approach) by primary site, stage and period of follow up, 1970 - 2009* (%)

MALES

ICD10	Site	Stage	Relative survival (%)							
			1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
C00-96	All sites	Total	32.2	36.3	40.9	42.7	47.6	52.2	58.2	65.9
C00-14	Mouth, pharynx	Total	62.2	64.5	59.2	57.6	55.6	56.7	57.1	60.8
		Localized	80.9	82.9	81.5	76.7	77.2	78.6	82.6	78.6
		Regional	21.9	28.4	25.3	26.4	27.6	33.4	41.1	49.2
		Distant	3.7	12.7	7.5	10.3	6.3	15.5	10.0	18.1
		Unknown	59.7	42.1	28.8	24.2	61.6	52.7	57.9	73.9
C15	Oesophagus	Total	3.6	3.7	2.1	5.0	5.0	5.7	8.9	10.4
		Localized	6.9	3.1	2.5	6.3	8.0	14.2	18.2	26.1
		Regional	0.3	8.9	3.1	7.7	4.9	6.6	9.0	15.8
		Distant	0.0	0.0	0.1	0.0	0.4	0.0	1.9	0.3
		Unknown	6.7	22.9	1.8	0.0	17.5	0.0	10.6	5.3
C16	Stomach	Total	11.4	13.6	16.8	16.4	18.1	16.0	18.7	22.2
		Localized	35.4	38.3	38.4	37.3	36.4	43.6	53.5	60.7
		Regional	12.5	15.3	20.8	20.2	20.0	17.1	23.9	21.5
		Distant	1.8	1.1	0.9	0.9	0.7	0.4	1.7	1.7
		Unknown	3.2	5.0	3.1	1.3	7.1	7.3	14.1	29.3
C18	Colon	Total	35.6	41.0	45.3	47.3	48.3	51.4	54.2	59.6
		Localized	68.4	70.1	74.6	76.6	78.4	84.9	87.9	86.1
		Regional	40.0	46.9	55.0	58.1	55.9	64.0	68.5	73.6
		Distant	4.5	6.0	4.4	4.3	4.7	4.9	6.3	9.1
		Unknown	6.7	24.4	18.2	10.2	11.3	15.6	55.8	61.9
C19-21	Rectum, rectosigmoid, anus	Total	31.5	36.5	42.8	45.3	47.3	54.5	57.4	62.6
		Localized	54.4	57.9	64.1	65.0	68.2	77.7	85.3	85.3
		Regional	20.5	27.2	39.0	43.8	44.2	57.1	64.3	72.4
		Distant	2.8	3.5	3.8	2.2	4.6	5.0	10.3	12.5
		Unknown	20.6	5.7	19.1	30.2	34.3	32.3	51.1	57.0
C22	Liver	Total	0.0	1.5	1.6	1.0	2.9	5.1	4.0	10.9
		Localized	0.0	4.0	2.0	2.0	5.0	11.4	10.2	24.5
		Regional	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
		Distant	0.0	0.0	0.3	0.0	0.0	0.5	0.0	2.4
		Unknown	0.0	0.0	0.0	1.8	1.1	1.6	1.3	8.1
C23-24	Gallbladder, bile ducts	Total	4.3	5.2	8.5	8.7	9.3	7.1	15.0	13.7
		Localized	11.0	10.8	15.5	18.1	13.5	26.4	27.8	28.6
		Regional	11.1	11.1	13.3	11.4	20.0	13.4	24.2	15.3
		Distant	0.4	0.0	1.7	0.4	2.5	0.8	1.0	2.5
		Unknown	0.0	0.0	0.0	4.3	0.0	0.0	9.9	9.3
C25	Pancreas	Total	1.2	0.9	0.8	1.1	2.0	1.5	2.5	4.9
		Localized	5.1	3.0	2.1	2.1	3.2	4.2	10.8	18.7
		Regional	3.2	2.3	3.6	2.3	8.1	6.6	4.0	9.5
		Distant	0.1	0.2	0.1	0.2	0.8	0.3	1.4	1.5
		Unknown	0.0	1.2	1.7	5.5	0.6	1.6	2.0	7.2
C33-34	Lung, trachea	Total	7.9	6.6	7.9	7.6	7.1	8.1	8.8	11.5
		Localized	20.5	15.3	18.4	18.0	14.6	25.2	35.7	44.6
		Regional	9.9	9.3	9.6	9.2	10.9	9.0	10.8	14.7
		Distant	0.5	0.7	0.7	0.5	0.7	0.5	0.8	1.2
		Unknown	2.7	1.9	4.9	1.6	4.7	6.0	7.7	12.6
C43	Melanoma of the skin	Total	54.5	64.7	72.0	72.0	76.6	79.6	77.9	77.0
		Localized	65.2	74.4	80.6	80.7	84.6	86.6	88.2	86.1
		Regional	32.0	29.0	36.6	26.3	38.4	26.5	49.2	43.3
		Distant	8.5	6.6	8.3	1.8	8.7	15.9	9.6	6.1
		Unknown	65.6	49.0	55.0	52.8	47.8	70.8	75.5	78.6
C61	Prostate	Total	50.4	52.4	56.5	56.3	59.3	68.4	79.2	87.0
		Localized	63.5	66.0	71.6	71.5	71.6	79.4	93.9	97.3
		Regional	39.7	37.5	39.5	41.9	61.6	74.6	77.2	83.8
		Distant	18.0	18.1	19.5	21.1	24.4	23.7	25.1	31.0
		Unknown	50.0	36.6	37.3	45.6	49.7	70.3	82.1	88.1
C62	Testis	Total	65.3	73.9	90.4	93.4	96.1	96.0	95.9	97.5
		Localized	84.1	89.5	98.0	98.6	98.6	99.8	98.4	99.7
		Regional	74.9	76.3	92.5	95.6	97.7	97.6	95.7	98.0
		Distant	19.4	30.6	64.3	72.6	80.4	77.1	84.5	84.4
		Unknown	64.2	61.5	83.0	41.0	96.1	90.2	96.4	97.7
C64	Kidney except renal pelvis	Total	32.6	37.1	37.8	40.4	45.2	46.6	55.9	62.9
		Localized	61.3	70.5	67.2	70.0	69.7	74.6	81.8	86.0
		Regional	38.8	39.1	49.0	47.2	51.0	53.3	55.8	51.7
		Distant	3.7	5.0	4.1	5.2	5.8	3.6	7.6	9.8
		Unknown	23.9	18.8	30.5	15.9	30.1	33.6	62.1	74.3
C66-68	Bladder, ureter, urethra	Total	55.3	62.9	66.8	68.1	71.7	71.3	71.8	74.5
		Localized	64.8	72.3	75.5	75.1	77.5	78.6	84.8	84.4
		Regional	14.8	22.3	26.3	24.2	27.7	22.9	25.0	29.8
		Distant	3.8	5.3	0.4	4.3	6.9	4.4	4.7	4.5
		Unknown	47.3	29.5	28.9	46.0	42.0	66.9	68.0	76.2
C70-72, D32-33	Central nervous system	Total	24.6	28.1	35.1	40.0	43.3	50.8	55.5	61.9
		Non-malignant	51.7	53.0	67.4	74.4	75.5	88.9	93.2	94.2
		Malignant	14.5	19.0	23.6	27.0	29.2	27.2	25.3	30.9
C73	Thyroid gland	Total	70.7	76.1	77.7	74.8	80.4	78.4	85.8	83.0
		Localized	91.2	86.9	95.7	89.5	99.1	97.7	98.3	98.9
		Regional	73.7	78.1	84.6	87.0	83.7	82.9	88.6	84.7
		Distant	17.2	31.9	13.2	9.8	19.9	22.2	32.0	31.5
		Unknown	0.0	8.9	0.0	46.1	0.0	54.4	88.3	84.9
C81	Hodgkin lymphoma	Total	48.1	52.0	61.7	71.6	83.7	85.2	89.2	88.8
C82-85, C96	Non-Hodgkin lymphoma	Total	29.3	35.7	45.0	43.8	48.9	51.4	56.8	66.5
C91-95, D45-47	Leukaemia	Total	14.4	20.4	24.0	29.2	38.9	44.4	51.6	58.2

*The numbers in are not comparable to the corresponding estimates published in Cancer in Norway 2008. The survival numbers are based on the first primary tumour of a patient, but an error in the data extraction for survival analysis in CIN 2008 resulted in the selection of a later cancer diagnosis for patients with multiple tumours. The discrepancy is largest for all cancers combined in the earliest time periods, with only marginal differences for specific cancers.

Table 18b Five-year relative survival (period approach) by primary site, stage and period of follow up, 1970 - 2009* (%)

FEMALES

ICD10	Site	Stage	Relative survival (%)							
			1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005-09
C00-96	All sites	Total	45.8	48.8	52.2	53.2	57.3	59.9	63.7	68.2
C00-14	Mouth, pharynx	Total	55.7	58.2	59.8	55.7	68.2	61.6	61.5	70.9
		Localized	71.7	70.7	80.3	68.8	81.1	80.8	82.3	85.5
		Regional	33.3	42.6	32.5	37.9	47.8	34.5	46.5	54.3
		Distant	20.9	33.6	14.2	10.8	9.3	13.0	5.6	19.4
		Unknown	72.4	42.6	46.0	37.4	72.2	61.4	55.5	83.1
C15	Oesophagus	Total	3.4	6.9	9.2	8.6	6.2	10.1	8.5	10.5
		Localized	3.4	7.8	13.5	9.1	10.4	13.5	25.9	25.0
		Regional	2.6	10.7	7.2	8.3	5.3	7.5	3.5	10.1
		Distant	0.0	0.1	0.0	6.7	0.0	0.0	0.0	4.7
		Unknown	0.0	0.0	18.8	7.3	0.0	24.3	4.3	5.3
C16	Stomach	Total	9.9	13.0	16.7	20.3	21.3	20.7	23.7	21.7
		Localized	31.8	33.6	42.6	40.4	39.2	49.9	64.3	56.6
		Regional	13.3	17.1	18.2	22.1	24.9	25.1	30.7	22.2
		Distant	1.2	2.0	0.6	0.8	1.3	0.7	3.0	3.6
		Unknown	2.7	4.9	4.2	6.3	15.2	9.4	14.3	25.4
C18	Colon	Total	38.7	40.3	46.4	48.5	52.4	55.2	56.9	62.2
		Localized	66.9	71.6	75.4	77.8	82.6	87.2	89.8	89.6
		Regional	42.1	46.1	57.5	58.3	58.8	66.1	69.6	73.4
		Distant	5.3	4.1	4.0	4.0	5.0	7.0	8.4	11.9
		Unknown	24.0	16.9	16.3	9.6	18.6	27.7	51.7	63.2
C19-21	Rectum, rectosigmoid, anus	Total	36.0	44.0	47.2	49.4	54.0	57.8	62.6	66.2
		Localized	59.8	69.9	70.1	70.9	73.3	79.5	91.1	90.7
		Regional	22.5	31.5	40.9	46.7	51.5	60.0	66.8	71.3
		Distant	3.9	5.0	6.0	4.0	5.5	5.1	9.2	13.5
		Unknown	41.6	23.4	11.0	20.1	24.7	46.6	52.9	67.6
C22	Liver	Total	2.8	1.7	2.4	3.0	6.3	6.9	9.1	10.7
		Localized	7.9	1.7	7.8	5.0	9.5	14.6	22.3	21.3
		Regional	0.0	0.0	0.0	3.5	10.5	8.7	2.9	7.0
		Distant	0.2	0.0	0.0	0.5	0.9	2.7	0.0	1.0
		Unknown	0.0	0.0	0.0	2.0	5.9	4.0	4.3	12.6
C23-24	Gallbladder, bile ducts	Total	4.6	6.0	8.1	9.1	6.7	8.6	10.5	12.5
		Localized	16.0	24.6	22.9	15.8	18.8	25.5	33.4	22.5
		Regional	14.8	13.0	4.9	17.7	11.7	15.3	23.0	22.4
		Distant	0.4	0.0	0.6	1.1	0.0	0.0	0.8	0.0
		Unknown	0.0	0.0	20.3	4.3	1.7	1.8	6.7	14.0
C25	Pancreas	Total	1.0	0.8	1.5	1.3	1.9	2.4	2.9	3.1
		Localized	4.0	4.2	3.1	2.3	5.8	10.0	10.5	15.6
		Regional	0.5	1.0	7.2	4.5	4.7	6.6	4.2	4.2
		Distant	0.1	0.3	0.4	0.4	0.2	0.6	0.9	0.9
		Unknown	0.0	0.0	0.0	0.8	1.1	2.2	4.2	5.1
C33-34	Lung, trachea	Total	12.3	9.3	10.5	7.0	10.0	11.0	13.2	15.1
		Localized	30.7	28.1	26.5	19.3	23.3	34.2	52.6	50.2
		Regional	12.3	14.0	12.8	6.3	12.5	12.0	13.4	18.2
		Distant	1.8	0.6	1.3	0.3	1.2	1.2	2.2	1.8
		Unknown	10.3	4.0	10.0	7.6	4.8	5.9	15.8	18.2
C43	Melanoma of the skin	Total	77.6	81.7	84.0	86.9	89.0	88.9	89.0	89.5
		Localized	88.1	87.4	89.2	91.3	92.6	93.8	95.0	94.8
		Regional	43.0	33.8	48.4	44.5	43.3	51.7	61.3	50.4
		Distant	16.4	23.5	9.8	6.7	17.3	15.1	17.0	25.4
		Unknown	69.7	45.1	69.5	66.3	72.5	82.5	88.3	90.0
C50	Breast	Total	66.5	68.2	73.2	73.9	75.6	79.9	85.2	88.3
		I	85.3	84.6	86.5	87.4	88.4	90.7	93.8	95.3
		II	55.5	59.2	63.8	68.1	73.6	77.7	82.8	87.5
		III	44.2	46.6	51.5	51.3	54.9	58.0	67.7	69.1
		IV	13.1	13.8	14.8	13.8	18.5	17.8	17.8	18.8
C53	Cervix uteri	Unknown	75.9	77.1	84.4	85.7	57.4	78.0	101.8	86.9
		Total	68.9	70.4	70.0	66.6	68.6	71.8	75.0	76.8
		I	87.0	89.9	86.5	84.8	85.5	88.4	93.2	93.1
		II	61.5	65.3	62.9	57.0	60.0	58.0	62.5	73.0
		III	32.9	26.4	38.0	29.6	23.8	36.1	40.7	44.9
C54	Corpus uteri	IV	8.1	10.0	5.5	10.4	22.4	15.0	11.0	18.0
		Unknown	43.6	5.6	31.0	57.9	57.1	69.7	57.4	73.8
		Total	72.8	77.3	77.0	75.6	77.6	79.9	83.2	83.5
		Localized	82.2	84.7	87.6	86.2	86.9	89.0	94.9	92.8
		Regional	34.5	61.7	61.4	56.3	68.1	74.6	73.7	74.8
C56	Ovary	Distant	14.6	21.8	20.4	25.2	29.9	38.2	34.8	41.7
		Unknown	60.4	50.1	41.6	26.2	31.0	40.5	80.2	85.9
		Total	39.2	37.8	38.3	36.9	40.1	40.7	45.9	44.1
		Localized	70.8	73.9	81.6	81.6	81.3	88.7	91.7	89.3
		Regional	44.0	39.6	48.2	45.2	55.8	44.0	67.9	73.1
C64	Kidney except renal pelvis	Distant	14.6	16.0	18.4	17.1	20.5	23.1	28.9	28.8
		Unknown	34.3	18.3	43.3	25.4	15.2	27.4	61.8	49.0
		Total	42.2	39.1	42.7	44.4	51.7	50.7	54.6	69.6
		Localized	68.4	66.9	70.9	71.4	77.1	79.4	86.0	86.6
		Regional	48.6	41.2	48.7	50.4	47.7	50.7	41.1	54.5
C66-68	Bladder, ureter, urethra	Distant	3.0	5.5	2.6	8.2	7.0	2.1	8.7	14.3
		Unknown	9.5	0.0	0.0	6.8	28.3	29.6	55.5	72.8
		Total	45.6	48.7	55.6	60.2	63.7	60.2	63.2	67.3
		Localized	64.0	63.2	68.9	69.5	72.3	73.6	84.4	80.4
		Regional	13.4	16.0	14.0	15.2	20.2	24.4	24.3	21.8
C70-72, D32-33	Central nervous system	Distant	3.5	4.1	2.6	5.7	4.2	3.0	2.4	6.9
		Unknown	40.6	14.1	20.6	32.5	28.1	51.2	56.2	69.9
		Total	33.0	41.0	44.4	52.2	60.0	64.8	70.8	77.7
		Non-malignant	60.3	74.1	78.5	83.6	84.5	91.2	92.7	95.3
		Malignant	15.8	18.7	20.9	25.9	34.3	30.3	29.6	35.0
C73	Thyroid gland	Total	73.2	84.6	85.5	87.0	90.8	89.0	91.6	92.9
		Localized	87.3	95.2	96.1	94.8	98.6	98.3	102.8	100.2
		Regional	71.6	86.4	80.0	83.4	88.3	86.7	86.3	90.6
		Distant	14.5	13.6	12.3	11.3	21.1	36.8	30.9	37.1
		Unknown	88.3	61.1	80.8	76.1	82.5	68.1	88.8	90.5
C81	Hodgkin lymphoma	Total	52.3	51.3	65.8	69.8	80.4	86.0	87.8	88.3
C82-85, C96	Non-Hodgkin lymphoma	Total	32.6	42.4	47.5	50.4	54.4	54.0	61.1	67.4
C91-95, D45-47	Leukaemia	Total	14.1	20.0	26.8	27.7	37.5	48.1	52.6	59.7

*See footnote in Table 18a

Table 18 describes the stage-specific relative survival, 5 years after diagnosis for selected cancers in consecutive 5-year periods of follow-up 1970 to 2009. While the stage-specific count of cases by -year period of diagnosis in Tables 15a and b are not equivalent to the size of patient groups used in the survival calculations, the underlying numbers do provide a reasonable indication of the absolute number of patients involved in the survival

analyses at different time periods and their relative distribution. In general, caution is required in interpreting cancer-specific incidence and survival according to stage, particularly given the time-varying proportion of staging recorded as unknown. A visual description of survival trends in colon, breast and prostate cancer by stage was provided in the Special Issue included in Cancer in Norway 2007.

Table 19 1-, 5-, 10, and 15-year relative survival (period approach) by cancer site and sex 2007 - 2009* (%)

ICD10	Site	Sex	1-year		5-year		10-year		15-year	
C00-14	Mouth, pharynx	Males	83.8	(80.9, 86.4)	62.6	(58.3, 66.7)	53.3	(48.2, 58.3)	45.9	(40.1, 51.8)
		Females	85.6	(82.0, 88.7)	72.1	(66.8, 77.1)	67.3	(59.9, 74.4)	61.5	(52.3, 70.8)
C15	Oesophagus	Males	42.1	(37.4, 46.7)	11.4	(8.1, 15.4)	9.9	(6.2, 14.9)	5.4	(2.0, 11.9)
		Females	35.9	(28.5, 43.4)	11.8	(6.8, 18.6)	10.4	(5, 18.6)	7.7	(2.1, 19.8)
C16	Stomach	Males	47.0	(43.6, 50.4)	24.4	(21.1, 27.9)	22.4	(18.5, 26.6)	20.6	(16.2, 25.7)
		Females	44.3	(40.2, 48.4)	23.8	(20.1, 27.8)	23.0	(18.6, 27.9)	19.2	(14.4, 24.9)
C18	Colon	Males	78.0	(76.4, 79.5)	60.5	(58.2, 62.8)	56.0	(52.9, 59)	57.1	(52.9, 61.4)
		Females	78.3	(76.8, 79.7)	63.2	(61.1, 65.2)	57.4	(54.7, 60.1)	55.3	(51.8, 58.8)
C19-21	Rectum, rectosigmoid, anus	Males	84.7	(82.8, 86.4)	63.8	(61.0, 66.6)	56.5	(52.9, 60.2)	56.3	(51.5, 61.3)
		Females	84.4	(82.3, 86.3)	67.6	(64.6, 70.5)	62.6	(58.8, 66.4)	60.5	(55.6, 65.5)
C22	Liver	Males	34.3	(28.3, 40.3)	10.4	(6.3, 15.8)	8.0	(3.6, 15)	9.3	(3.9, 18.5)
		Females	32.1	(24.8, 39.8)	7.4	(3.8, 12.7)	6.4	(2.9, 11.9)	8.4	(3.9, 15.8)
C23-24	Gallbladder, bile ducts	Males	41.4	(33.7, 48.9)	13.6	(8.8, 19.6)	15.5	(9.4, 23.4)	16.4	(8.6, 27.6)
		Females	42.1	(35.3, 48.9)	15.5	(10.2, 21.9)	12.1	(6.7, 19.6)	13.4	(6.9, 23)
C25	Pancreas	Males	20.2	(17.8, 22.7)	5.2	(3.8, 6.8)	3.9	(2.4, 6.0)	3.9	(1.9, 7.3)
		Females	18.7	(16.5, 21.1)	3.9	(2.6, 5.5)	4.2	(2.7, 6.2)	4.4	(2.5, 7.3)
C33-34	Lung, trachea	Males	34.9	(33.5, 36.4)	12.2	(11.1, 13.4)	9.3	(8.1, 10.6)	7.6	(6.2, 9.1)
		Females	40.9	(39.1, 42.6)	15.7	(14.3, 17.2)	11.8	(10.3, 13.4)	8.5	(6.9, 10.3)
C43	Melanoma of the skin	Males	92.5	(90.9, 93.8)	76.8	(74.0, 79.4)	71.8	(68.3, 75.1)	71.4	(67.3, 75.5)
		Females	96.7	(95.5, 97.6)	90.7	(88.6, 92.6)	87.9	(85.0, 90.6)	87.3	(83.8, 90.6)
C50	Breast	Females	97.5	(97.0, 97.9)	89.0	(88.0, 89.9)	82.0	(80.6, 83.3)	77.7	(75.9, 79.5)
C53	Cervix uteri	Females	89.5	(87.2, 91.5)	75.3	(72.0, 78.3)	74.7	(71.0, 78.2)	75.0	(70.9, 78.9)
C54	Corpus uteri	Females	93.5	(92.1, 94.6)	84.3	(82.0, 86.4)	81.9	(78.8, 84.9)	81.2	(77.2, 85.2)
C56	Ovary	Females	76.2	(73.6, 78.5)	44.0	(41.0, 47.0)	35.7	(32.6, 38.9)	34.3	(30.9, 37.8)
C61	Prostate	Males	98.1	(97.7, 98.5)	88.8	(87.8, 89.9)	78.0	(76.2, 79.9)	66.6	(63.3, 69.9)
C62	Testis	Males	99.3	(98.3, 99.7)	97.7	(96.2, 98.8)	96.9	(94.9, 98.4)	95.7	(93.1, 97.7)
C64	Kidney except renal pelvis	Males	80.1	(77.4, 82.5)	63.8	(60.2, 67.4)	57.0	(52.2, 61.8)	53.1	(46.7, 59.7)
		Females	84.4	(81.2, 87.2)	70.8	(66.1, 75.2)	64.0	(57.5, 70.3)	58.9	(50.8, 67.3)
C66-68	Bladder, ureter, urethra	Males	88.5	(87.0, 89.9)	74.7	(72.3, 77.2)	69.2	(65.7, 72.7)	65.7	(61.2, 70.4)
		Females	80.8	(77.9, 83.4)	67.8	(63.7, 71.8)	67.5	(62.1, 72.8)	62.4	(55.4, 69.6)
C70-72, D32-33	Central nervous system	Males	75.3	(72.7, 77.6)	61.7	(58.6, 64.7)	58.8	(55.2, 62.4)	56.8	(52.4, 61.2)
		Females	85.5	(83.6, 87.2)	77.7	(75.2, 80.0)	77.7	(74.6, 80.7)	75.9	(71.7, 79.9)
C73	Thyroid gland	Males	85.6	(79.3, 90.3)	78.9	(71.0, 85.5)	79.7	(70.3, 87.9)	82.9	(71.2, 93.4)
		Females	93.8	(91.0, 95.8)	94.3	(90.7, 97.2)	94.4	(89.5, 98.5)	96.8	(90.7, 102.0)
C81	Hodgkin lymphoma	Males	91.8	(87.0, 95.1)	88.8	(82.9, 93.2)	87.0	(80.1, 92.5)	88.3	(80.6, 94.4)
		Females	93.3	(87.1, 96.7)	90.6	(83.1, 95.8)	92.9	(84.2, 99.2)	90.7	(80.2, 98.6)
C82-85, C96	Non-Hodgkin lymphoma	Males	79.2	(76.7, 81.5)	68.6	(65.3, 71.8)	61.5	(57.1, 65.8)	55.2	(49.8, 60.7)
		Females	82.4	(79.9, 84.8)	71.2	(67.7, 74.6)	65.8	(61.2, 70.4)	64.6	(58.6, 70.5)
C91-95, D45-47	Leukaemia	Males	75.8	(73.2, 78.2)	59.4	(56.0, 62.8)	51.5	(46.9, 56.0)	52.1	(46.3, 58.1)
		Females	77.3	(74.5, 79.9)	61.3	(57.5, 64.9)	56.8	(51.8, 61.7)	53.5	(47.1, 60.1)

*See footnote in Table 18a

Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9A: All sites (ICD10 C00–96)

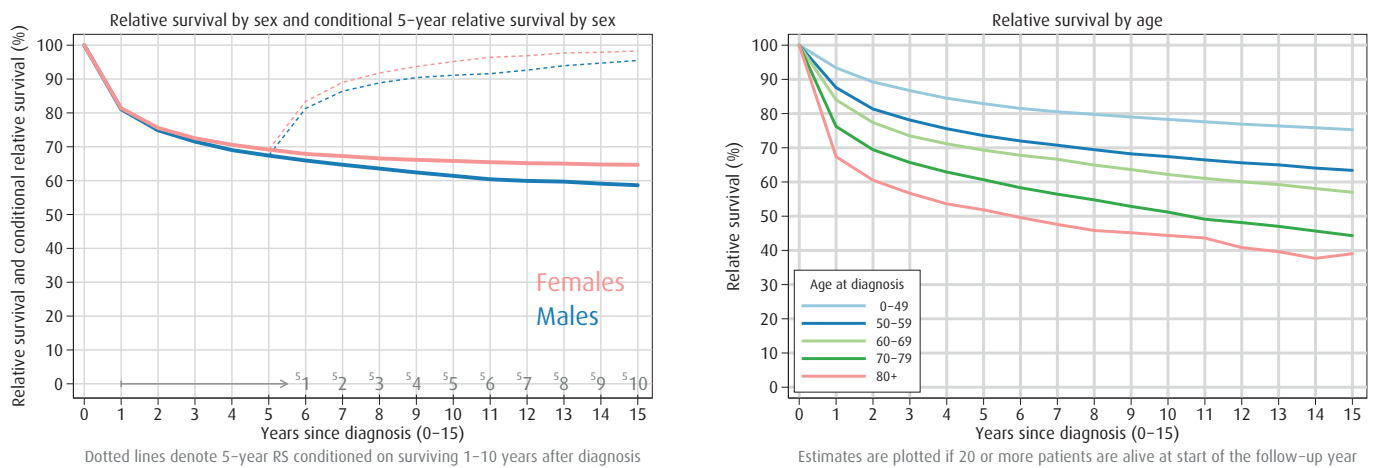


Figure 9B: Mouth, pharynx (ICD-10 C00–14)

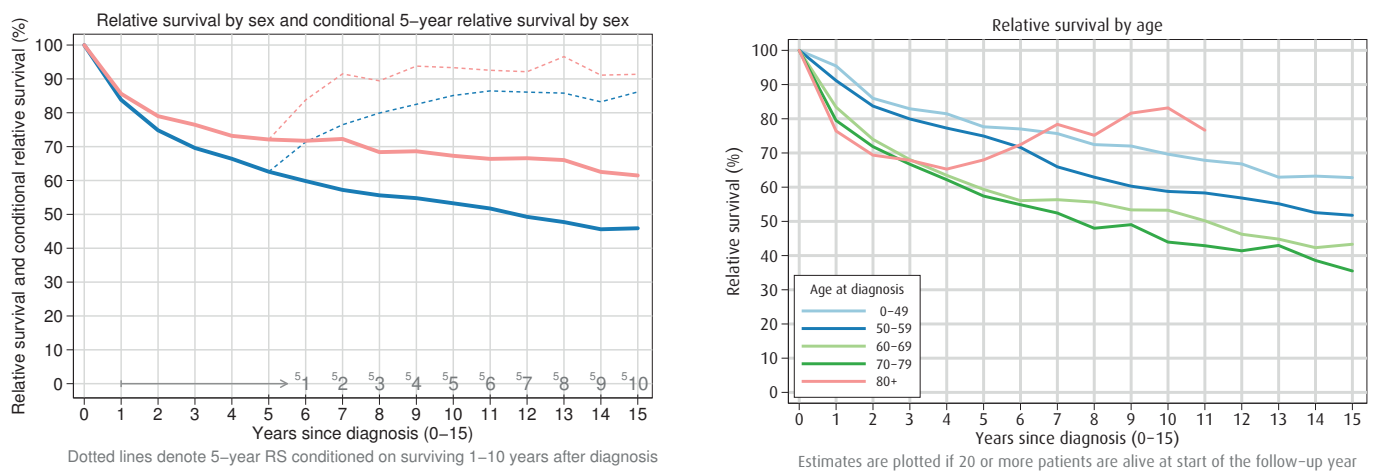
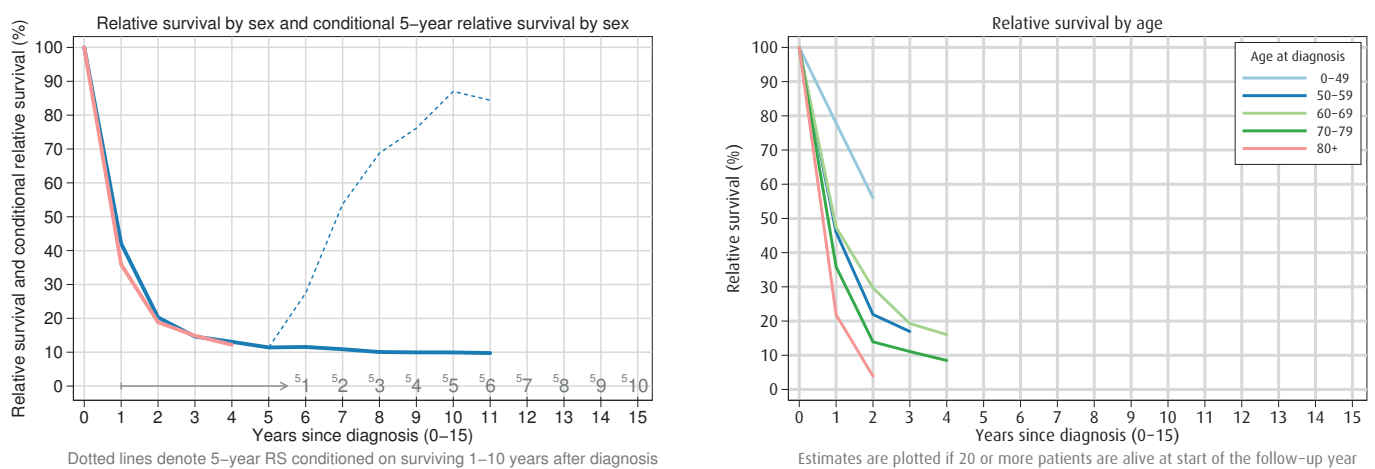


Figure 9C: Oesophagus (ICD-10 C15)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9D: Stomach (ICD-10 C16)

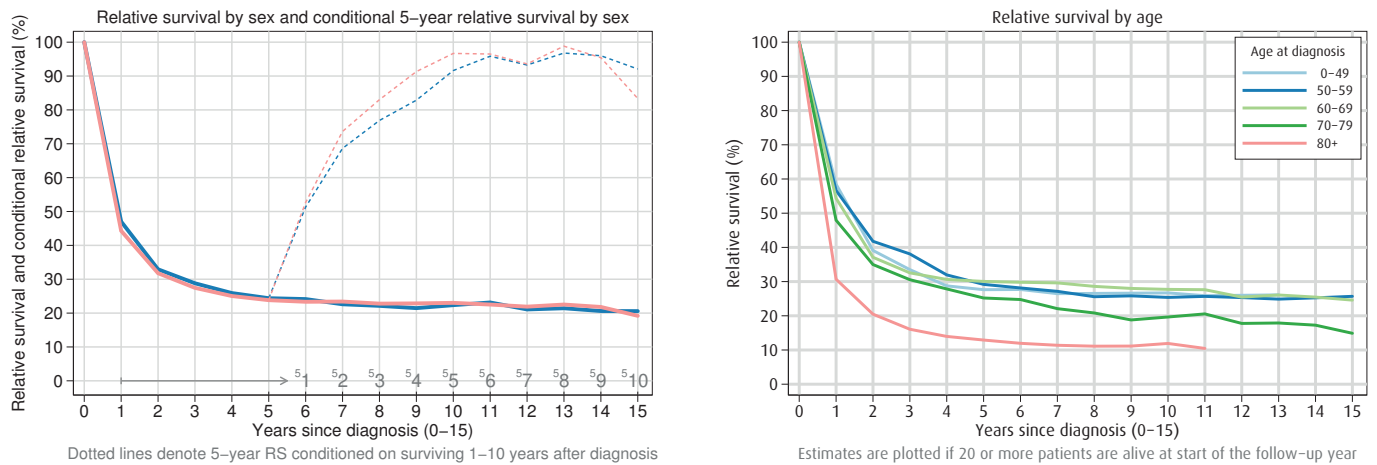


Figure 9E: Colon (ICD-10 C18)

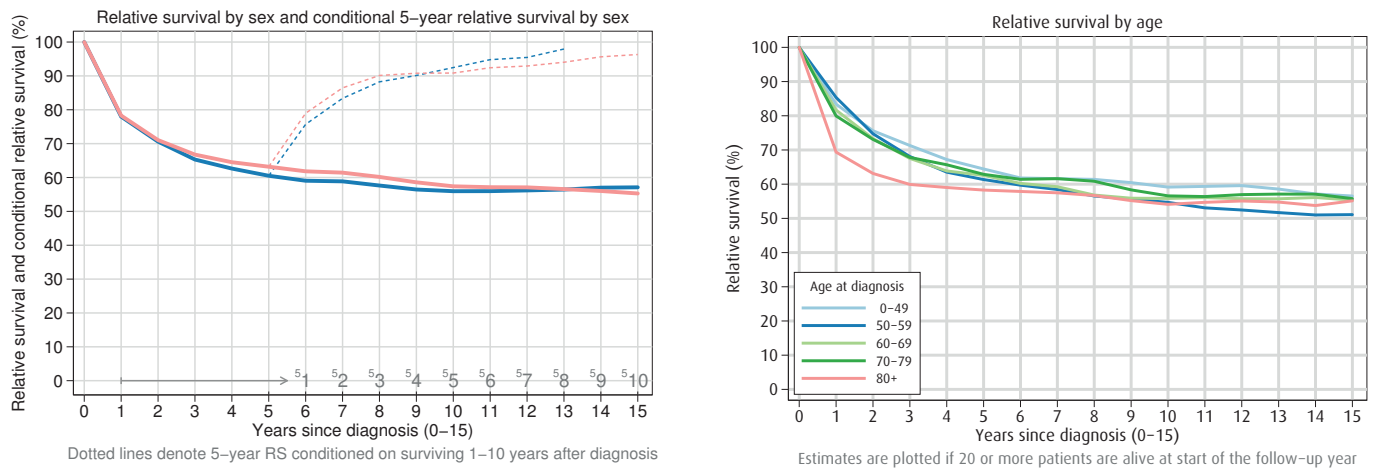
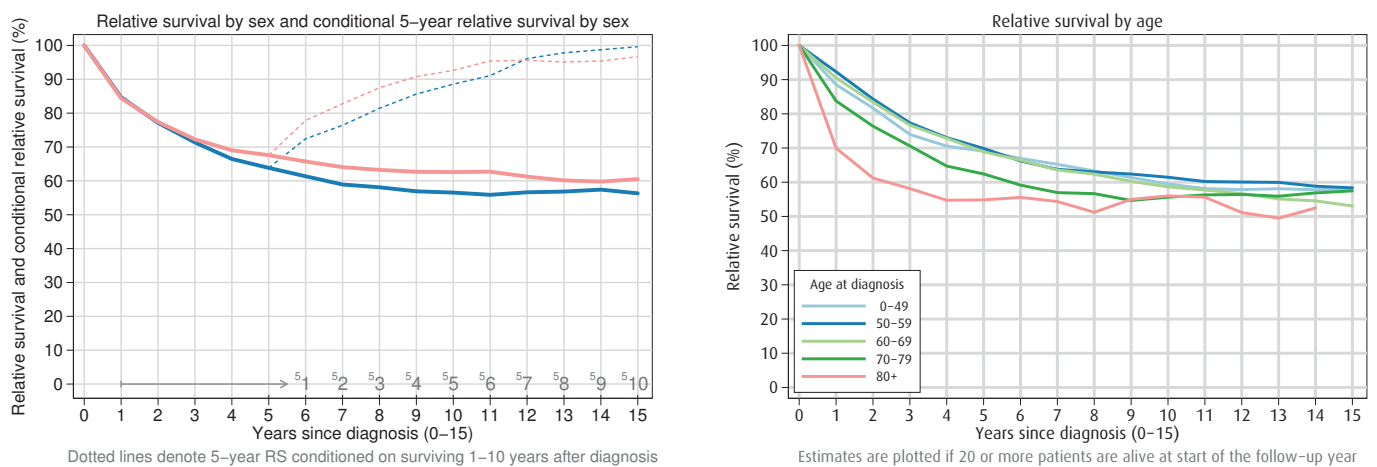


Figure 9F: Rectum, rectosigmoid, anus (ICD-10 C19–21)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9G: Liver (ICD-10 C22)

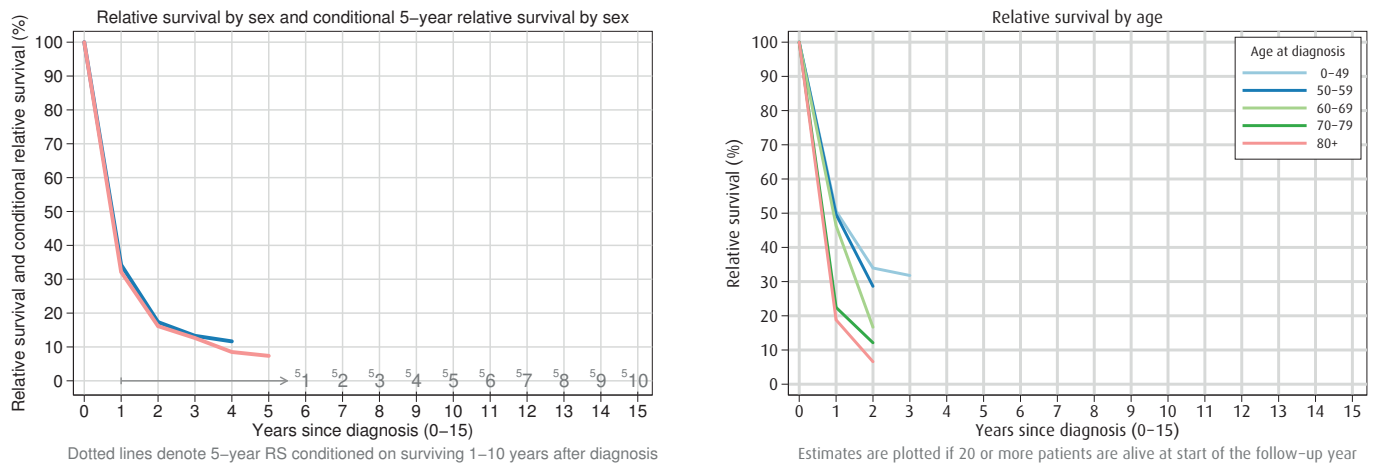


Figure 9H: Gallbladder, bile ducts (ICD-10 C23–24)

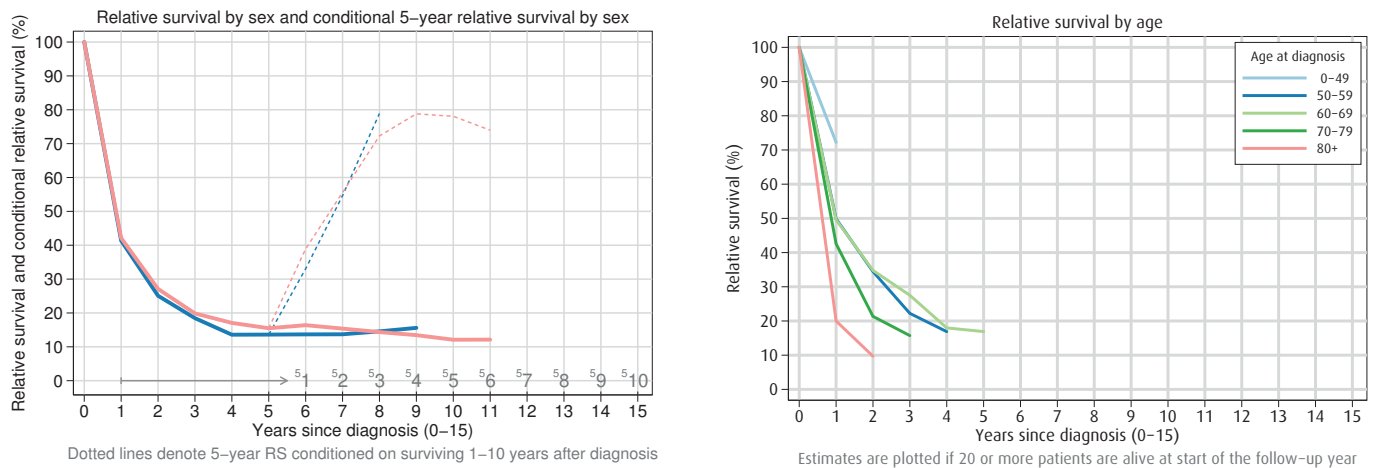
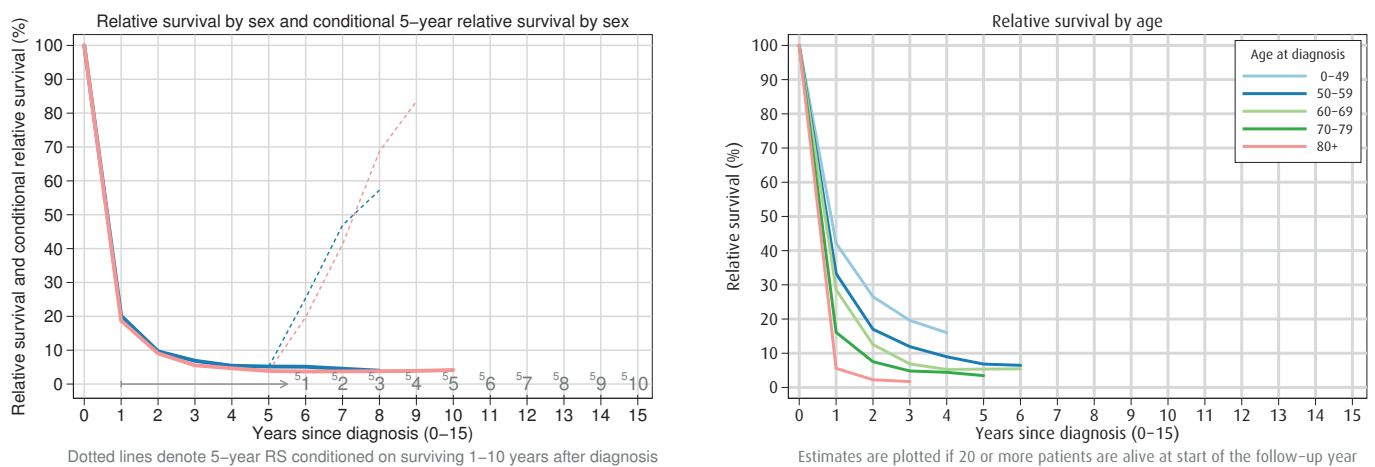


Figure 9I: Pancreas (ICD-10 C25)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9J: Lung, trachea (ICD-10 C33–34)

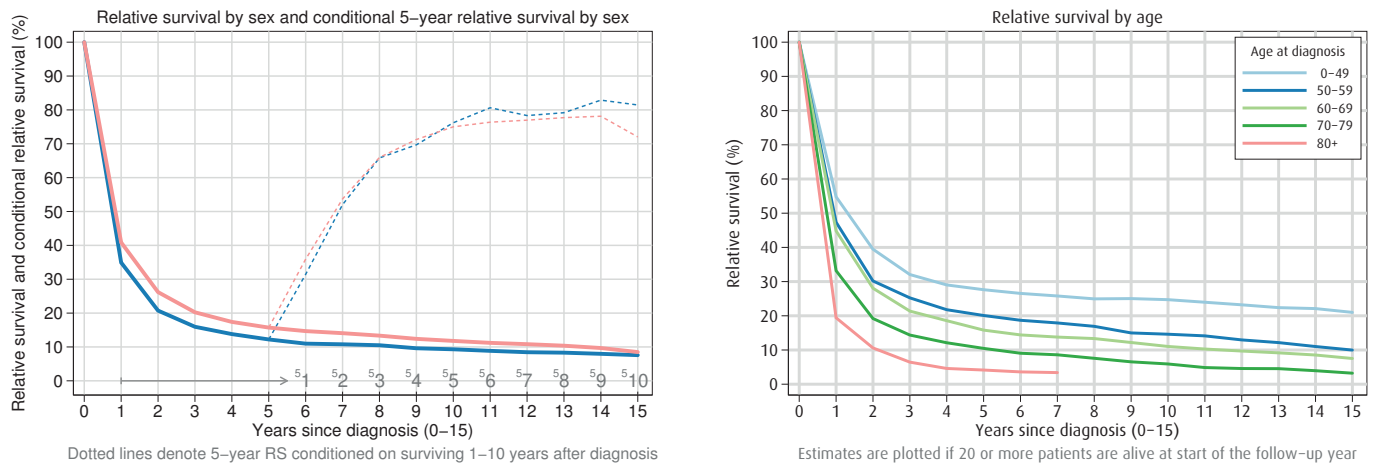


Figure 9K: Melanoma of the skin (ICD-10 C43)

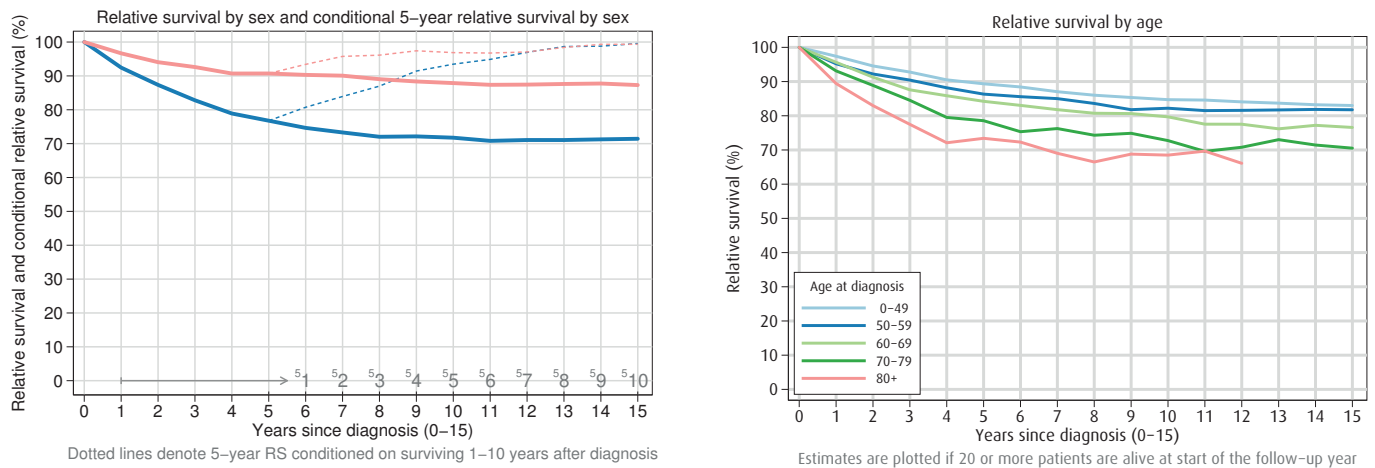
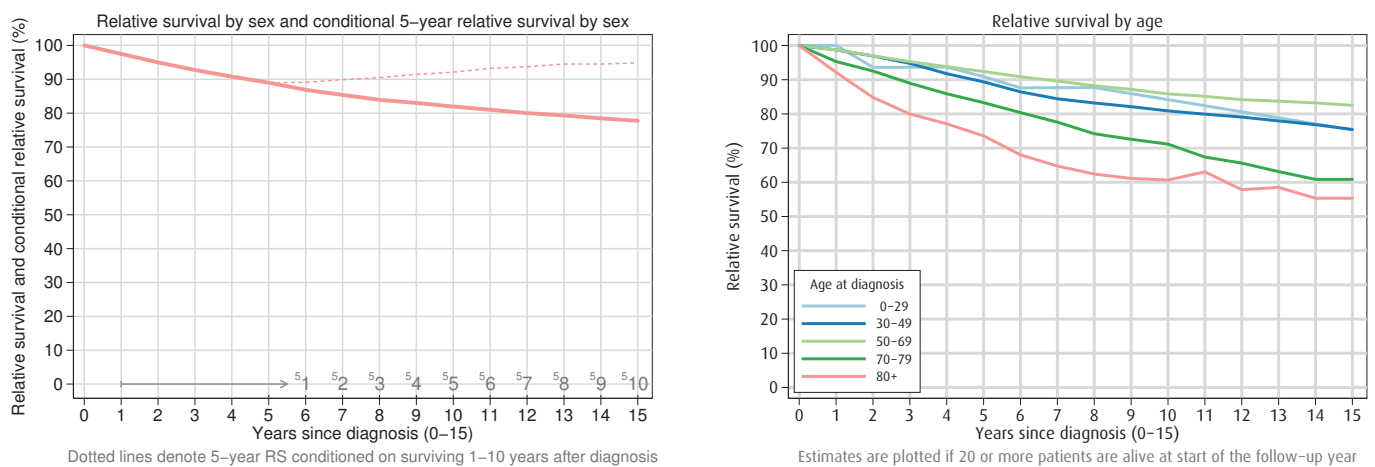


Figure 9L: Breast (ICD-10 C50)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9M: Cervix uteri (ICD-10 C53)

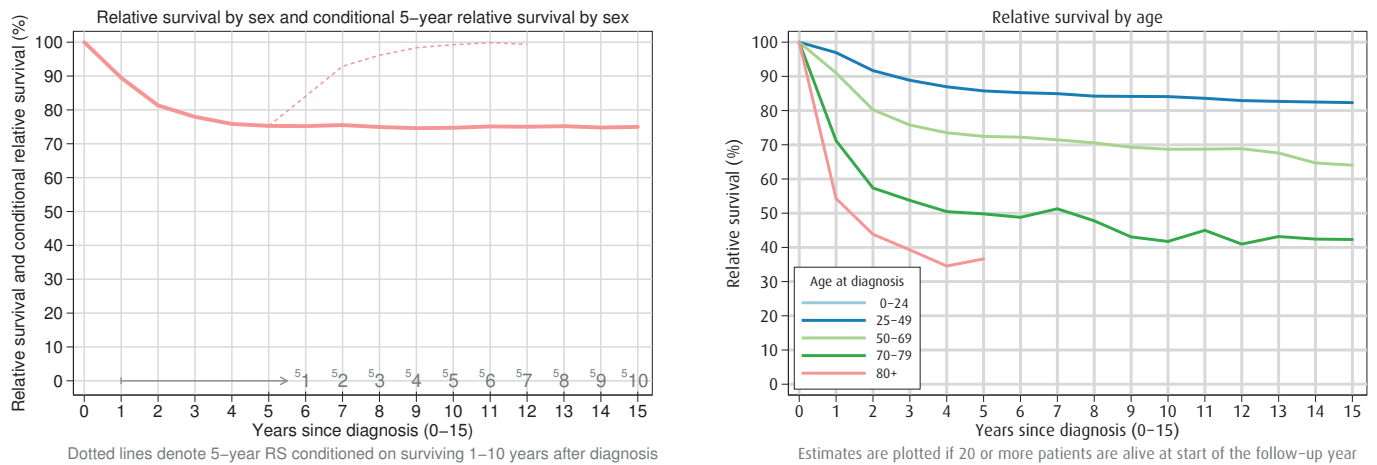


Figure 9N: Corpus uteri (ICD-10 C54)

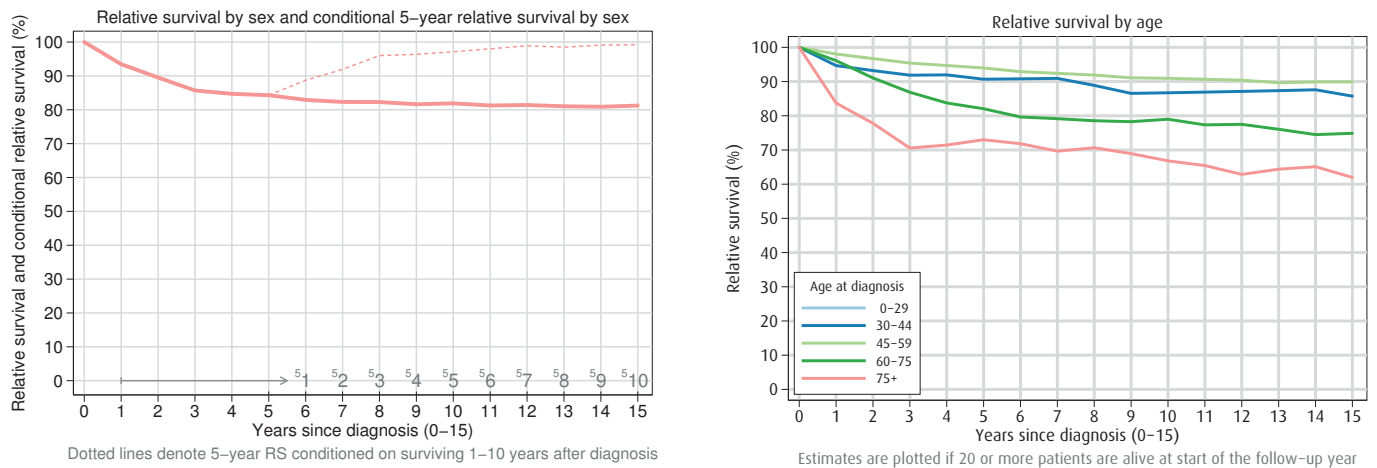
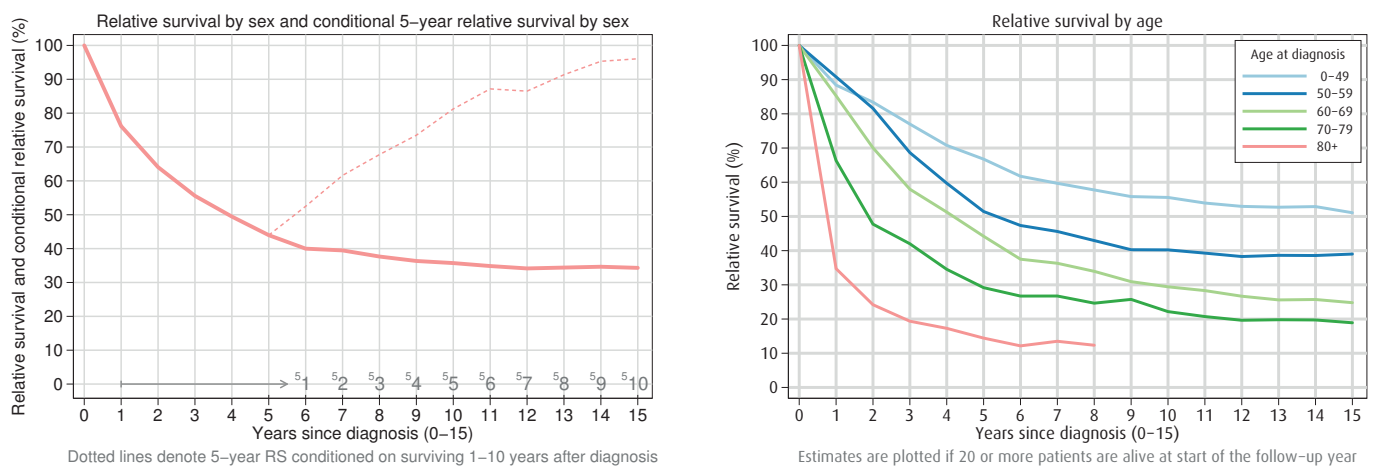


Figure 9O: Ovary (ICD-10 C56)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9P: Prostate (ICD-10 C61)

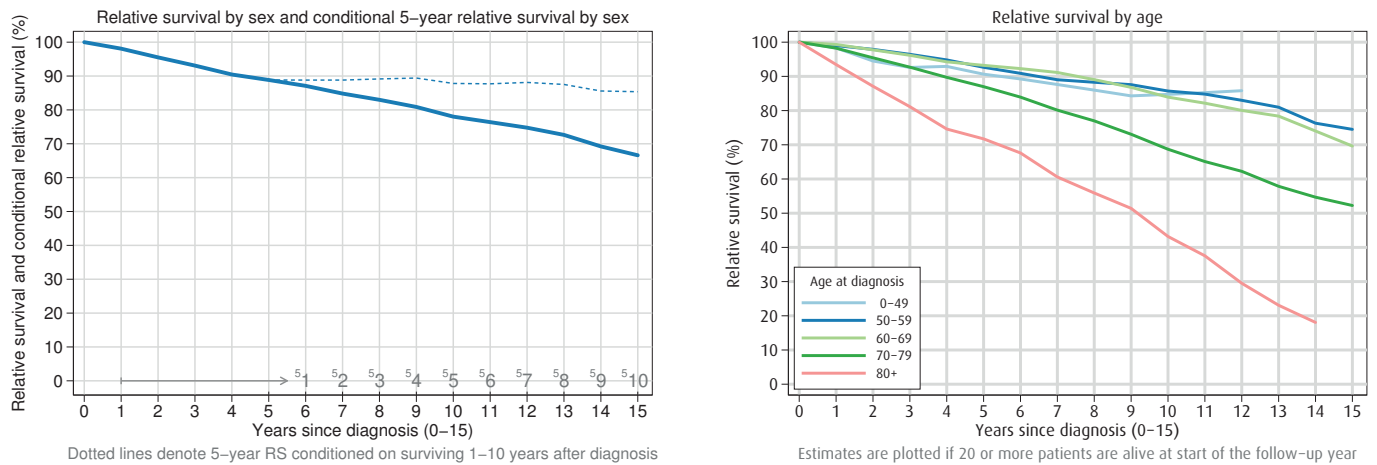


Figure 9Q: Testis (ICD-10 C62)

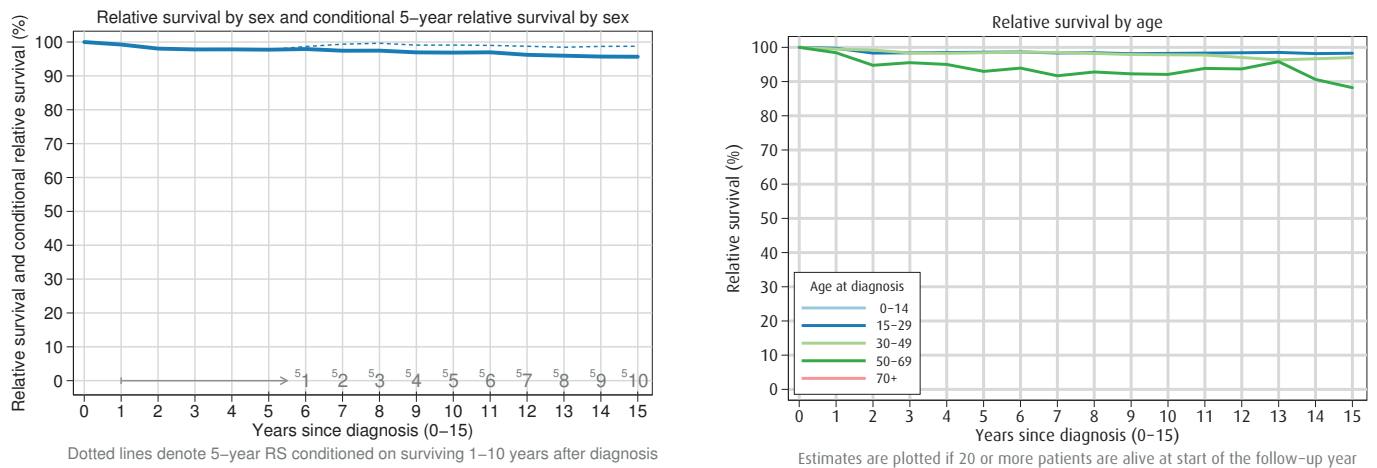
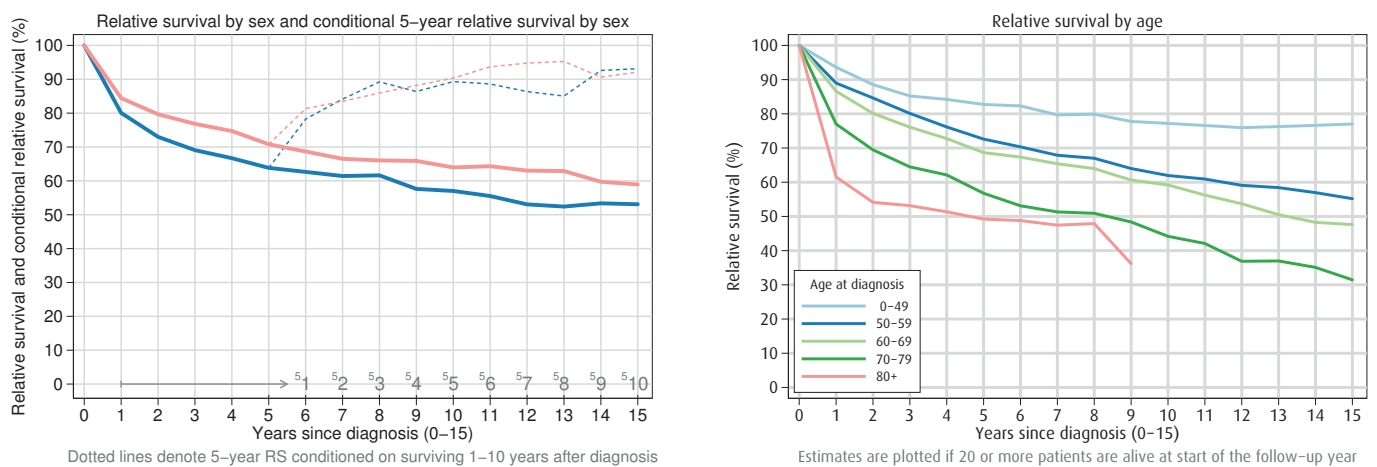


Figure 9R: Kidney excluding renal pelvis (ICD-10 C64)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9S: Bladder, ureter, urethra (ICD-10 C66–68)

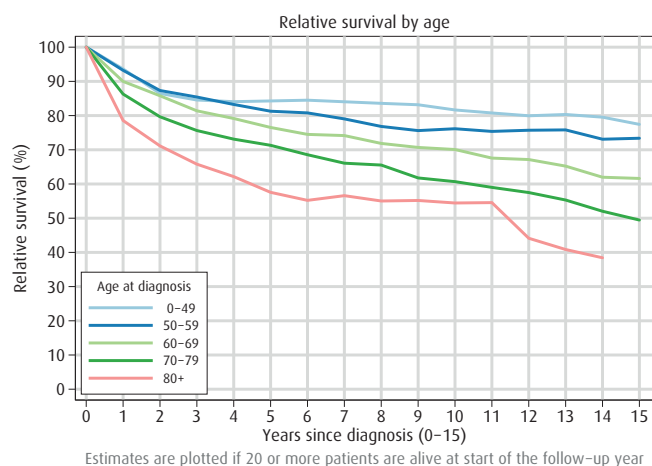
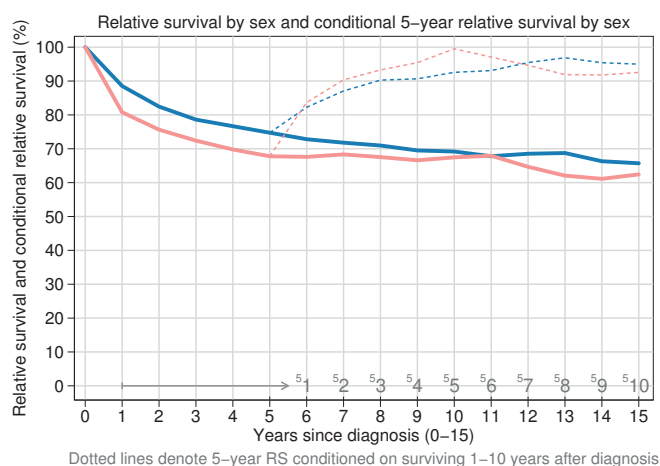


Figure 9T: Central nervous system (ICD-10 C70–72, D42–43)

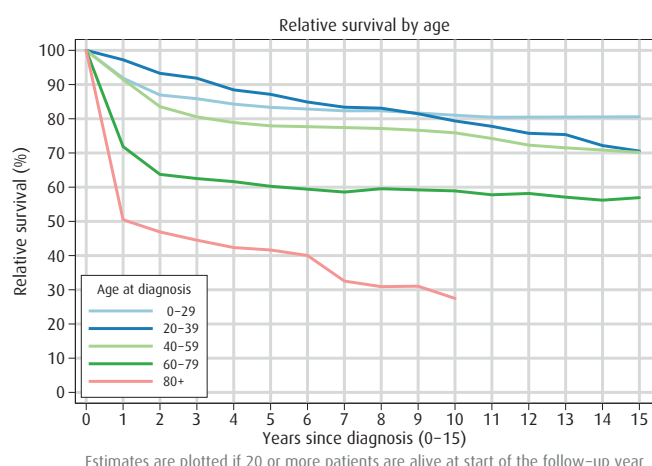
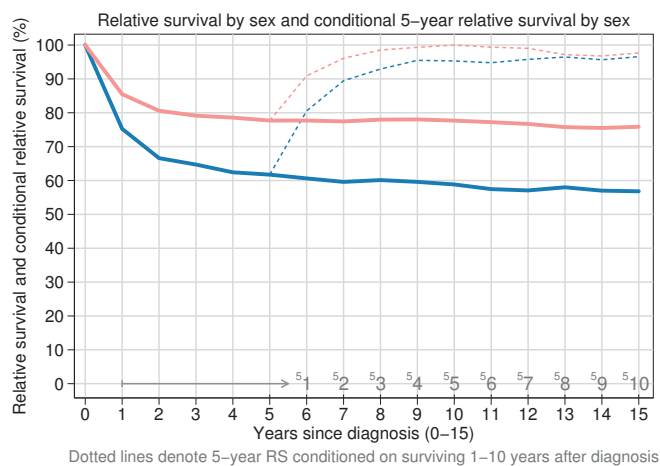
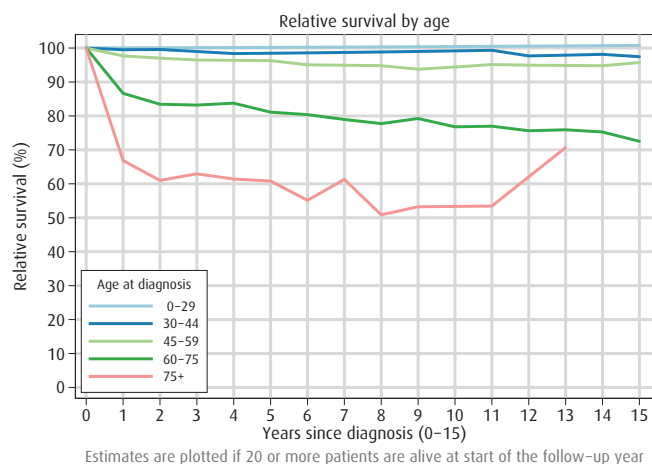
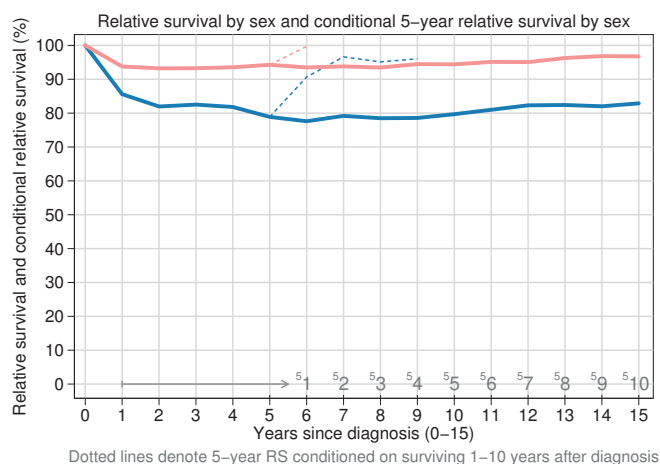


Figure 9U: Thyroid gland (ICD-10 C73)



Relative survival (RS) up to 15 years after diagnosis by sex and age (2007–9)

Figure 9V: Hodgkin lymphoma (ICD-10 C81)

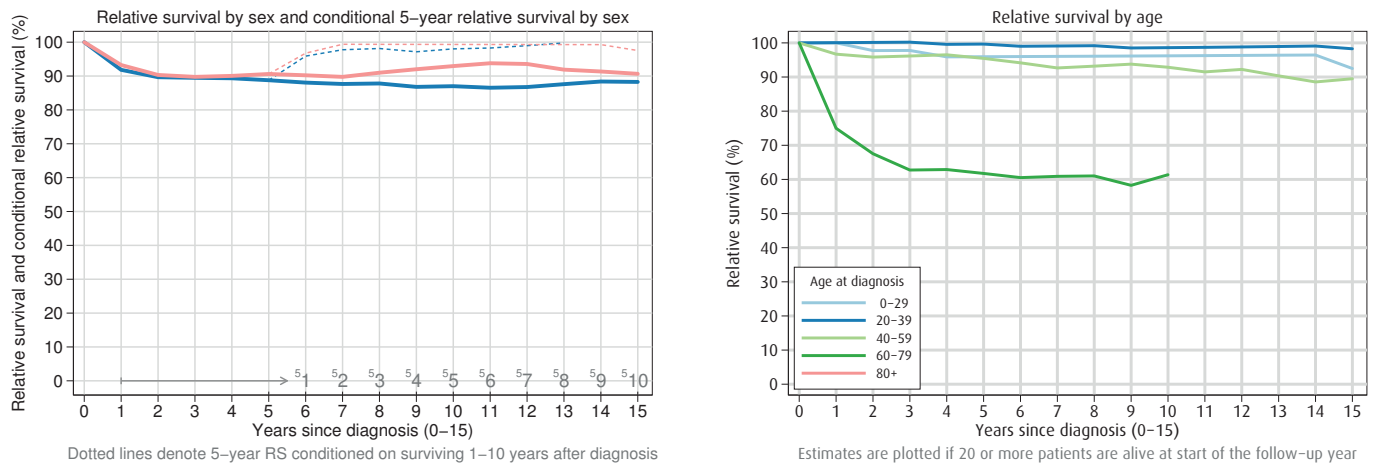


Figure 9W: Non-Hodgkin lymphoma (ICD-10 C82–85, C96)

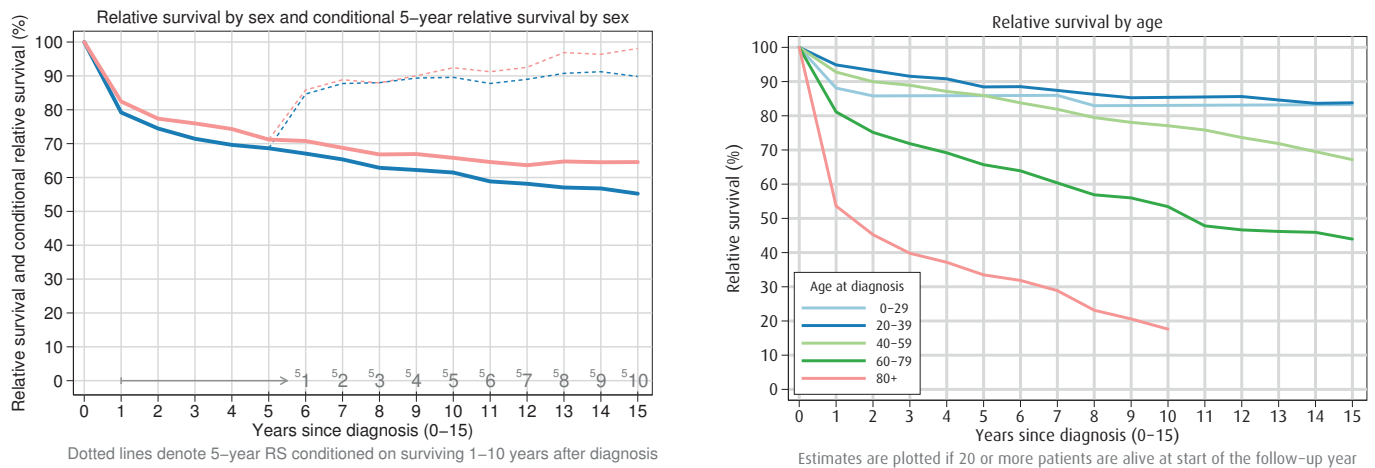
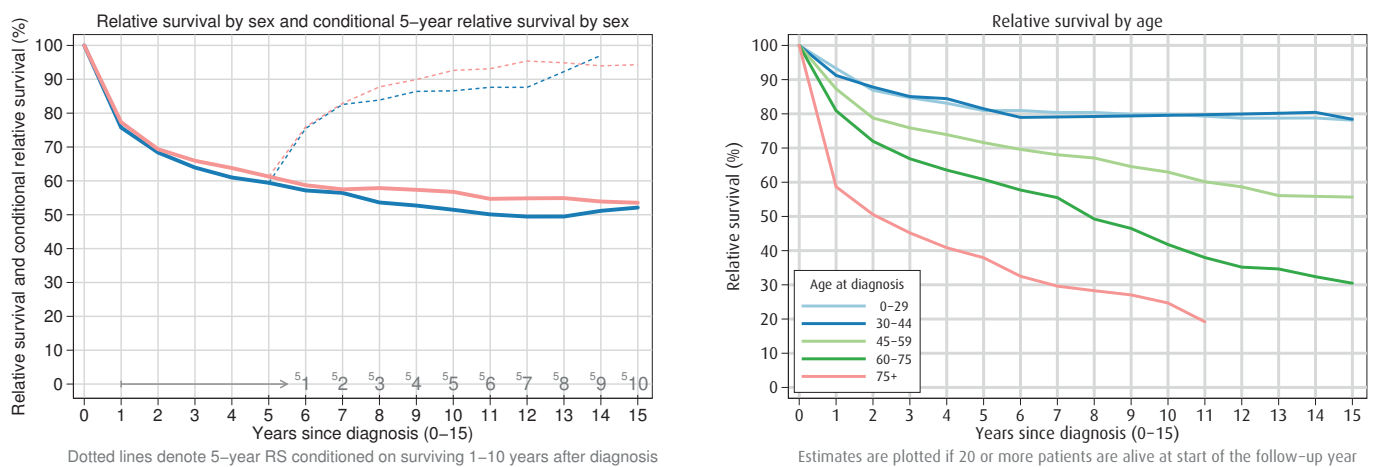


Figure 9X: Leukaemia (ICD-10 C91–95)



Prevalence

As of 31 December 2009, nearly 200 000 persons were alive and previously diagnosed with cancer in Norway. The cancer prevalence in Table 20 provides the numbers of cancer survivors a given number of years after diagnosis (<1, 4-9, 5-9 and ≥10 years), and approximates the number of patients in Norway (of both sexes) potentially requiring some form of cancer care. Breast, colorectal and prostate cancer, commonly-diagnosed cancers with reasonable 5-year patient survival, have the highest 10-year prevalence in Norway.

The 8 917 persons alive and diagnosed with melanoma of the skin 10 or more years after diagnosis ranks second only to breast cancer (14 371 persons), while the prevalence of melanoma is eleven times that of lung cancer (797 persons). Differences in prognosis - rather than incidence - may explain much of the site-specific variability in prevalence. Lung cancer in terms of new cases, for example, doubles that of melanoma in Norway, and the considerably higher melanoma prevalence reflects the vast differentials in survival between the two cancers.

Table 20 Prevalence of cancer 31.12.1999 and 31.12.2009, both sexes

ICD10	Site	Total no. of persons alive		Years after diagnosis			
		31.12.99	31.12.09	<1	1-4	5-9	10+
C00-96	All sites	138725	199170	19813	58675	46556	74126
C00-14	Mouth, pharynx	3094	3761	433	1162	791	1375
C00	Lip	1345	1287	116	376	210	585
C01-02	Tongue	416	638	95	198	148	197
C03-06	Mouth, other	558	645	87	203	146	209
C07-08	Salivary glands	382	473	32	123	104	214
C09-14	Pharynx	436	775	116	293	190	176
C15-26	Digestive organs	22577	30150	3956	9607	7057	9530
C15	Oesophagus	211	351	130	127	53	41
C16	Stomach	2199	1951	307	538	367	739
C17	Small intestine	396	738	123	258	194	163
C18	Colon	12120	16657	1939	5420	4000	5298
C19-21	Rectum, rectosigmoid, anus	7369	9856	1093	3103	2420	3240
C22	Liver	144	252	75	86	28	63
C23-24	Gallbladder, bile ducts	226	308	73	104	53	78
C25	Pancreas	363	601	267	194	75	65
C26	Other digestive organs	85	147	45	36	39	27
C30-34, C38	Respiratory organs	4404	6382	1631	2314	1133	1304
C30-31	Nose, sinuses	253	294	26	110	59	99
C32	Larynx, epiglottis	991	1081	97	322	276	386
C33-34	Lung, trachea	3125	4987	1505	1881	804	797
C38	Mediastinum, pleura (non-mesothelioma)	47	51	13	12	2	24
C40-41	Bone	469	670	59	132	118	361
C43	Melanoma of the skin	12518	17611	1344	3981	3369	8917
C44	Skin, non-melanoma	7657	11829	1488	4221	2922	3198
C45	Mesothelioma	57	100	52	37	4	7
C46	Kaposi's sarcoma	99	87	7	21	16	43
C47	Autonomic nervous system	229	251	10	36	31	174
C48-49	Soft tissues	910	1237	142	322	221	552
C50	Breast	25108	35966	2649	9615	9331	14371
C51-58	Female genital organs	17736	20458	1365	4289	3950	10854
C53	Cervix uteri	6721	6770	276	911	1004	4579
C54	Corpus uteri	6501	8660	663	2173	1998	3826
C55	Uterus, other	43	41	4	6	13	18
C56	Ovary	3681	4053	335	929	748	2041
C51-52, C57	Other female genital	934	1121	108	335	252	426
C58	Placenta	129	143	1	11	13	118
C60-63	Male genital organs	19011	36100	4408	14385	9554	7753
C61	Prostate	14812	29804	4070	13226	8292	4216
C62	Testis	3945	5978	315	1072	1191	3400
C60, C63	Other male genital	298	426	41	143	99	143
C64-68	Urinary organs	11775	15475	1709	4851	3753	5162
C64	Kidney excl. renal pelvis	2899	4482	545	1530	1065	1342
C65	Renal pelvis	429	533	68	155	117	193
C66-68	Bladder, ureter, urethra	8619	10724	1148	3268	2621	3687
C69	Eye	759	920	63	187	183	487
C70-72, D42-43	Central nervous system	5335	9686	798	2752	2441	3695
C73	Thyroid gland	3311	4270	228	754	739	2549
C37, C74-75	Other endocrine glands	1446	2653	221	757	587	1088
C39, C76, C80	Other or unspecified	475	560	138	169	90	163
C81-96	Lymphoid and haematopoietic tissue	9392	15821	1855	5288	3658	5020
C81	Hodgkin lymphoma	1489	2143	116	399	446	1182
C82-85, C96	Non-Hodgkin lymphoma	4131	6654	759	2157	1590	2148
C88	Malignant immunoproliferative diseases	226	354	36	147	97	74
C90	Multiple myeloma	1051	1498	273	716	312	197
C91-95, D45-47	Leukaemia	2505	5251	695	1906	1229	1421

Trends in Incidence, Mortality and Survival, Norway 1965-2009

There has been considerable discussion as to the relative merits of incidence, mortality and survival in cancer research generally, and in time trend analyses specifically (Peto *et al.*, 2000; Doll and Peto, 1981; Coleman, 2000; Boyle, 1989). Analysing trends in incidence may provide some insight into changes in the incidence and distribution of risk factors, and to the impact of interventions aimed at prevention and early diagnosis. Mortality rates and survival proportions are both key measures of disease outcome, and may alert us to the beneficial effects of screening, or to the introduction of more effective therapies and better disease management.

The importance of determining artefacts and considering their contribution to observed cancer incidence and mortality trends have been comprehensively addressed by Saxen (Saxen, 1982) and Muir *et al.* (Muir *et al.*, 1994), while many studies have investigated the accuracy of death certificates (e.g. (Percy *et al.*, 1981)). Other than artefacts related to registration practices, many of the factors that affect incidence equally apply to mortality, given that both rely on the accuracy of the initial cancer diagnosis. As with incidence, survival estimates are susceptible to changes in diagnostic practices and disease classifications, as well as the spread of screening tools that detect cases earlier.

There is a general consensus that a combined description of trends in incidence, mortality and survival often serves to confirm and clarify understanding of the underlying biological, epidemiological and clinical processes. As each indicator is subject to unique or shared artefacts that tend to vary according to cancer type over time, their simultaneous assessment often enables the identification of systematic deviations in one or more of the three measures. Figure 10-A to 10-X present annual age-standardised (world) incidence (1965-2009) and mortality (1965-2009) rates together with period-based (3-year window 1965-2009) 5-year relative survival probabilities for all cancers combined and for 23 specific cancer sites. The survival trends are plotted as crude rather than age-adjusted estimates for purposes of consistency; the age-specific numbers were sparse for certain neoplasms for certain years, and thus standardised estimates could not be calculated. It should be noted that these summary measures will often fail to reflect true underlying age-

calendar year interactions for specific cancers, such as differentials in survival and mortality trends by age with respect to calendar time, or the presence of strong birth cohort influences in incidence trends.

The trends for “all sites” in Figure 10-A conveys a general picture of uniform increases in cancer incidence and survival in Norway over the last four decades, coupled with fairly constant mortality trend up until the early-1990s. The decline in mortality that follows is more evident in men than in women. The interpretation of these aggregated estimates is evidently a non-trivial exercise, in that they comprise many different cancer forms variable in terms of their capacity to be diagnosed as well as treated. In combination however, prostate, breast, lung and colorectal cancer represent half of the total incidence and mortality burden, specifically, 48.4% of the new cancers cases in Norway in 2009, and 50.6% of the deaths in 2009.

For men, close to one-third of all cancers diagnosed in 2009 were prostate cancers. The marked increases in both incidence and 5-year relative survival from 1990 (Figure 10-O) reflects the availability of the PSA test and the upsurge in its use in the detection of the disease in a subsequent biopsy. Mortality has declined from around 1996 and both early diagnosis and improved and more active treatment may have had an impact.

Breast cancer among women comprises one-quarter of all female cancer cases. There has been a notable decline in the incidence rate of breast cancer since 2005. The 5-year relative survival has increased in the last two decades, while mortality began declining around 1996 (Figure 10-M). The Norwegian Breast Cancer Screening Programme began screening women aged 50-69 at the end of 1995 as a four-year pilot project in four of the 19 Norwegian counties, and gradually expanded to become national by 2005. The implementation of screening may explain much of the recent year's trend with increases in incidence from the mid-1990s to 2005 with subsequent declining rates and, partly as a consequence of advancing time of diagnosis, the increasing survival. The recent declines in mortality in Norway most likely reflect a number of interventions acting in combination, amongst them

improvements in breast cancer therapy and management from the 1990s, as well as the increasing screening coverage.

Trends in lung cancer incidence and mortality are quite similar and reflect the uniformly poor survival over time, whereas the varying trends by sex reflect the differing phases of the smoking epidemic in Norwegian men and women (Figure 10-J). Overall lung cancer incidence and mortality rates among males began to plateau in the early-1990s, in contrast to the continuing increases in female rates. As these rates are for all ages however, they do not capture a possible recent plateau in trends among generations of women born around 1950. While five-year relative survival for lung cancer patients has not changed substantively, the observation of moderately increasing survival in the 1990s, more evident in women, is intriguing. It is not clear as to the degree to which these changes are real and might reflect genuine improvement of lung cancer management, earlier stage at presentation, less co-morbidity, or changes in other factors that contribute to improved life expectancy.

Both colon and rectal cancer incidence has been increasing for many decades, but the overall picture is one of stabilisation for colon cancer and possibly recent declines for rectal cancer, more evident for men (Figure 10-E and 10-F). Of particular note is the increasing survival and declining mortality following rectal cancer in Norway in both sexes. Among the likely determinants is

the introduction of total mesorectal excision, increasing specialisation, and use of preoperative radiation.

Among specific sites, several are worthy of note. The constant decline in stomach cancer incidence and mortality, for example, is considered part of an unplanned success of primary prevention of the intestinal type, with survival only moderately increasing over time (Figure 10-D). In contrast, the uniform and presently-unexplained increases in testicular cancer incidence in the last decades (Figure 10-Q) are contrary to the rapid increases in survival (and concomitant declines in mortality) in the 1970s following the introduction of cisplatin therapy for advanced germ-cell tumours, and a correspondingly improved prognosis in these young- and middle-aged men.

In summary, the overall trends in cancer survival probably reflect both artifacts (screening and improved diagnostics) as well as improvements in treatment. For prostate and breast cancer both early diagnosis and improvements in treatment are likely to have played a role. The recent increments in rectal cancer survival in both sexes will also have partially contributed to the recently overall decline in cancer mortality. The remaining cancer types also contribute substantially to explaining the overall trends.

Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-A: All sites (ICD10 C00-96)

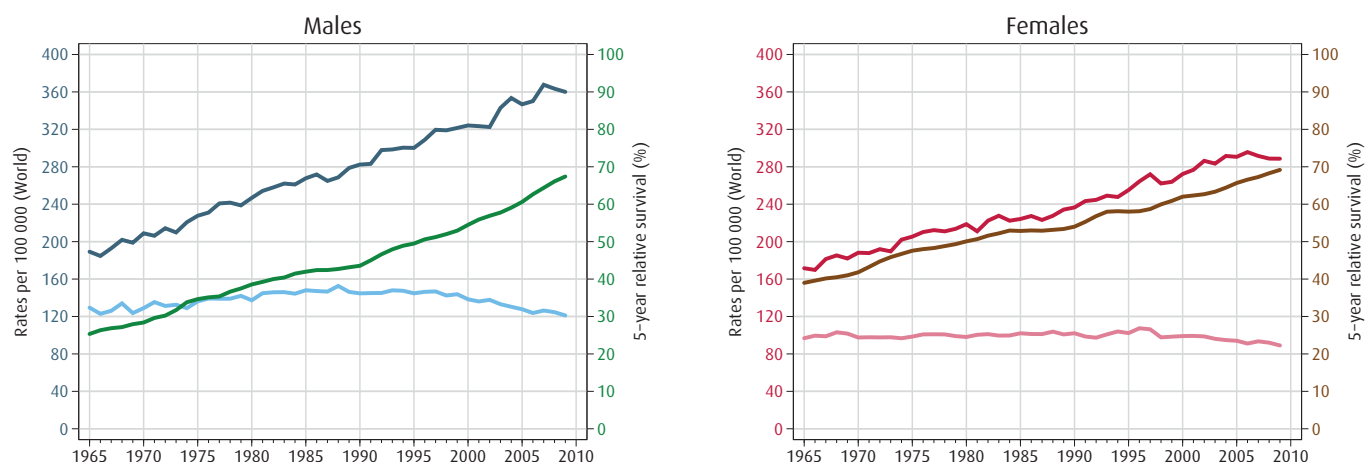


Figure 10-B: Mouth, pharynx (ICD-10 C00-14)

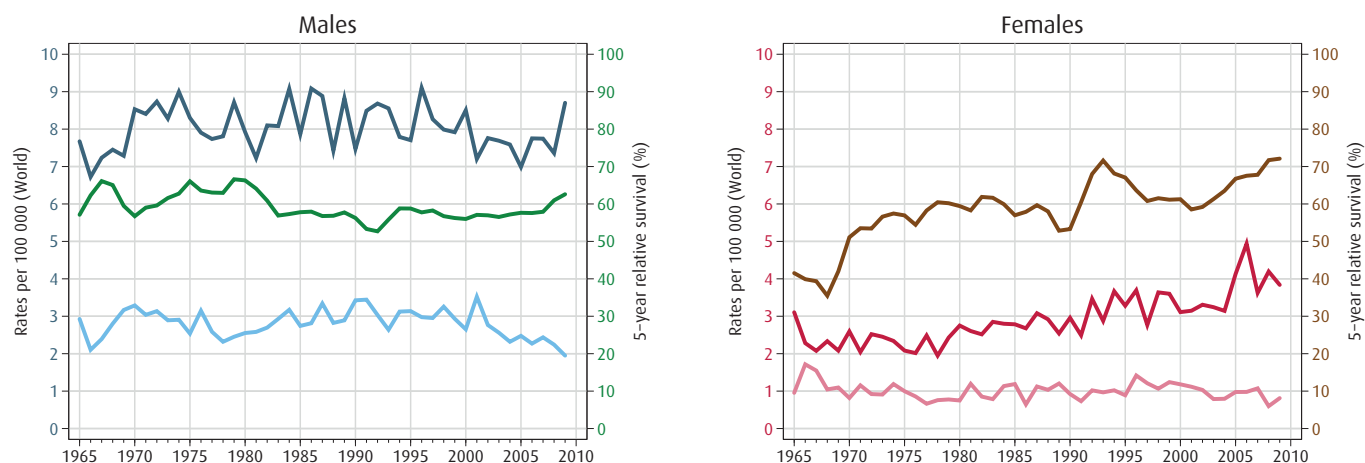
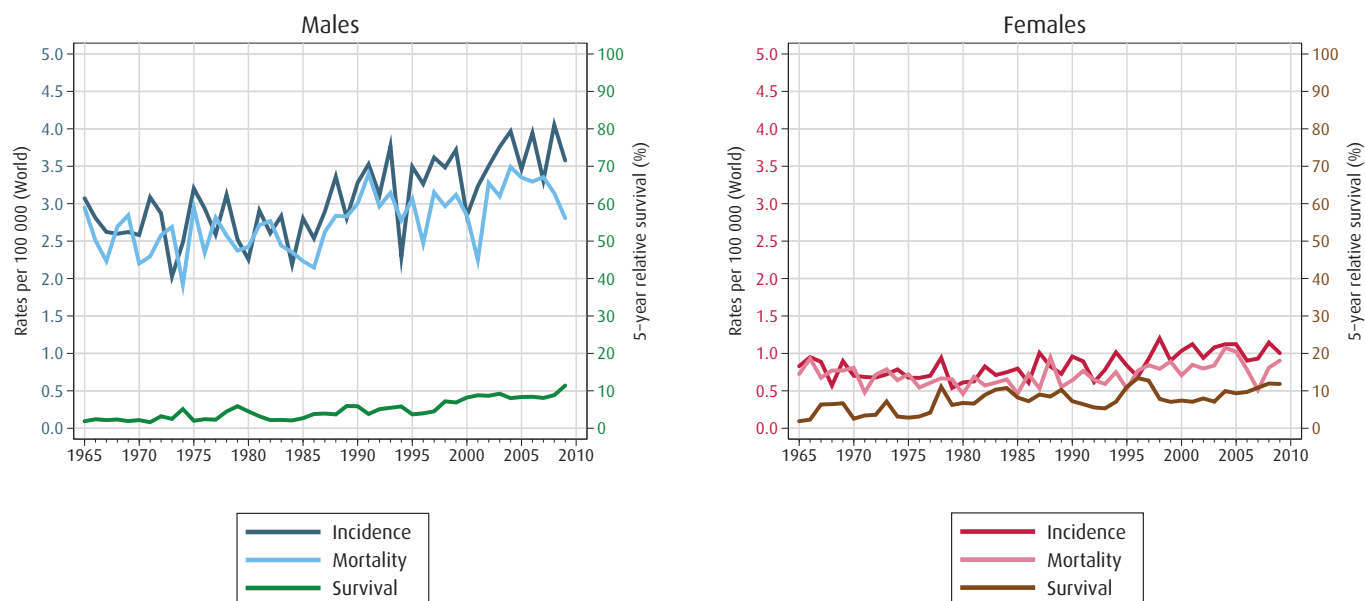


Figure 10-C: Oesophagus (ICD-10 C15)



Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-D: Stomach (ICD-10 C16)

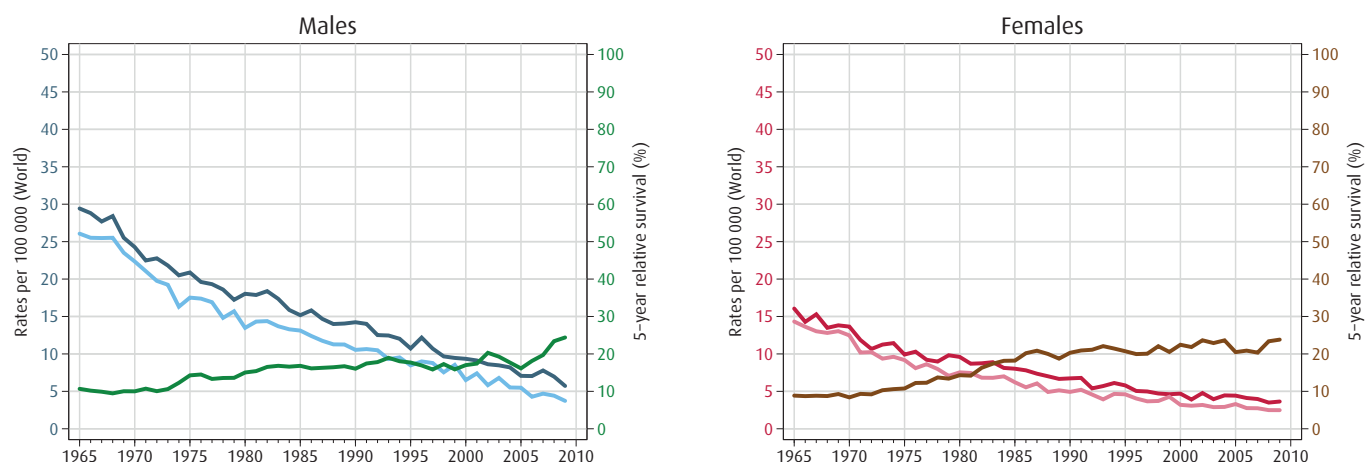


Figure 10-E: Colon (ICD-10 C18)

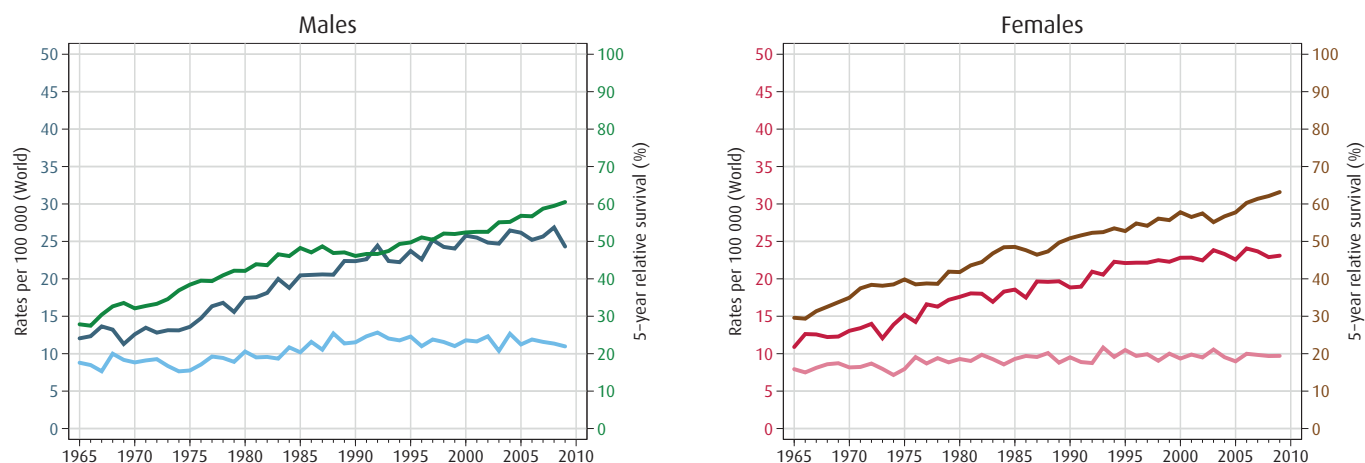
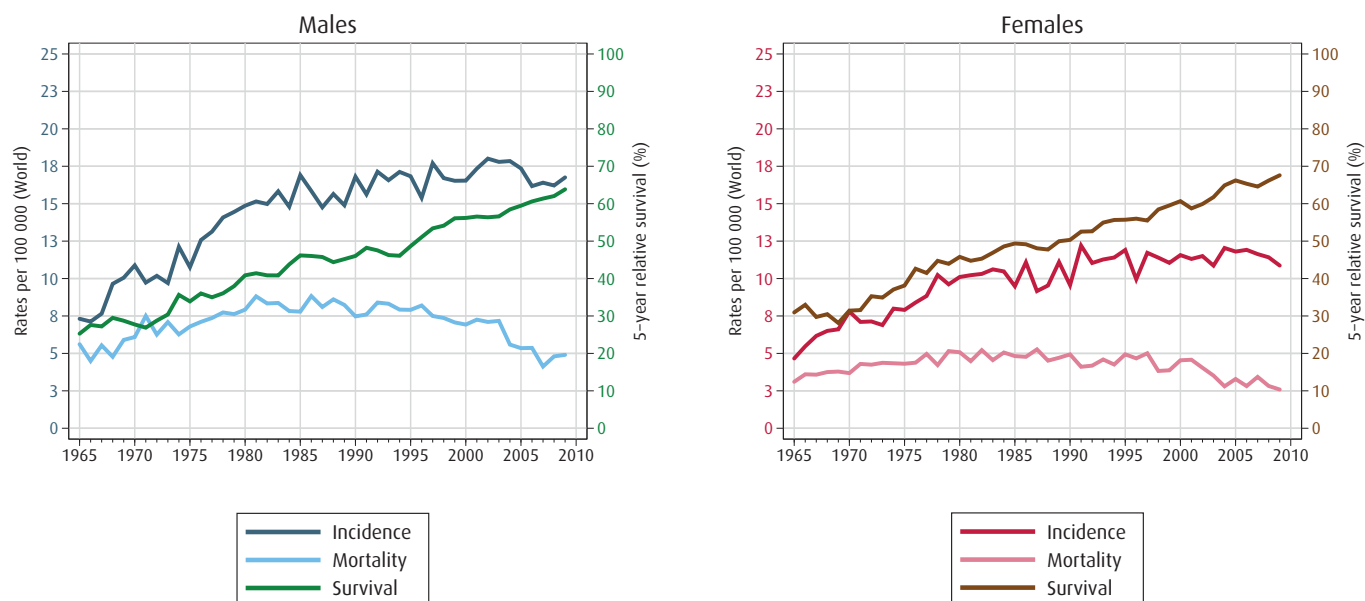


Figure 10-F: Rectum, rectosigmoid, anus (ICD-10 C19-21)



Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-G: Liver (ICD-10 C22)

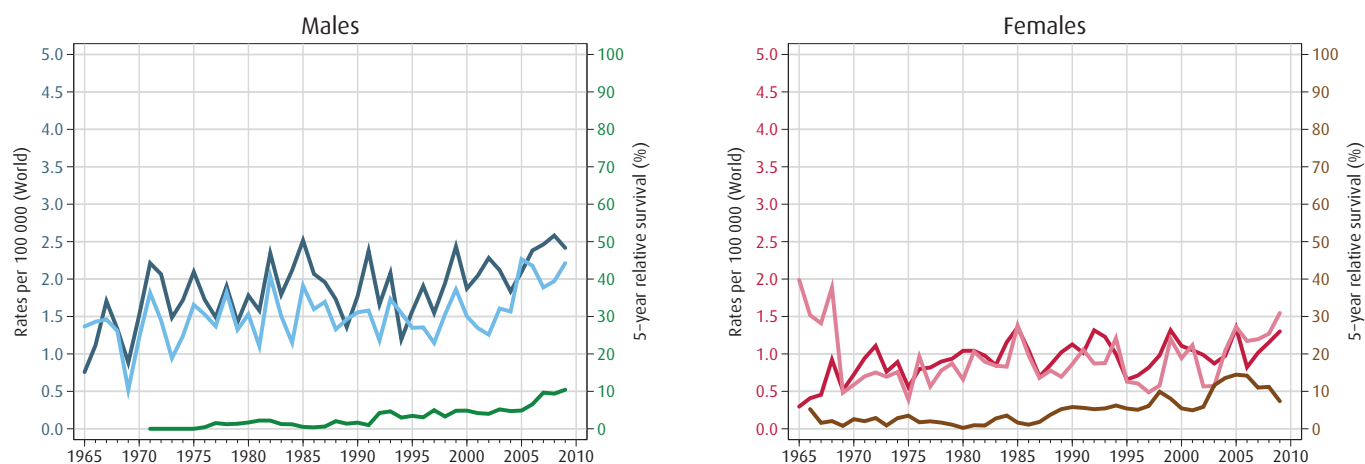


Figure 10-H: Gallbladder, bile ducts (ICD-10 C23-24)

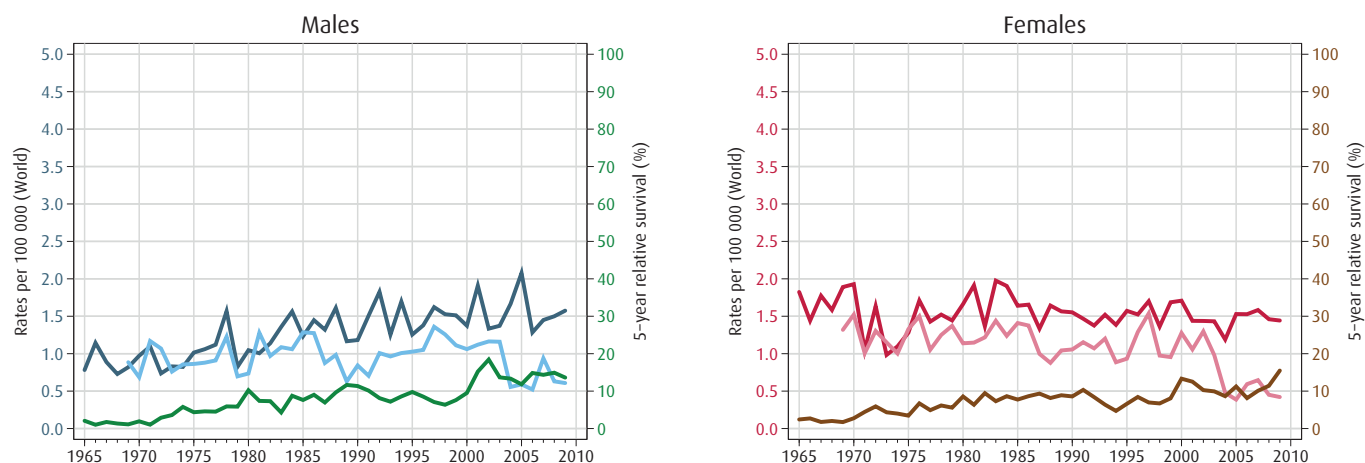
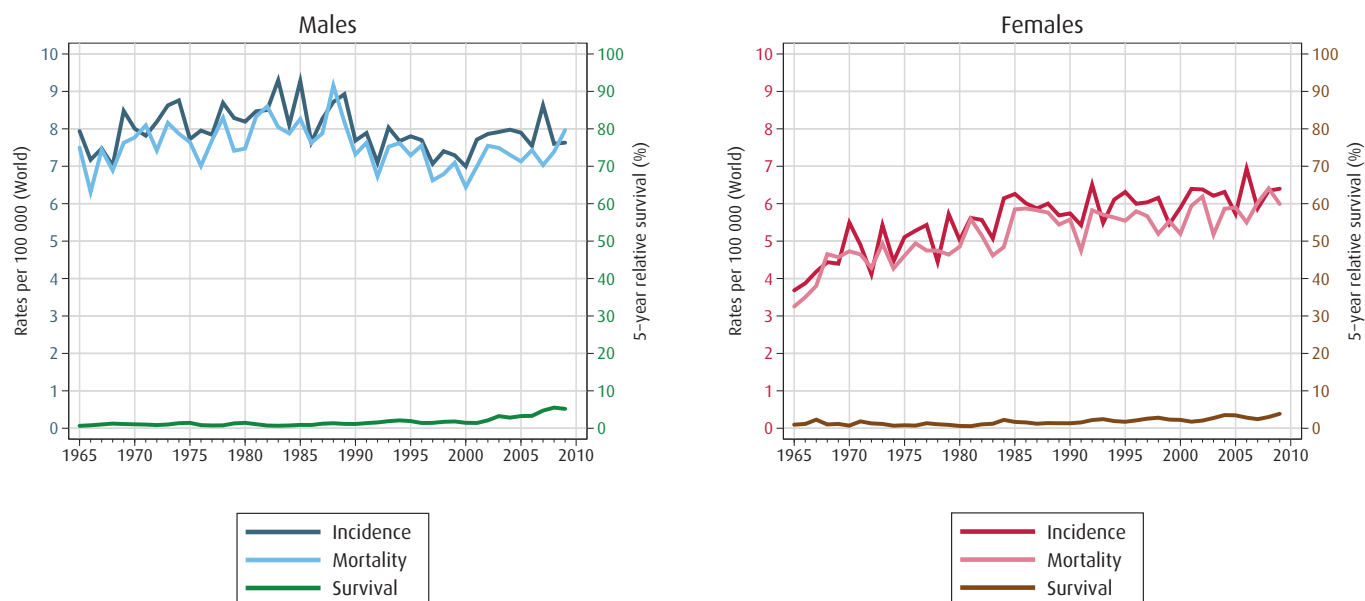


Figure 10-I: Pancreas (ICD-10 C25)



Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-J: Lung, trachea (ICD-10 C33-34)

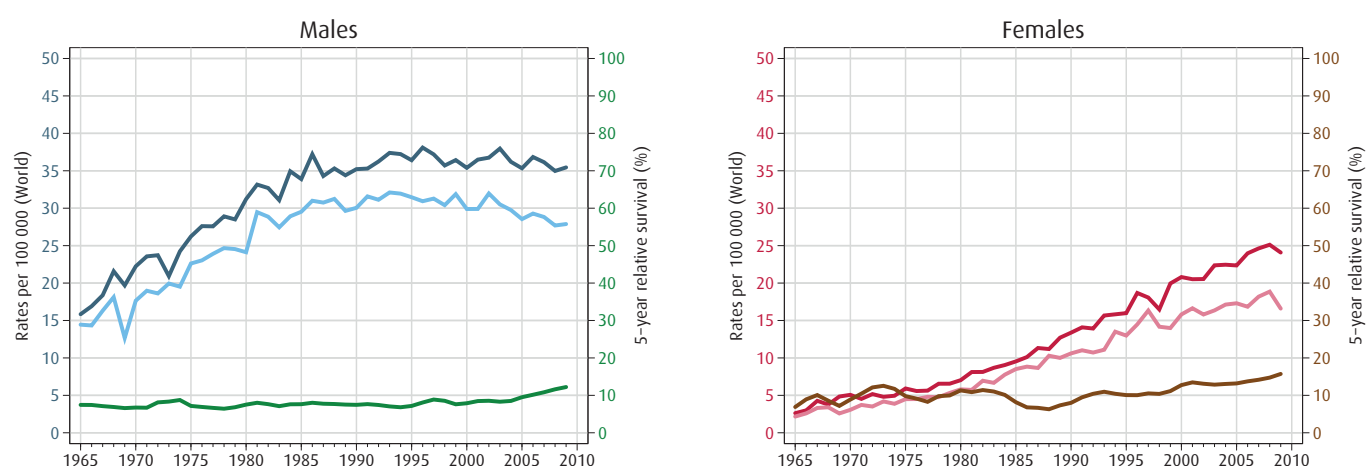


Figure 10-K: Melanoma of the skin (ICD-10 C43)

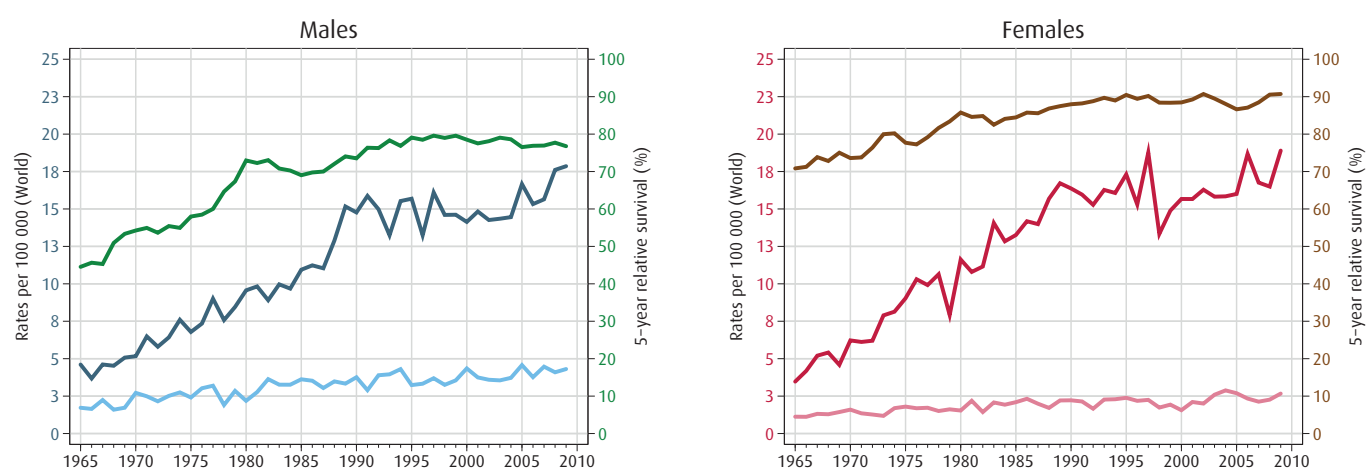
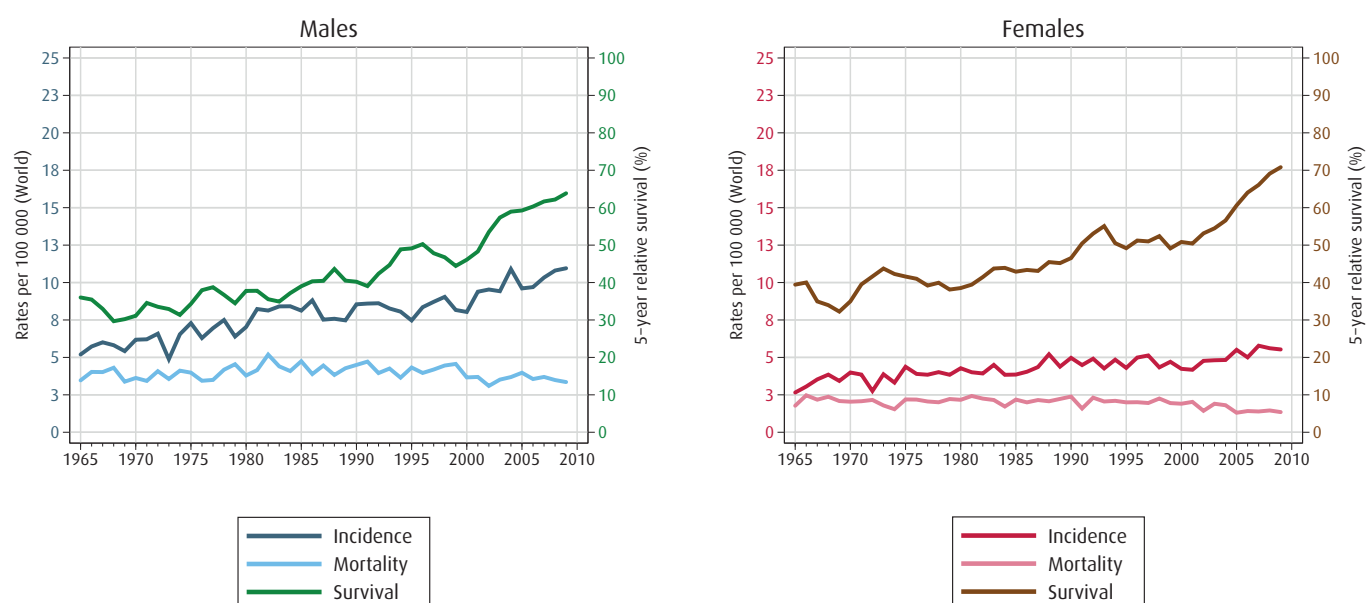


Figure 10-L: Kidney excluding renal pelvis (ICD-10 C64)



Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-M: Breast (ICD-10 C50)

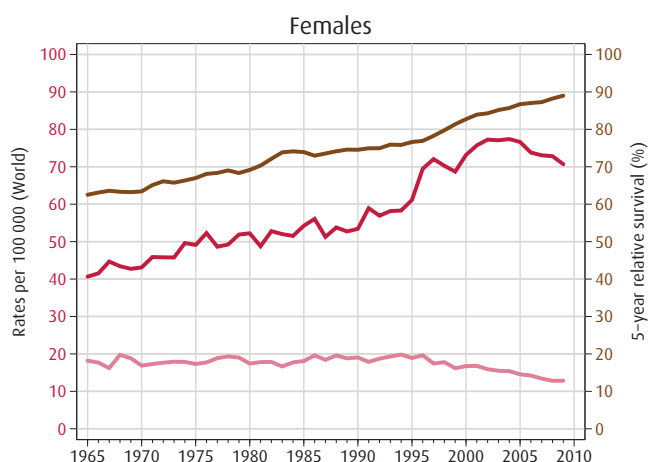


Figure 10-N: Cervix uteri (ICD-10 C53)

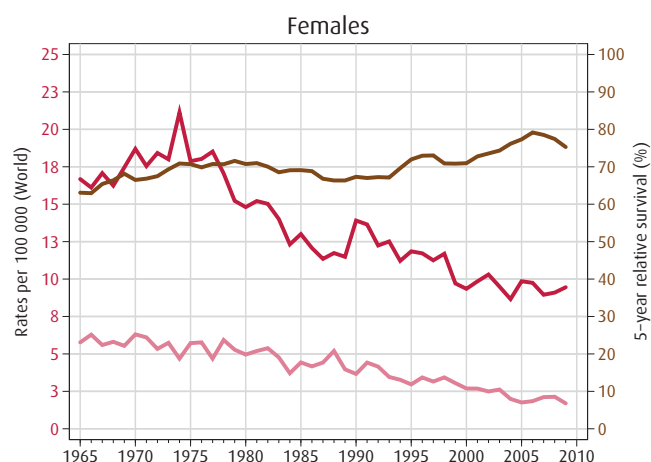


Figure 10-O: Prostate (ICD-10 C61)

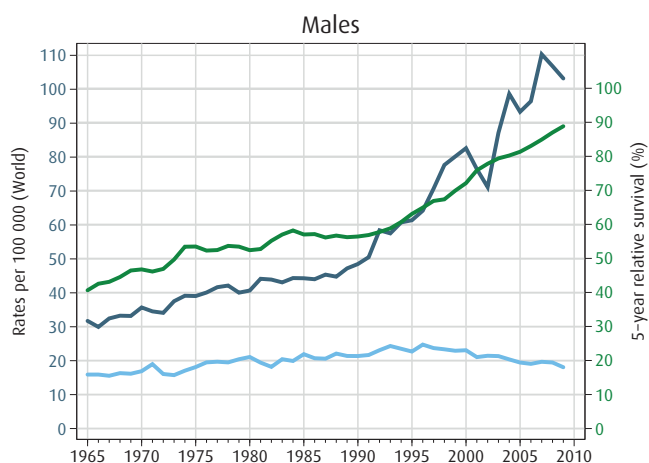


Figure 10-P: Corpus uteri (ICD-10 C54)

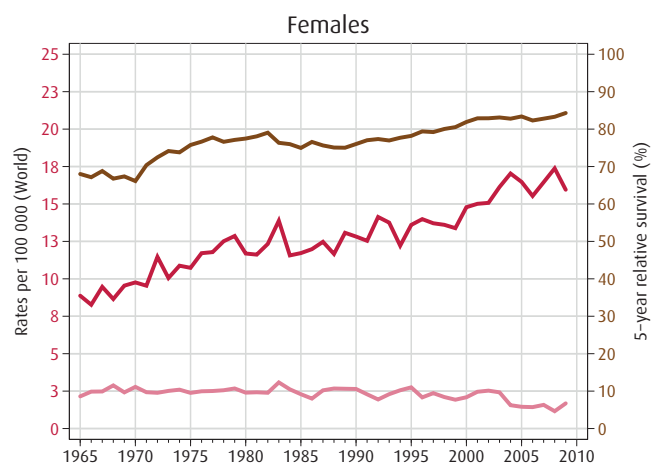


Figure 10-Q: Testis (ICD-10 C62)

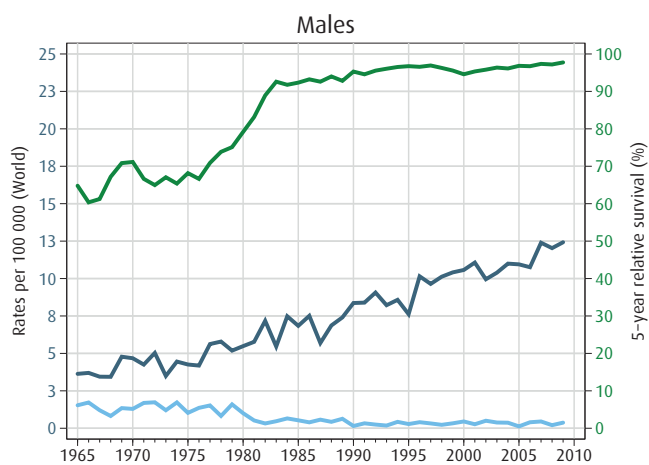
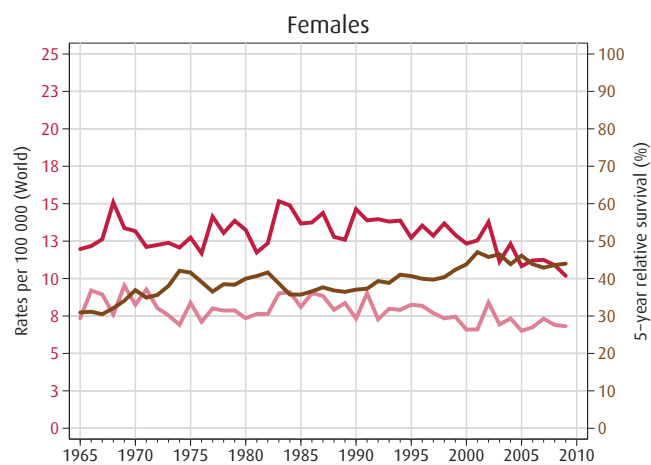


Figure 10-R: Ovary (ICD-10 C56)



— Incidence
— Mortality
— Survival

— Incidence
— Mortality
— Survival

Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-S: Bladder, ureter, urethra (ICD-10 C66-68)

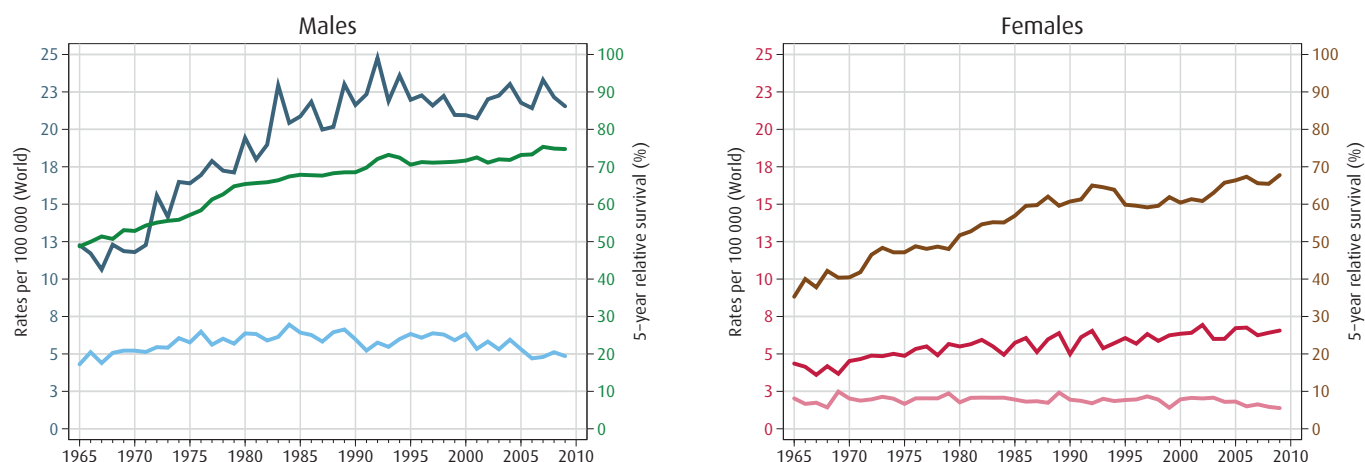


Figure 10-T: Central nervous system (ICD-10 C70-72, D42-43)

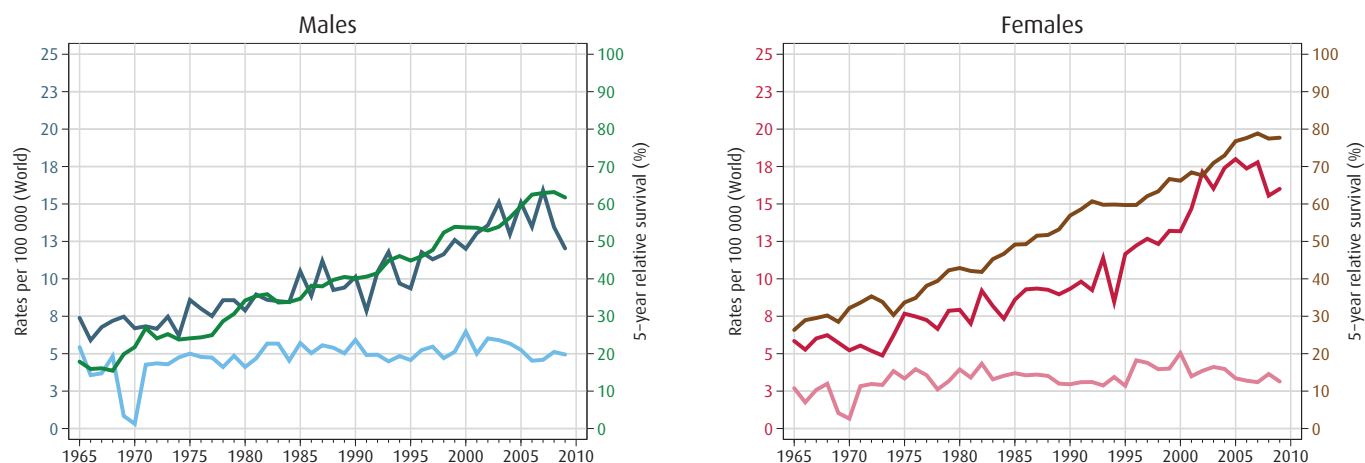
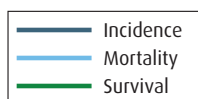
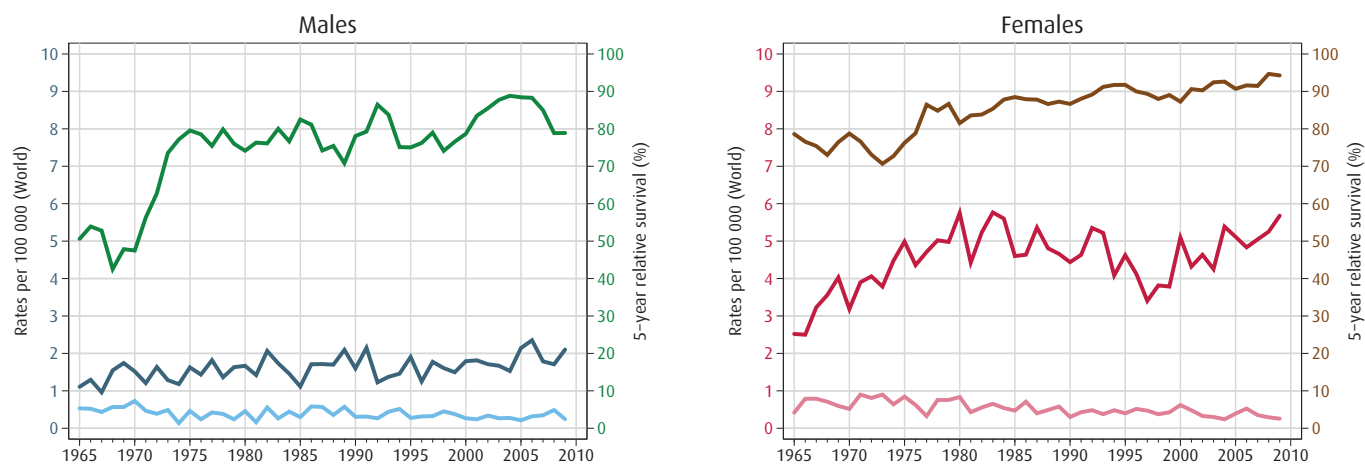


Figure 10-U: Thyroid gland (ICD-10 C73)



Trends in incidence and mortality rates and 5-year relative survival proportions

Figure 10-V: Hodgkin lymphoma (ICD-10 C81)

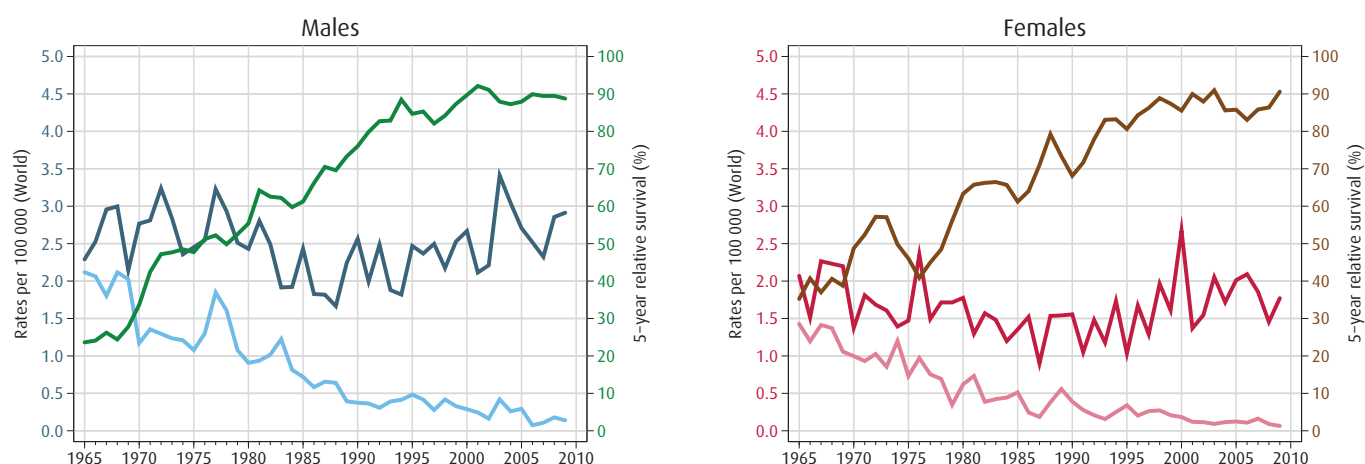


Figure 10-W: Non-Hodgkin lymphoma (ICD-10 C82-85, C96)

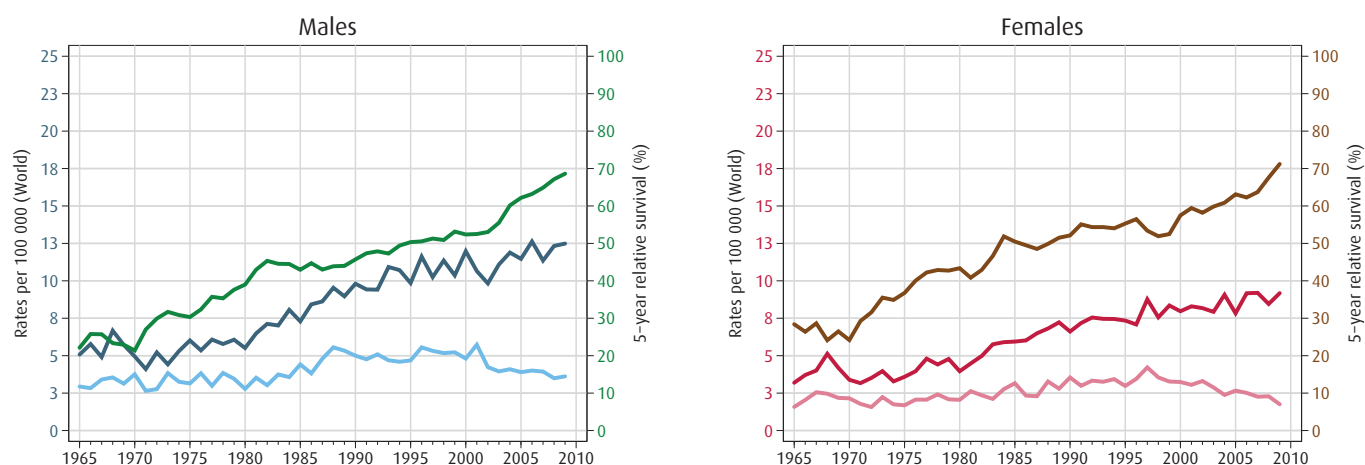
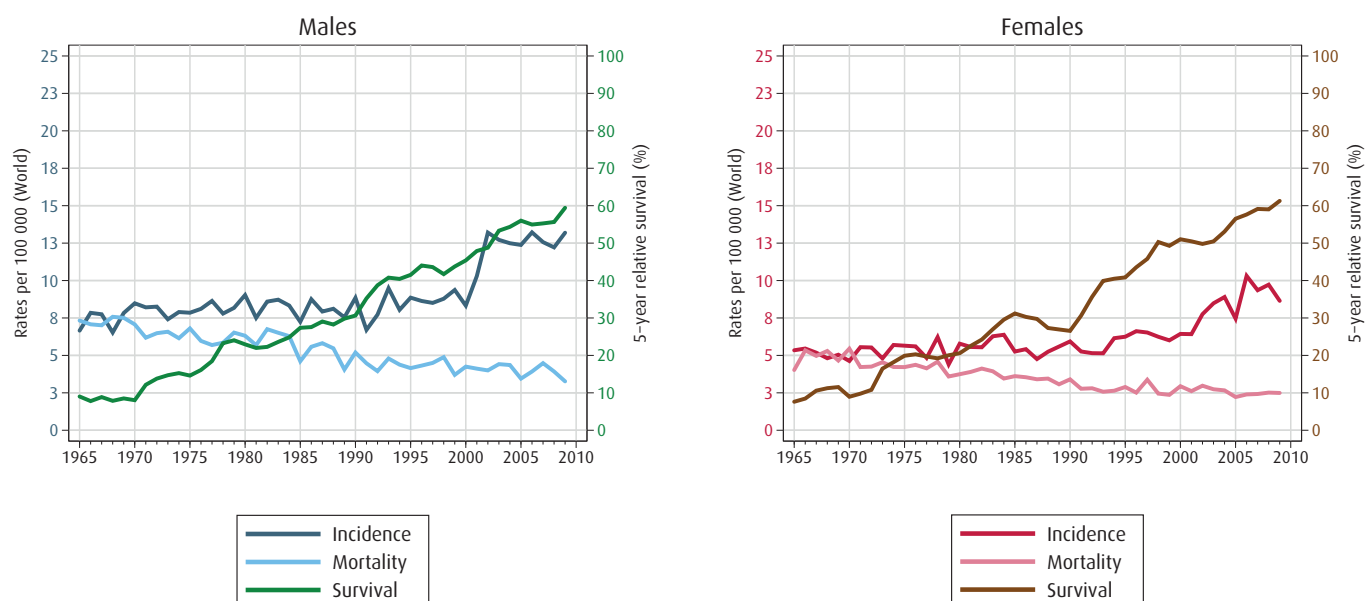


Figure 10-X: Leukaemia (ICD-10 C91-95)



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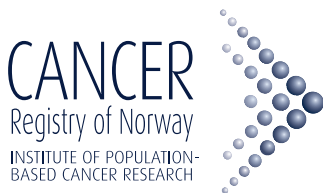
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Research activities at the Registry

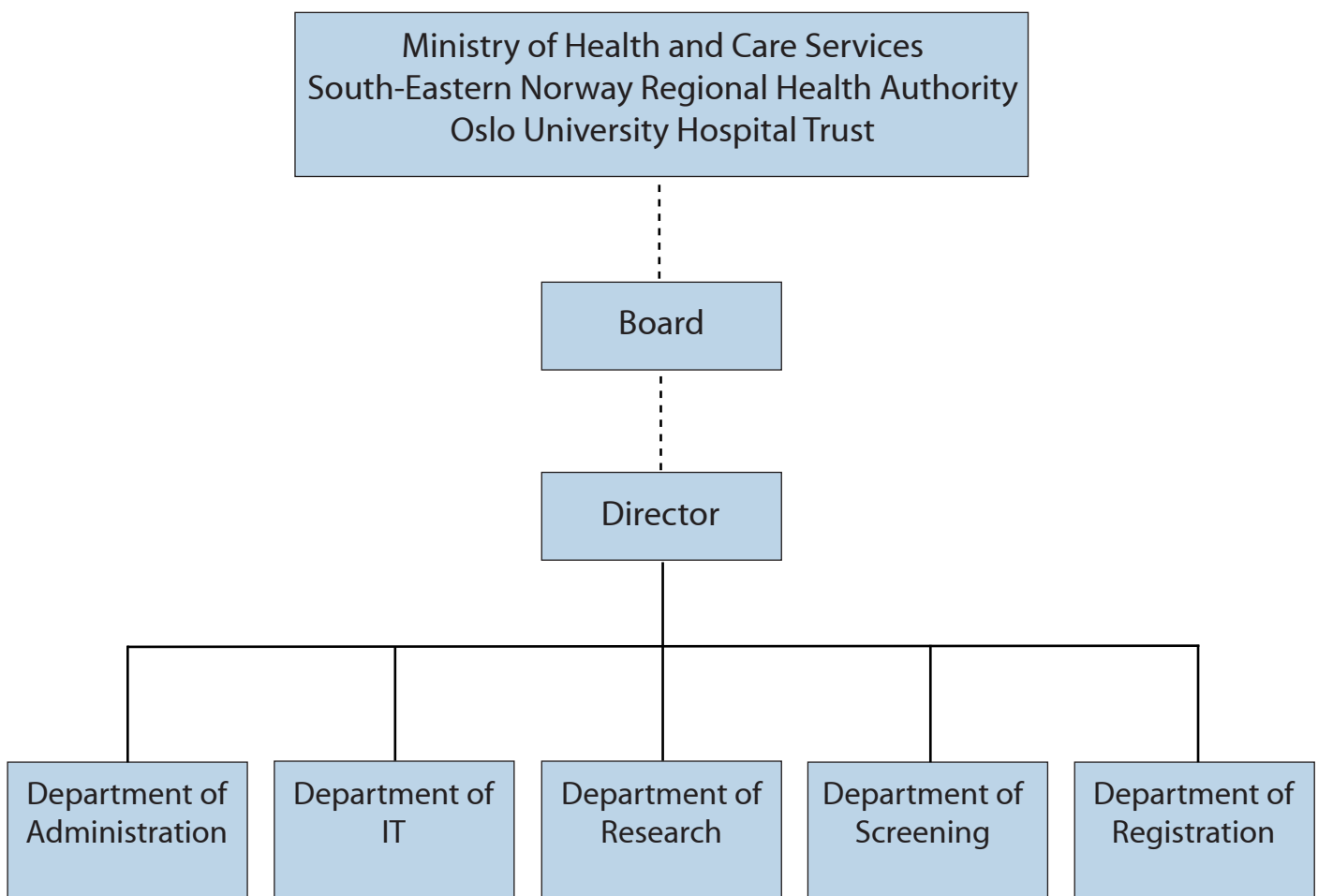
Organisation and founding principles

The Cancer Registry of Norway is a national, population-based cancer research institute, which was founded and financed by the Cancer Society 1951-1979. Since then the institution has been governmental, with a board (except for the period 1994-2002) and a chapter in the National Budget plan. Since 2002 it has been allied to the Norwegian Radium Hospital and from 2009 to Oslo University Hospital Trust. This organisational platform signals the importance attached to close links with cancer research milieus and cancer clinics. It also increases the possibilities for Norway as a nation to move towards the Comprehensive Cancer Centre organisational model.

As early as 1951, reporting of cancer and some precancers has been mandatory from all milieus that diagnose and treat cancer. From 2002 however, new regulations have strongly enforced the legal premises, substantially improving the Registry's capacity to perform clinical population-based research and evaluate the quality control of health care. Comparative advantages are compulsory reporting without patients' consent and the uniquely identifying personal number. As a result of these advantages, organ-specific treatment quality registries are increasingly part of the Registry's duties, in close collaboration with the clinical milieus.



Structure of the Cancer Registry of Norway (June 2011)



Department of Research

Leader: Steinar Tretli Professor PhD

Department objectives

The principal goal of the Department of Research is to bring forth new knowledge on carcinogenesis and the causes of cancer. In recent years the Department has covered several topics within epidemiological cancer research, such as: heredity, infectious diseases, biomarkers, occupation, lifestyle, and environmental factors. The main objectives of the Department in years to come, is:

- To initiate/stimulate new research of high quality by use of registry data and biobanks
- To contribute to the development of bio-statistical methods in cancer epidemiology
- To initiate, lead and participate in national and international research collaborations
- To maintain our position as a leading research milieu on cancer epidemiology in Norway

Current research priorities

Research on long-term effects of exposures during fetal life, childhood, youth and adult life ("life course epidemiology") will have high priority in the department. Several of our studies have already investigated the impact of early life on adult cancer risk, specifically for hormone-related cancers such as breast, prostate, and testicular cancer. Studies on cancer development related to life style and environmental and societal factors will also be emphasized. This life course epidemiology will often include the study of molecular, genetic, and hereditary aspects of cancer development, in for instance the study of gene-environment interactions.

Research on cancers associated with occupational and environmental exposures has a long tradition in the Department, and the identification and quantification of such risks will still be important. Studies on working populations may often be the only method to obtain knowledge of possible population effects of low-dose exposures. Occupation is also an important classification variable concerning the knowledge on differences in cancer risk by social class.

The understanding of the carcinogenic process has traditionally been based on experimental, clinical, and epidemiological research. New bio-statistical methods have been developed in recent years in order to assess the importance of different mechanisms in the disease process. Currently, the Department is focusing on research related to statistical modeling and simulation. Biorepositories have become an important resource in medical research. The most important aspect of biobank operations is to evaluate the quality of the biospecimens.

In the Department, this research is related to the JANUS serum bank with studies on the quality of the samples and the component stability in relation to long time storage. The Janus serum bank is utilised in a large number of national and international research collaborations. Cancer survivorship is a relatively new research area, and the Norwegian registries are very well suited for this kind of research. In the Department, studies on marriage, divorce, parenthood and employment and earnings among cancer survivors, have been performed. These studies have received much attention internationally.

Recent important results

In 2009, the research activity at the department led to 43 scientific publications in national and international journals, some from international collaborations. In addition, one doctoral dissertation was defended in 2009. Furthermore, a report was published on cancer incidence among workers at Sola oil refinery and among residents in the surrounding area.

Theses published in 2009

Syse A. Life after cancer – A registry-based study of the social and economic consequences of cancer in Norway. Faculty of Medicine, University of Oslo, 2009.

Department of Screening

Leader: Rita Steen MD PhD

Department objectives

The Screening Department at the Cancer Registry of Norway administers two programs for early detection of cancer and premalignant disease, the Breast Cancer Screening Program and the Cervical Cancer Screening Program. Women aged 25-69 years are recommended to undergo cervical cytology examination every third year, and all women aged 50-69 years are offered mammography screening every two years. The Cervical Cancer Screening Program sends a personal letter to women aged 25-69 whom have not had a cervical cytology examination in the last three years, with a recommendation to take a test. Invitation to mammography screening is sent to eligible women, together with a scheduled appointment for examination. The Screening Department monitors the programs' effectiveness and efficacy by examining early quality indicators (e.g. coverage/attendance, detection rate, tumour stage for breast cancer, and stage of premalignant lesions of the cervix), as well as changes in rates of cancer incidence and mortality. The main objective of the Norwegian Breast Cancer Screening Program is to reduce mortality from breast cancer with 30%. For the Cervical Cancer Screening Program, the main objective is to achieve a reduction of 50% in the incidence and mortality rates of cervical cancer compared to the rates prior to the program launch. The most important factor determining the success of these screening programs is high coverage. In 2008, coverage was 75% in the Cervical Cancer Screening Programme, and the attendance rate was also 75% in the Breast Cancer Screening Programme, raising expectations that the programs will accomplish these objectives.

In 2009 the Screening Department included a research group working with studies of Human Papilloma Virus (HPV) related diseases, which participates in monitoring the effect of the prophylactic vaccine against four HPV types 6/11/16/18 (Gardasil™) in the Nordic countries. The research includes studies of incidence, prevention, natural history and development of cancer related to HPV infection. These studies are financed by MSD/Merck.

Registries at the Department of Screening

For administration of the screening programs several registries have been established.

Screening registries per June 2011:

Name:	Date of launch
Mammography Screening Registry	20.11.1995
Cervical Cytology Registry	01.11.1991
Cervical Intraepithelial Lesion Follow up and Treatment Registry (CIN Registry)	01.01.1997
Cervical Histology Registry	01.01.2002

Current Research Priorities

The current research priorities of the Cervical Cancer Screening Program are:

- Evaluation of the CIN (cervical intraepithelial neoplasia) register, a follow-up register with data on treatment, established in 1997
- Study of the impact of HPV-testing in triage after PAP smear screening on CIN 2+
- Investigate the need for a more individual-orientated approach to Cervical Cancer Screening Program, dependent on vaccination status

The current research priorities of the Breast Cancer Screening Program are:

- Further investigations of early (process) indicators and tumor characteristics in screening.
- Study of the effectiveness of the program in relation to breast cancer survival and mortality
- Study of overdiagnosis associated with the Breast Cancer Screening Program
- Study of breast cancer screening in Norway and the U.S.A. (Vermont)
- Study of hormone therapy and risk of breast cancer

For the Breast Cancer Screening Program, one PhD student is evaluating the Norwegian Breast Cancer Screening Program with regards to DCIS, overdiagnosis and implementation of new technology. Within the Cervical Cancer Screening Program, one PhD student is undertaking a population-based follow-up study on women diagnosed with severe cervical dysplasia in Norway.

The current research priorities of the HPV group are:

- Vaccine impact in Population (VIP) study
- Long Term Follow Up (LTFU) of Gardasil™ vaccine study
- Studies from a survey of lifestyle and health among women
- Quality assurance of registration of pre-invasive lesions in vulva and vagina

Department of Registration

Leader: Bjørn Møller PhD

Department objectives

The Department of Registration has a broad remit.

One of its fundamental responsibilities is the continued collection, storage and quality control of data on all cases of cancer in Norway, as defined by the Statutory Regulations. This information is collected from clinicians, pathologists, administrative patient discharge files, and the Cause of Death Registry.

The Department provides relevant information on cancer patterns and changes in cancer over time in Norway, via various dissemination routes including scientific publications and reports such as the Cancer in Norway series. The Department has put an emphasis on activating and collaborating in good research projects at the national and international level, initiated in-house, or via external requests or invitations, and focusing on building strong ties with the clinical community in Norway.

The Department is organised into two sections, according to the key areas of ongoing activity:

1. Section for Registration. Management of the incidence register and development of the clinical registries. The section is divided into four broader organ groups, which manages all the cancer types within the group. The clinical registries offer novel opportunities for population-based research into cancer care (see below).
2. Section for Research. Research using the incidence register, focusing on areas of particular public health importance alongside the application of appropriate methodologies.

In addition, the department has a medical advisory group, with the responsibility for documentation of quality control, the revision of in-house coding procedures and guidance in medical coding.

Clinical registries

The Statutory Regulations for the Cancer Registry of Norway include the registration of treatment and follow-up of Norwegian cancer patients. Clinical registries – comprehensive registration schemes dedicated to specific cancers – have been established to include detailed information on diagnostic measures, therapy, and follow-up. By fostering strong collaborative links with the clinical community, the aims are to provide an empirical base for scientific studies concerning prognostic factors and treatment outcomes as well as evaluation of quality of cancer care.

The ongoing and expanding activities of these clinical registries are a major focus for the Registry, and several clinical registries are now established. Each clinical register is underpinned by a Reference Group, a panel of multi-disciplinary experts drawn from the clinical and research milieu in Norway, whose remit is to advise on the operations of the registry, and its strategic direction. These newly-established clinical registries will be integrated into the Registry's coding and registration activities. The table below indicates the status of these clinical registries as of June 2011.

Clinical registry for	Clinical reference group established	Established with extended data*	Clinical parameters for electronical report specified	Electronical report form developed
Colorectal cancer	Yes	Yes	Yes	Yes
Malignant melanoma	Yes	Yes	Yes	Yes
Breast cancer	Yes	Yes	Yes	Yes
Prostate cancer	Yes	Yes	Yes	Yes
Lymphoma	Yes	Yes	Yes	No
Lung cancer	Yes	Yes**	Yes	No
Childhood cancer	Yes	Yes***	Yes	No
Ovarian cancer	Yes	Yes****	Yes	No
Leukaemia	Yes	No	Yes	No
Central nervous system	Yes	No	Yes	No
Oesophagus and stomach cancer	Yes	No	Yes	No
Testis cancer	Yes	No	Yes	No

* Either by having a separate clinical report form and/or by having a database with extended information beyond the incidence registry. The delay compared to the timeline outlined in Cancer in Norway 2008 for some of the registries are due to lack of funding.

** Established for surgically treated patients, planned to be extended to all lung cancer patients.

*** Will be extended with treatment data when integrated with the incidence registry.

**** Planned to be extended to all gynecological cancer patients.

List of publications 2009

Registry staff and affiliated researchers collaborated on 92 publications (research papers and books) in 2009.

Aas GB, Aagnes B, Strand LA, Grimsrud TK. Suggested excess of occupational cancers in Norwegian offshore workers: preliminary results from the Cancer Registry Offshore Cohort. *Scand J Work Environ Health* 2009; 35(5):397-399.

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Introduction

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Background

Screening programmes against cancer represent an important part of the government's cancer control efforts in several countries. The purpose of screening is to reduce the burden of cancer in the population by detecting and treating lesions before they become symptomatic. Treatment of precursors of cancer may prevent development of invasive disease and treatment of cancer at an early stage may prevent or postpone a fatal outcome of the disease. Screening is an example of secondary prevention of disease. Implementation of a screening programme in a region or country will depend on the organization of health services, culture and economy. International organizations such as the World Health Organization (WHO) and European Union (EU) recommend countries to establish screening programmes against cancer (World Health Organization, 2011; Council of the European Union, 2003). These organizations also support the work on guidelines for cancer screening and diagnosis (Perry *et al.*, 2008; Arbyn *et al.*, 2010) as well as handbooks of screening for different types of cancer (IARC Handbooks of Cancer Prevention Volume 7., 2002; IARC Handbooks of Cancer Prevention Volume 10., 2005). Opportunistic, non-programmatic screening is encouraged in many countries without organised screening, especially in the USA. However, to secure evaluation and quality assurance, the WHO and the EU Commission recommend screening activity to be organized in a programme as part of the public health services.

Public screening programmes have been part of the Norwegian National Cancer Plan in recent years

(Norges offentlige utredninger, 1997; Helse- og omsorgsdepartementet, 2006). Currently, there are national screening programmes for cervical cancer (NCCSP) (Johansen and Bjørge, 2011) and breast cancer (NBCSP) (Hofvind and Skaane, 2011), and a pilot study on screening for colorectal cancer is being planned (Hoff and Bretthauer, 2011). Prostate cancer is the most common cancer among Norwegian men, but a general screening programme for this type of cancer has not been found tenable (Kvåle *et al.*, 2011). In this world of rapid developments in medical science, the conditions for a screening programme might change due to new methods (Iversen *et al.*, 2011), or by emergence of new preventive measures (Nygård and Iversen, 2011).

Screening

In screening, asymptomatic people are examined and classified as likely, or unlikely, to have a certain disease (Morrison, 1992). Those who appear more likely to have the disease, are investigated further to determine if they do. A diagnosis is usually not made during the screening examination itself unless the screening modality chosen is targeting visualization of structural changes, such as flexible sigmoidoscopy or colonoscopy screening for colorectal cancer. The quality of the screening device (test) is measured by its ability to separate the population into those who have and those who do not have the disease. Two measures commonly used for characterizing the test are sensitivity and specificity. Sensitivity is the proportion of truly diseased persons who have a positive test and specificity is the proportion of truly

nondiseased persons who have a negative test. Even if these measures are very high i.e. close to 1.0, there will be some diseased persons with a negative test (false negative test) and some nondiseased persons with a positive test (false positive test). Both groups experience unfortunate aspects of the screening and the magnitude of these must be compared to the benefits. In a general population most diseases screened for are rare, i.e. the prevalence of the disease is low. In that case, there will be a large number of false positive tests, even with a test with high specificity. Most individuals with a positive test will actually not have the disease. For characterizing the combined effect of the screening test and prevalence of disease, two measures are useful: Positive predictive value (PPV) which equals the proportion of persons with a positive test that actually have the disease and negative predictive value (NNP) which equals the proportion of persons with a negative test that do not have the disease.

The screening concepts above are adapted from situations in clinical trials and laboratory medicine. In practical screening situations there might exist several options for defining some of the concepts (Hakama *et al.*, 2007).

A prerequisite for screening is that the disease in question has a preclinical phase before symptoms occur, where the disease or precursor of the disease is detectable. This period is called sojourn time. The length of sojourn time will depend on the individual, the tumour and the screening device. In the case of screening for cancer the growth rate of the tumour is an important determinant of the length of this period. When screening is applied in a population, fast growing tumours are less likely to be found than less aggressive tumours. For tumours diagnosed through screening, the time from diagnosis till they would have been diagnosed without screening is called lead time. A further discussion of screening can be found in the following texts in English and Norwegian (Morrison, 1992; Tretli and Weiderpass, 2007).

Principles of screening

Several issues should be clarified before starting screening in a population. The discussion of pros and cons might end either way as demonstrated by the articles in this Special issue. The major principles of screening as formulated in 1968 (Wilson and Jungner, 1968) were:

1. The condition sought should be an important health problem.
2. There should be an accepted treatment for patients with recognized disease.
3. Facilities for diagnosis and treatment should be available.
4. There should be a recognizable latent or early symptomatic stage.
5. There should be a suitable test or examination.
6. The test should be acceptable to the population.
7. The natural history of the condition, including development from latent to declared disease, should be adequately understood.
8. There should be an agreed policy on whom to treat as patients.
9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole.
10. Case finding should be a continuing process and not a "once and for all" project.

A prerequisite for implementation of screening is that the screening test has documented properties and is effective in reducing morbidity and/or mortality of the disease. Given that any screening method has both beneficial and harmful effects, the former must outweigh the latter. There should be a plan for managing and monitoring the programme to secure that it is in accordance with accepted quality standards. Participation should be voluntary and

potential screening participants should be supplied with adequate information for making an informed decision.

Evidence for screening

The scientific evidence for starting screening could come from a variety of experimental and non-experimental studies, but it is strongly recommended that randomized controlled trials (RCT) have been made to investigate the main effects of the proposed screening. Mammographic screening for breast cancer has been organized in many countries. At least six RCTs have been made for estimating the beneficial effect on breast cancer mortality due to inviting women to mammographic screening. The results of these studies have been summarized to show a 25 % reduction in breast cancer mortality (IARC Handbooks of Cancer Prevention Volume 7., 2002).

Even if RCTs have demonstrated favourable effects of screening, further studies could be necessary for securing a successful introduction of a screening programme. For some programmes there is a demanding infrastructure which should be tested before launching a full-scale programme. In other cases, there is a need for comparing alternative procedures. This can be done in implementation studies. Screening against cervical cancer has for many years utilized a Pap smear as a screening test. In later years there have been several trials with a HPV test as a primary screening test. A Norwegian expert group has considered the scientific evidence for superiority of the HPV test as convincing. Consequently, they have proposed an implementation study in four counties, preceding a national programme for all nineteen counties. (Iversen *et al.*, 2011).

Results achieved in a pioneer medical trial, cannot always be reproduced in routine health care. When starting screening there should be plans for how to evaluate the effects of the fully implemented programme. In some instances this has been done

by starting the programme at different points in time for subgroups of the population and using randomization for selection of groups (Hakama *et al.*, 1999). Others have used statistical models for estimating the effects of the programme when there has been a stepwise introduction of the programme (Olsen *et al.*, 2005; Kalager *et al.*, 2010).

Organization of screening

Screening should only take place within an organized programme. The very nature of this health service with both beneficial and adverse effects for the population calls for close surveillance of the population before and during screening. A careful registration of all activities is necessary, and such data should be readily accessible for those responsible for the programme. This is necessary for performing optimal quality assurance. For both screening programmes against cancer currently operating in Norway the responsibility for central coordination has been given to the Cancer Registry of Norway. In a report from January 2001 it was recommended that the national centre for cancer screening should be situated at the Cancer Registry (Sosial- og helsedepartementet, 2001). It is internationally acknowledged that there should be guidelines for each type of screening programme. Both for cervical screening and screening for breast cancer there are international guidelines that are periodically revised by international experts (Perry *et al.*, 2008; Arbyn *et al.*, 2010). These guidelines have been the basis for Norwegian quality manuals in the screening programmes (Kreftregisteret, 2003; Kreftregisteret, 2005). These manuals are revised by experts in the advisory boards of the programmes and contain guidelines for all types of work within it. Important parts of these guidelines are definitions of limits of process indicators for each part of the programme. If process indicators have unusual values, it might be an early warning that the programme is not functioning and adjustments should be made. In screening programmes for cancer in which reduction of cancer mortality is the main aim, there will often be an extended time period before any effect could possibly

be observed. In the meantime the surveillance of the programme has to be based on the process indicators (Hofvind *et al.*, 2004).

Basic elements for evaluation of screening

An indispensable tool in the evaluation of screening against cancer is cancer registration covering the target population of screening. This registration should have been operating for a long period before starting screening in order to provide useful reference values. Some programmes are aimed at reducing cancer mortality; in that case the estimation of effect is dependent on an appropriate registration of cause of death. Since 1964 all citizens of Norway have been given a unique identification number. This has been used for registration of vital events and for events in major parts of social life. A centralized person register which is continuously updated, is available for administration and evaluation of screening programmes in Norway. All incident cases of cancer and some types of precursors have been registered since 1953 in the Cancer Registry of Norway. Registration of cause of death has for a long time been based on international recommendations and data from 1951 onwards is easily accessible. The incidence register and the cause of death register provide opportunity to study national and regional trends in cancer epidemiology. These registers contain identifiable information and are available for linkage to individual data from screening activities. Thus, some of the cornerstones for evaluating the effect of screening programmes against cancer are present.

Regrettably, Norwegian legislation does not give satisfactory conditions for administration, quality control and evaluation of screening programmes. Both programmes, NCCSP and NBCSP, started as scientific projects and were accordingly legally founded. These provided the opportunities for administration of the programme and evaluation of the results. Later on when the programmes had achieved national status, the screening activity was covered by Statutory regulations for the Cancer Registry (Helsedepartementet, 2001). These

regulations demand that personal information on negative findings should not be kept for more than six months without active informed consent from the woman. The authorities subsequently decided that such consent had not been properly acquired in the programmes. The Cancer Registry was then told that it either had to obtain adequate consents by a certain time limit or delete the individual data. Deletion of data could seriously affect quality control and proper evaluation of mammographic screening. Moreover, the cervical cancer screening programme cannot be continued without keeping data on the screen-negative women for more than 6 months. The Ministry of Health and Care Services is working on a slight change of the legislation for the Cancer Registry, to allow the screening programmes to be run according to international recommendations. This legislation will hopefully be implemented this year (2011).

Aspects of evaluation

The results from the screening programmes can be regarded from different angles. For society that has initiated the programmes and is paying most of the expenses, the decrease in mortality and incidence in the total population is important. These results will depend on participation rate and should ideally be separated from the effects of screening outside the programme. One of the reasons for governmental engagement in the organization of screening, is the opportunity to secure equity in health services for the population. Statistics on participation by social class and region will give information whether such an aim has been achieved. Among those participating in screening there will be some who will have benefits, others will experience adverse effects. Estimates of these effects in the actual screening programme are needed by the health authorities who have the responsibility for evaluating these effects and decide whether the screening is worthwhile. These estimates should also be included in the information which is given to those eligible for participation in screening. They need facts for making their individual decision regarding participation.

There are some inherent difficulties in the evaluation of a national screening programme; the lack of a comparison group calls for making assumptions in the analysis that might be questioned. A national programme might have side-effects that should be considered when evaluating a programme. Cervical cancer screening is more integrated in public health services in Norway than in most national screening programmes. The programme performs follow-up of single patients and participates in quality control of work at the participating national laboratories (Johansen and Bjørge, 2011). Mammographic screening (NBCSP) was introduced in a stepwise fashion in Norwegian counties. Before entering the national programme each county had to establish multidisciplinary breast cancer care units, which probably have increased survival for breast cancer patients in all ages (Kalager *et al.*, 2009).

Improvement and changes in screening programmes

From time to time it may be necessary to redesign screening programmes. Rapid development in medical knowledge may open for improvement in existing programmes or completely alter the panorama of prevention strategies within which the screening programme is a part. The HPV vaccination of younger cohorts of women will certainly have an impact on future screening for cervical cancer (Franco *et al.*, 2006; Nygård and Iversen, 2011). Even with an effective vaccine there will be need for a cervical cancer screening programme and the results from the programme may be utilized in surveillance of the vaccinated cohorts. Less fundamentally, HPV tests have been introduced into different parts of the screening algorithm (Cuzick *et al.*, 2008). New screening modalities have also been discussed in screening for breast cancer (Hofvind and Skaane, 2011). The introduction of these is in part connected to a discussion of selective use of screening modalities. For breast cancer there is currently a discussion on which age groups should be offered screening. For prostate cancer it seems that the effect of screening may depend on comorbidity (Kvåle *et al.*, 2011).

The existing cancer screening in Norway includes only to a limited extent selective strategies. The access to background variables and complete screening history may open for even more effective screening programmes.

Changes in screening programmes should be based on scientific evidence. Demonstration of the effects of a new algorithm can be a demanding process. Large samples and long follow-up are needed for stand-alone evaluation of cancer screening programmes. A running programme could be an appropriate setting for testing new modalities (Hoff, 2010). With a proper design the results from such experiments may give efficiency estimates of new methods relative to the older ones. Often this will be an easier task than demonstrating the efficiency in absolute terms. In many respects the infrastructure in Norway is well suited for such experiments since there are common national health services, several health registers and opportunity to link information from different sources. Nevertheless, in the case of cancer screening the knowledge and experience from other countries is important. Experiences from the Norwegian setting must be combined with evidence from other countries and international recommendations to make an optimal offer of cancer screening programmes to the Norwegian population.

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Perspectives on the Norwegian Breast Cancer Screening Programme

Solveig Hofvind and Per Skaane

Introduction

Breast cancer is the most frequent cancer among women with an estimated 1.4 million new cancer cases diagnosed worldwide in 2008 (Ferlay *et al.*, 2010). In Norway, between 2 700 and 2 800 women were diagnosed with breast cancer every year in the period 2001-2008 www.kreftregisteret.no/no/Registrene/Kreftstatistikk/. The last decade, an additional 300 women were diagnosed with Ductal Carcinoma In Situ (DCIS) every year (Sorum *et al.*, 2010). The incidence rate has declined from 2002 onwards; age adjusted (world) incidence rate in 2004: 77/100 000 women years; 2008: 73/100 000 women years. Breast cancer survival is influenced by stage at diagnosis. Five year relative survival for those diagnosed with breast cancer in 2004-2008 was 95% for stage I and 18% for stage IV. The mortality from the disease in women aged 45-64 years has been relatively stable between 46 and 56/100 000 women-years in the period 1980-1995, but a declining trend has been observed since the mid 1990s. The rate was 33/100 000 women-years in 2009 www.norgeshelsa.no/norgeshelsa/. The causes of breast cancer are not well understood, but several risk factors have been identified. Hormonally related factors such as age at menarche, age at first childbirth, number of births, age at menopause and use of hormonal therapy are all well known risk factors, in addition to age, heredity, previous breast biopsy, height, weight, and other lifestyle related factors (Key *et al.*, 2001).

Aim of mammographic screening

As there are limited efforts to prevent breast cancer, mammographic screening was introduced in order to detect the cancer in an early stage and thus reduce mortality from the disease. Several trials and service screening programmes have demonstrated that mammographic screening reduces the mortality from the disease (IARC Handbooks of Cancer Prevention Volume 7., 2002; Olsen *et al.*, 2005; Paap *et al.*, 2010; Gotzsche and Nielsen, 2011) and in 2002 the World Health Organization stated that there was sufficient evidence from randomized trials to recommend mammographic screening for women aged 50-69 years (IARC Handbooks of Cancer Prevention Volume 7., 2002). Further studies supporting the evidence have been published since 2002 and mammographic screening is implemented in most European countries today (European Commission, 2006). The target group is mainly women aged 50-69 years, but some countries and regions include from 40 to 74 years of age.

Benefits and harms of mammographic screening

There are benefits and harms of mammographic screening. The reduced mortality from the disease and breast conserving treatment, instead of mastectomy, are considered the main benefits. However, the effect of screening versus treatment on mortality reduction is still somewhat debated (Kalager *et al.*, 2010) and the effects of screening and treatment in an early stage of the disease versus

the effects of general improvements in diagnostics and treatment is still a matter of some controversy. Treatment is closely related to stage at diagnosis, and it might thus be impossible to separate these effects. Evaluating mammographic screening is a complex task where individual data on the first invitation to screening and adequate follow-up time are but two of several prerequisites for estimating the mortality. However, the benefits of mammographic screening are difficult to measure because most of them are not measureable on an individual level. After the introduction of organized mammographic screening in Norway, breast surgery has been centralized to 17 instead of previously 50 hospitals. All women with breast problems will benefit from this improved and consolidated knowledge and competence. Continuous surveillance and quality assurance of the work performance related to the screening programme ensure high quality of the screening service.

False positive and false negative screening tests, in addition to overdiagnosis and ionizing radiation exposure are considered harms of mammographic screening. A false positive screening test, (i.e. a positive screening test and a subsequent workup that does not show any malignancy) is considered a harm of mammographic screening because it often leads to anxiety and concern (Brett *et al.*, 2005). It is thus very important to keep the recall rate as low as possible. Studies have shown the psychological strain related to a recall to be transient and most women reattend two years later (Ekeberg *et al.*, 2001). However, most probably a recall including a biopsy is more stressful than a recall including additional imaging only. False negative screening tests might lead to delayed diagnosis and less favourable prognosis. Continuous quality assurance is recommended to minimize the problem, which has to be considered a part of all screening programmes, and for breast cancer, mammography is the only test that has proven to reduce mortality. Overdiagnosis is defined as the detection of breast malignancy at screening that

would have never clinically surfaced in the absence of screening. Overdiagnosis might be mirrored in the incidence of the disease and is related to the natural history and lead time of the disease and exists both for screening and diagnostic mammography.

Administration and logistics of the Norwegian Breast Cancer Screening Programme (NBCSP)

The NBCSP started as a four year pilot project in four counties (Akershus, Hordaland, Oslo, and Rogaland) in 1995/96. At that time, it was considered neither necessary nor ethically acceptable to do a randomized trial because several trials had shown convincing results in favour of screening. Dr. Steinar Thoresen, MD, was the head of the screening department at the Cancer Registry of Norway (CRN) at that time. After two years performance of the pilot project, the Government decided to introduce the programme nationwide as fast as feasible. In 2004, the last county was included in the programme. The NBCSP is run according to the European Guidelines and is targeting women aged 50-69 years (European Commission, 2006; Kreftregisteret, 2003). The women are invited by a personal letter to have a two view mammographic screening biennially. The invitation letter states time and place for the examination, in addition to serving as a source of information about benefits and harms of mammographic screening. The screening test takes place at 28 dedicated stationary and four mobile units. The mammograms are independently read by two radiologists. If one or both readers have interpreted the screening mammograms as positive and a subsequent consensus has stated the mammograms positive, the woman is recalled for further examination at one of 17 breast clinics established as a part of the NBCSP (Figure 1). At the breast clinics radiographers, nurses, radiologists, pathologists, surgeons, and oncologists are working together in multidisciplinary teams which are aimed at diagnosing and treating women with breast problems professionally.

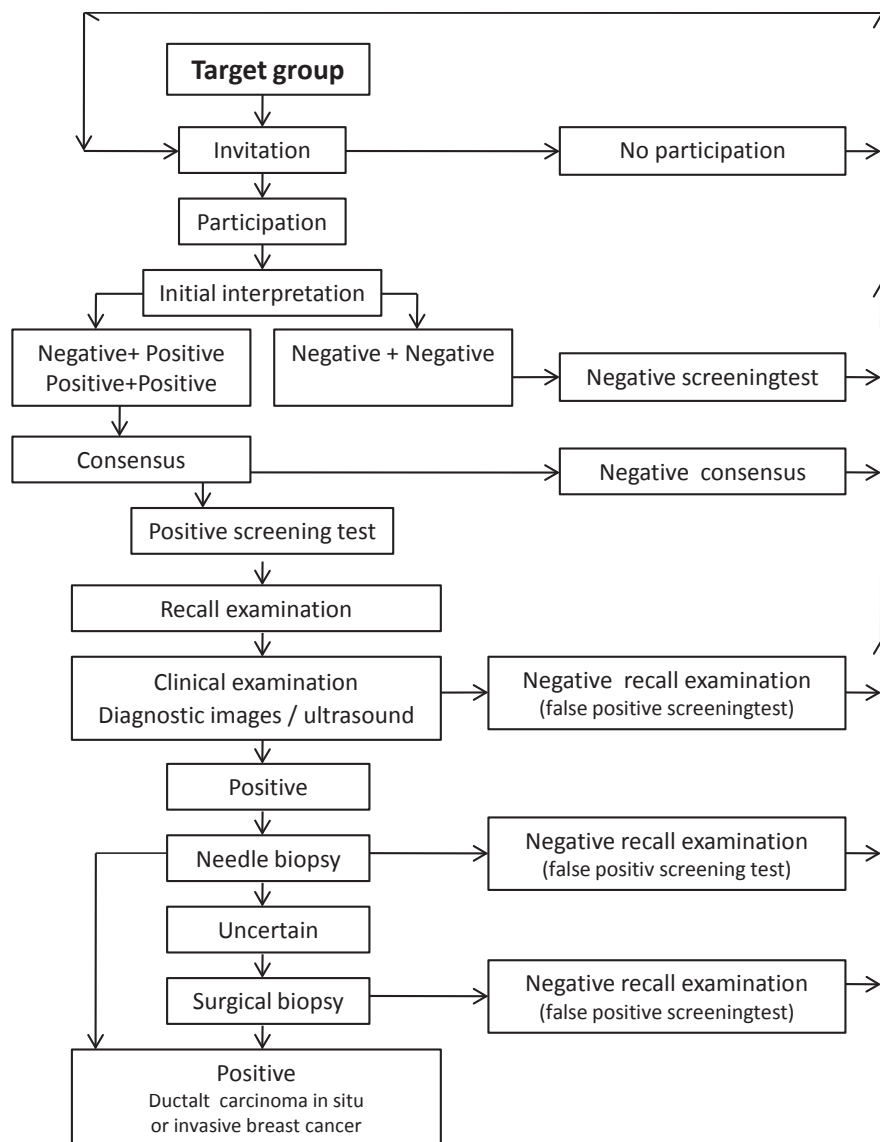


Figure 1
The screening and follow-up procedures in the Norwegian Breast Cancer Screening Programme.

The NBCSP is run in collaboration with the Government, the Cancer Registry, the National institute of Public Health, the Norwegian Radiation Protection Authority, and the five Health Regions. It is headed by the Ministry of Health and Care Services and administered by the Cancer Registry of Norway. The Registry is also responsible for quality assurance and –control of performance measures and the data collected. Members of the staff are also represented in European and International networks and are taking part in several national and international research projects. A national advisory group has been included in different organization models since the pilot project started. Its aim is

to support the administration and professions in the clinical aspects of the screening programme. Further, the National Institute of Public Health is responsible for the practical work of sending invitations, reminders and letters to all women with a negative screening test and the Health Regions are responsible for running the screening programme in each county, including screening interpretation, recall examinations, further diagnostics and eventual treatment and follow-up. The Norwegian Radiation Protection Authority is responsible for the quality control of technical equipments used in the screening and work up.

The present

Participation

As of January 2011, close to 2.5 million invitations had been sent to women in the target group of the NBCSP, and close to 1.9 (76%) million screening examinations had been performed (Figure 2). About 700 000 women have received an invitation once or more. A high uptake is needed to maximize the benefit of the NBCSP. The participation rate among those invited varies by county. Hedmark had the lowest rate in the prevalent screening round (first) in 2003-2004 (2003-04: 63%; 2003-2009: 67%), while Oslo had the lowest rate in the subsequent screening rounds (2006-2007: 62%; 1996-2009: 64%). Other counties with low participation rates are Østfold (2001-2009: 73%) and Møre og Romsdal (2002-2010: 72%). The different participation rates might be explained by use of private clinics for mammographic examinations (opportunistic screening and diagnostic mammography) (Hofvind and Sanderud, 2010). Hedmark was the second last county to be included in the NBCSP, and unpublished quality

assurance measures have shown that 40% of the women in Rogaland (first county in the NBCSP) had had a previous mammography (at private clinics or at a hospital) before they entered the NBCSP, while it was 65% for Hedmark and 80% for Vestfold (the two last counties included). Rogaland, Troms and Finnmark, Sogn og Fjordane and Hordaland all have participation rates close to 80%. The county specific variation is mirrored in the rate of women who have notified the Cancer Registry that they do not want to be invited to the NBCSP. That rate is highest in counties with a high volume of private clinics and lowest in counties with no or only a small volume of such an offer. Use of private clinics will bias future evaluation of the efficacy of the NBCSP since the women are invited, but do not attend and have their eventual breast cancer diagnosed outside the screening programme in a later stage compared to those diagnosed in the screening programme (Hofvind *et al.*, 2008). Today there is no systematic registration or surveillance of mammographic service at private clinics.

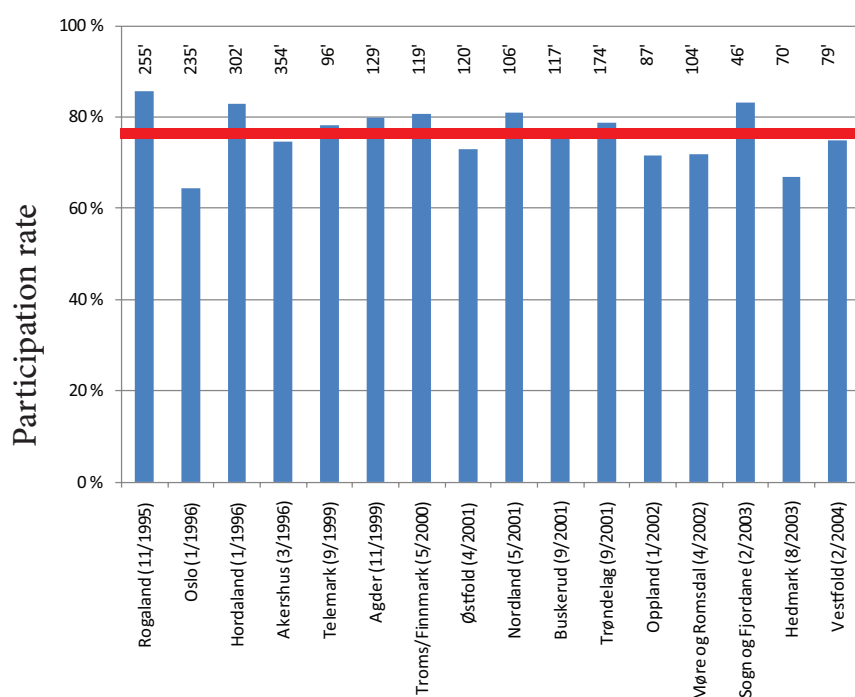


Figure 2

Participation in the Norwegian Breast Cancer Screening Programme given in % of the invitations sent from start up and until April 2011 by county. Approximate number of invitations sent is given above the bars. Month and year of start up of the screening programme in each county/area is in parenthesis after the county/area name. Red line is indicating the average participation rate (76.4%).

Recalls

Using independent double reading with consensus is probably the reason for a recall rate below 3% in subsequently screened women in the NBCSP (Table 1). Subsequently screened women have been screened previously in the NBCSP, while prevalently screened have their first screening test in the programme. The recall rate is lower in subsequently screened as in prevalently screened women because previous mammograms are used for comparison in subsequent screening examination. Also the women are older and thus have less mammographic dense breast which makes the mammograms easier to interpret. Between 15 and 20% of the recall examinations due to mammographic findings conclude with a breast malignancy after which treatment is recommended (Positive Predictive Value, PPV). The recall rate, adherent procedures, including waiting time for the procedures and the statements are regularly measured as a part of the quality assurance in the programme, to ensure they are kept at acceptable levels.

Detection of cancers

Between five and six cancers are detected in every 1 000 women screened in the NBCSP. The interval cancer account for an additional one to two cases per 1 000 screened (Table 1). Due to lead time, the detection rate is assumed to be about three times the incidence before screening was introduced in prevalently screened women (European Commission, 2006). In subsequently screened women the rate is expected to decrease to about one and a half the background incidence. These rough estimates are related to invasive cancer. Introduction of organized screening has led to an increased detection of Ductal carcinoma in situ (DCIS), which account for about 20% of the screen-detected malignancies and less than 7% of the interval cancers. The rate was less than 5% before the programme started. DCIS is considered a premalignant breast disease and the increased detection of DCIS is considered to be due to lead time. Therefore a reduced rate of invasive cancers is expected after a while. This is often referred to as stage migration. The progression of DCIS is not known today, but it is assumed that

Table 1

Number of prevalent and subsequent screens performed in the Norwegian Breast Cancer Screening Program in the period 1996-2007 and respective rates of recalls, biopsies, screen-detected and interval cancer

	Prevalent screens	Subsequent screens	Total
	n=540 135	n=997 721	n=1 537 856
Recall rate	4.8%	2.6%	3.4%
Biopsy rate	2.0%	1.1%	1.4%
Screen-detected cancer			
Ductal Carcinoma In Situ	0.11%	0.09%	0.10%
Invasive cancer	0.50%	0.42%	0.44%
Total	0.61%	0.50%	0.54%
Interval cancer*			
Ductal Carcinoma In Situ	0.01%	0.01%	0.01%
Invasive cancer	0.16%	0.15%	0.15%
Total	0.17%	0.16%	0.16%

*Two years follow-up after screening test; followed to 2010

the majority of the DCIS-lesions will progress into an invasive cancer if left untreated (Virnig *et al.*, 2010). The increased incidence of DCIS is observed worldwide and the topic has drawn considerable attention.

Tumour characteristics

The prognostic tumour characteristics of screen-detected cancers are favourable compared with the interval cancers and cancers detected outside the screening programme (Hofvind *et al.*, 2008). The screen-detected cancers have a smaller tumour size, are less frequently grade III and lymph node positive. Survival is closely related to these parameters. Due to the smaller tumour size, a higher percentage of the women diagnosed with breast cancer in the NBCSP have breast conservative treatment compared to those diagnosed outside the screening programme (Hofvind and Skaane, 2011). This is according to the goal of mammographic screening.

Quality assurance

Continuous quality assurance has been performed since the programme started, both at the Cancer Registry and at the local breast centres. The results have been communicated on site visits, meetings, reports and scientific publications. More than 70 scientific papers and 20 reports are based on data from the programme. Three PhDs are partly or fully based on the data (H Wang, 2002, S Hofvind 2005, H Wedon-Fekjær, 2008), and four more (RS Falk, IHR Hauge, M Kalager, and SR Hoff), are in progress. Unfortunately, only limited quality assurance and –control have been performed based on data from the NBCSP the last two years. This is due to lack of regulations that make the Cancer Registry able to store data collected in women with a negative screening test for more than six months after her screening examination. Until the Cancer Regulation was introduced in 2002, the NBCSP had its own license which allowed the Cancer Registry to collect, store and use the data without time restrictions. The content of the license was not transferred completely into the Cancer Regulation. Due to this all women participating in the NBCSP have to be asked to sign

an informed consent to give the Cancer Registry permission to store their data created from the screening programme. The collection of informed consent started mid 2008, and about 96% of the women participating in the NBCSP agree. The events concerning these regulations have required substantial resources from the Cancer Registry, particularly the NBCSP staff. We are now looking forward to further improve the organization of the NBCSP in order to achieve its aims.

The future

Introduction of mammographic screening in general, including the NBCSP has led to new knowledge about risk, detection, and treatment of early stage breast cancer.

Screening tools

Mammography is considered the best tool for population based breast cancer screening today, but other methods might be available in the future. Magnetic Resonance Imaging (MRI) has a very high sensitivity for invasive breast cancer and is in some counties the recommended screening tool for women at high risk. Studies have reported a sensitivity for breast cancer of 33% for mammography, compared with 80-91% for MRI (Kriege *et al.*, 2004; Kuhl *et al.*, 2005). For many years, MRI was suggested to have a low sensitivity for DCIS, but a recent report concluded that MRI had a comparable or even superior detection of DCIS compared with mammography (Kuhl *et al.*, 2007). “Post-MRI second look ultrasound” will often identify a small tumour detected at MRI. However, if a small mass is neither identified on mammography nor on ultrasound, a MRI-guided vacuum-assisted biopsy, which is an expensive and time-consuming procedure, may occasionally be necessary. Experience from the last few years indicate that the problem of false positive MRI-findings probably are less than earlier suggested. Another advantage of MRI is no use of ionizing radiation.

It is well known that ultrasound, as an adjunct to mammography, may reveal many cancers missed on mammography in women with dense breast parenchyma (Berg *et al.*, 2008). Automated whole breast volume ultrasonographic scanning systems (ABVS), now commercially available, may offer important advances for screening as compared with hand-held equipment. The examination can be carried out by trained technicians. The images are standardized and reproducible, and follow-up is therefore easier. Images can be interpreted in batch readings, and the interpretation time seems to be shorter for radiologists than with hand-held devices. In a larger prospective study, the number of breast cancers detected was twice as high when ABVS plus mammography was used as compared with mammography alone in women with dense breast parenchyma (Kelly *et al.*, 2010).

Limited data on the impact of Computer Aided Detection (CAD) in double reading programmes suggests that CAD has the potential to increase the cancer detection rates. Prospective studies in a screening setting are needed to evaluate the role of CAD input on the recall, biopsy and cancer detection rates. However, in double reading programmes of screening mammography (Gromet, 2008).

Advances in digital mammography have led to the development of digital breast tomosynthesis (DBT or “3D mammography”). This technique provides thin tomographic images of the breast and may reduce the obscuring effect of overlying and underlying tissue. DBT may have a potential in mammographic screening, either in a combined mode (FFDM plus DBT) or by replacing the conventional 2D images. Some few clinical studies published on DBT so far have demonstrated that DBT has the potential to increase both sensitivity and specificity in mammographic screening (Andersson *et al.*, 2008). This early experience indicates that DBT may be of especial importance for the detection of small spiculated masses and distortions.

Screening based on individual risk factors

Age, heredity, mammographic breast density, previous breast biopsies, and hormonal factors

are known risk factors for breast cancer. Several computer programmes and models are available to estimate individual risk profiles for breast cancer (www.cancer.gov/bcrisktool/) after which individualized screening intervals- and tool(s) can be recommended (Gail *et al.*, 2007; Barlow *et al.*, 2006). Based on available knowledge, the cost effectiveness of introducing individualized screening intervals and possibilities for a multimodality approach in the NBCSP should be investigated. The ethical aspects should also be taken into consideration.

Women with a BRCA1 or BRCA2 gene, have a 50% to 85% lifetime risk of developing breast cancer. Recommendations for screening high risk women are established in Norway www.nbcg.no, but there is not yet an established surveillance or quality assurance system. Establishing a programme for registering the screening testing and follow-up in high risk women, as a part of the NBCSP, thus appears appropriate.

Expansion of the target population

Results from recent studies show a substantial reduction in mortality from breast cancer in women aged 40-49 years invited to screening (Hellquist *et al.*, 2011). These findings indicate a need to consider the age group targeted in the NBCSP to be lowered to 45 years. Benefits and harms of an expansion should be discussed. Analyses of costs have been performed (Aas *et al.*, 2007), but further, updated analyses are probably needed. There is also a need to ensure women 70 years and older effective diagnostics and treatment of breast cancer, when they are no longer invited to the NBCSP. The ability to be screened in the NBCSP should be possible for otherwise healthy women who want to be screened.

Complete database

A prerequisite to study the challenges related to the NBCSP and the heterogeneity of breast cancer is complete and valid data. Information about use of mammography and diagnostic work up in all Norwegian women provides a unique opportunity to study the overall efficacy of the NBCSP, the county and age specific diversity, and the natural history of breast cancer. Collecting uniform data

from all mammographic examinations performance is therefore needed. The unique possibility of linking this information with data from different Norwegian registries creates exclusive possibilities for internationally high quality research.

Conclusion

The NBCSP has run for 15 years with an overall participation rate of 77%, suggesting that women in general accept the harms associated with screening, in order to benefit from the early diagnosis. The cancers detected are prognostically favourable compared to cancers diagnosed before the screening programme started, but also compared to those diagnosed among women in the same age group who do not attend the screening programme. The NBCSP is run according to the European Guidelines, and preliminary results of early outcome measures make us expect a mortality reduction as a result of the programme. The programme will be evaluated

by external research groups nominated by the Research Council of Norway. The evaluation will take place as soon as data become available, which is expected to be at the end of 2011. A concerted effort among all the specialties involved in screening, diagnostics and treatment of breast cancer is desirable to better understand the continuum of breast cancer care. The Cancer Registry of Norway holds experience and qualifications to be the coordinating organ, responsible for proper collection of data covering all aspects of the disease, including screening, diagnostics, and treatment, in addition to epidemiology, and biostatistics.

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The main objective of most cancer screening programmes is to reduce disease specific mortality. Because cervical cancer has a defined precancerous stage, cervical cancer screening also aims at reducing the incidence of cancer by detecting and treating women with cervical precancerous lesions which, if left untreated, could lead to cancer. This article includes epidemiologic data of cervical cancer in Norway as well as a brief historic overview and a description of the screening activities, some results and finally a discussion of the adverse effects of cervical cancer screening.

Epidemiology of cervical cancer in Norway

While the incidence burden from cancer in general has been increasing the last decades, there has been

a decreasing trend in both incidence and mortality from cervical cancer in Norway.

Figure 1 and 2 illustrate time trends in age-adjusted incidence and mortality rates for cervical cancer in the Nordic countries. From 1960 to 1975, there was a steady increase in incidence of cervical cancer in Norway. However, from the mid 1970s, a decline was observed parallel to the introduction of opportunistic screening. Around 1990 it seemed as if organised screening had lost its power, and an increase in cancer incidence was observed followed by a decline attributed to the implementation of the organised screening programme in 1995.

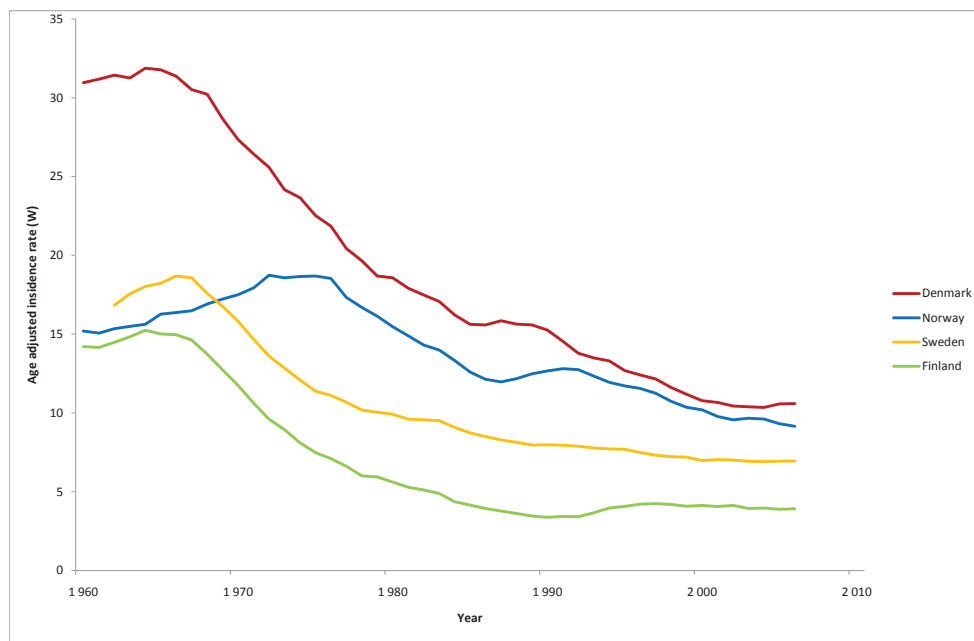


Figure 1
Age-adjusted incidence rates (per 100 000) of cervical cancer in the Nordic countries 1960-2008, (Source: NORDCAN, Engholm et al. 2009)

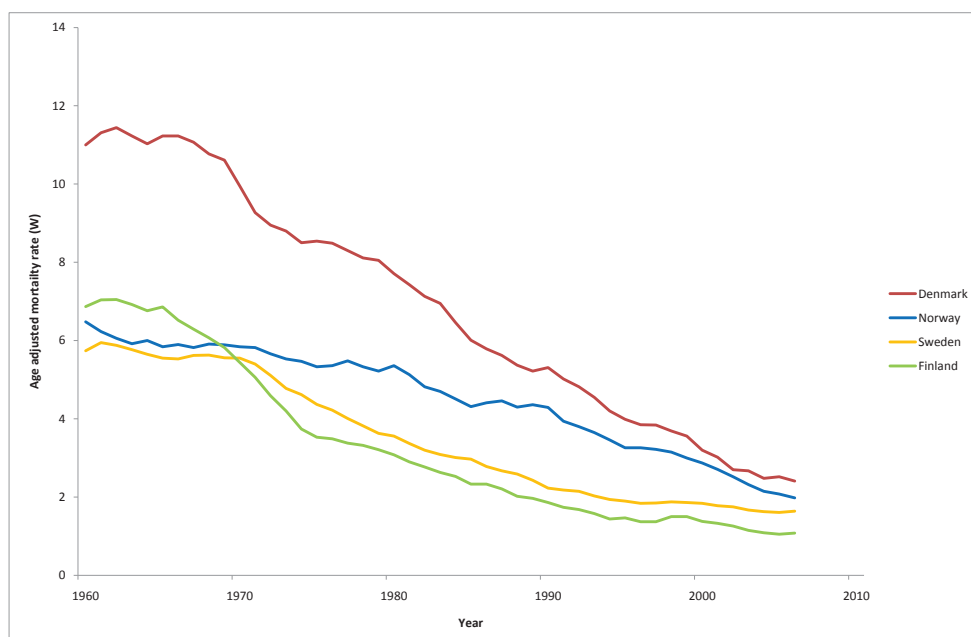


Figure 2

Age-adjusted mortality rates (per 100 000) of cervical cancer in Norway 1960-2008,
(Source: NORDCAN, Engholm et al. 2009)

The decreases in incidence and mortality rates in Norway occurred considerably later than in the other Nordic countries. This is most probably due to the fact that Finland and Sweden had nation-wide, organised screening programmes from the late 1960s. Norway, in contrast, had organised screening in only one county at this time (Hakama, 1982).

In table 1, the actual numbers of cervical cancers and deaths as well as precancerous lesions (CIN2 and CIN3) in Norway are presented together with information on incidence and mortality rates for the period 2003-2008.

Table 1

Number of cervical cancers, incidence rate, number of deaths, mortality rate, and number of CIN2 and CIN3 in Norway 2003-2008 (Cancer Registry of Norway, 2003-2008)

	2003	2004	2005	2006	2007	2008
Number of cancer cases	297	269	305	309	264	270
Incidence rate	9,5	8,7	9,8	9,6	8,4	7,7
Number of deaths	109	81	72	79	84	93
Mortality rate	2,6	2,0	1,8	1,8	2,1	2,5
Number of CIN 2/3	3354	3203	3101	3236	3546	3469

Cervical cancer screening in Norway

In the 1950s, the Pap-smear was introduced as a diagnostic and opportunistic screening tool. An organised cervical cancer screening programme was first introduced as a pilot project in Østfold County (Magnus et al., 1987). The first two screening rounds took place in 1959-1965, and the last in 1974-1977. A cohort was followed up until the end of 1982. The observed incidence and mortality of cervical cancer were compared with women in five neighboring counties who were not offered organised screening. Women not participating in the screening programme had a 61% higher incidence of cervical cancer and a more than two-fold excess in the mortality rate.

During the 1970s and 1980s, the number of Pap smears taken increased steadily all over the country. At the same time, it became obvious that frequent and unorganised screening had limited effect on the incidence and the mortality rates and also at a gradually higher expenditure. In 1990, the Norwegian Department of Health and Social Affairs decided to start a national screening programme for cervical cancer, based on recommendations specified in NOU 1987:8 (Norges offentlige utredninger, 1987). From 1990-1993, all spontaneous cervical screening activity in Norway was recorded in a central registry. In addition, a pilot project was implemented in the two counties of Vestfold and Sør-Trøndelag, to evaluate the organizational aspects of the programme. An evaluation of the project revealed that coverage in the two counties was approximately 71% compared to 65% in the rest of the country. The overall experience from three years of recording and piloting was convincing with respect to coverage, and useful guidelines for a national screening programme was provided (Bjørge et al., 1992).

Aims of the programme

From the start in 1995, the overall aims of the Norwegian cervical cancer screening programme were to reduce the incidence and mortality from cervical cancer by 50%, compared to the incidence and mortality for the period 1990-1994, and also to prevent an escalation of the number of screening tests

taken in the period of 1992-1994, before organised screening started. Furthermore, the coverage, that is the proportion of eligible women being screened every tree years, should be kept at 80%. Internal and external quality management of the cervical cytology laboratories should be optimal and in accordance with the demands of the European guidelines for cervical cancer screening (European commision, 2008). Hence, each laboratory is supposed to analyse a minimum of 15 000 screening tests yearly. Moreover, the laboratories are responsible for keeping the cyto-histological, cyto-virological and cyto-clinical correlations high. Sample takers should be informed about test results as soon as possible or at least within three weeks.

Organisation

Today, the cervical cancer screening programme is organised as an integrated part of the national health care system. A cytological specimen (Pap smear) is taken by general practitioners or gynaecologists. Approximately 390 000 women have 430 000 Pap smears taken every year (Kreftregisteret, 2008). The Cancer Registry of Norway (CRN) receives mandatory reports from private as well as public pathology and microbiology laboratories. The CRN keeps complete record of the results from the recommended and opportunistic Pap smears, the histology specimens as well as the HPV tests. Individual screening data with a personal identifier are recorded and organised into four sub-registries: the Cytology Register, the Histology Register, the HPV Test Register and the CIN Register; the last holding follow-up and treatment data. The CRN runs the Secretariat of the Norwegian Cervical Cancer Screening Programme (NCCSP). The Secretariat keeps an administrative database which is based on the four sub-registries mentioned above. By monthly linkages to the external National Population Register, reminders (personal letters) are sent to women aged 26-69 who are not registered in the database with a smear or a test for the last three years. A second reminder is sent after an additional year if a test still cannot be traced. In addition, all women aged 25 receive an introductory letter with

information about the screening programme and an invitation to participate.

The smear takers are supposed to inform the woman and record if she does not approve registration of a personal identifier in the CRN, if the tests are negative. Positive screening results can be registered without consent according to Norwegian regulations. Women also have the opportunity to make reservations from receiving reminders. The CRN keeps a register containing all reservations, including those women who have reported their hysterectomies.

Biological material originating from screening is to be stored in a biobank linked to the particular pathology unit engaged in the screening activities. There are 20 units diagnosing cytology and/or performing histology diagnostics and 11 laboratories analyzing HPV tests, and some of them incorporate HPV genotyping. Since 2005, the CRN and the laboratories have used the Bethesda System of Classification (Solomon et al., 2002). The FIGO system is used for staging of cervical carcinomas (Sobin and Wittenkind, 2002).

So far, only four laboratories have converted to liquid based cytology; the remaining still practice conventional cytology, or are about to convert.

The laboratories are obliged to inform the physicians about the results and give recommendations for follow-up, and to transfer relevant data to the CRN. Information on screening and the screening programme is provided orally within the doctor-patient context. Women are also informed by letters, i.e. introductory letters and reminders sent from the Secretariat in the CRN. Furthermore, the screening programme keeps a website with extended information. It's important to notice that women who have their smears taken at regular intervals will not receive reminders, and will therefore not receive any information by mail.

The Secretariat is guided in medical and screening questions by an Advisory Board with members from all expert fields involved in the screening activities. The Board is supervised by a Steering Committee established by the Norwegian Directorate of Health. The Advisory Board is authoring a Quality Assurance Manual and provides recommendations for screening algorithm, screening tests, evaluation, etc. (Kreftregisteret, 2005).

A flow chart illustrating the organization of the Norwegian Cervical Cancer Screening Programme is presented in Figure 3. Key characteristics of the Norwegian as well as the other Nordic programmes are summarized in Table 2.

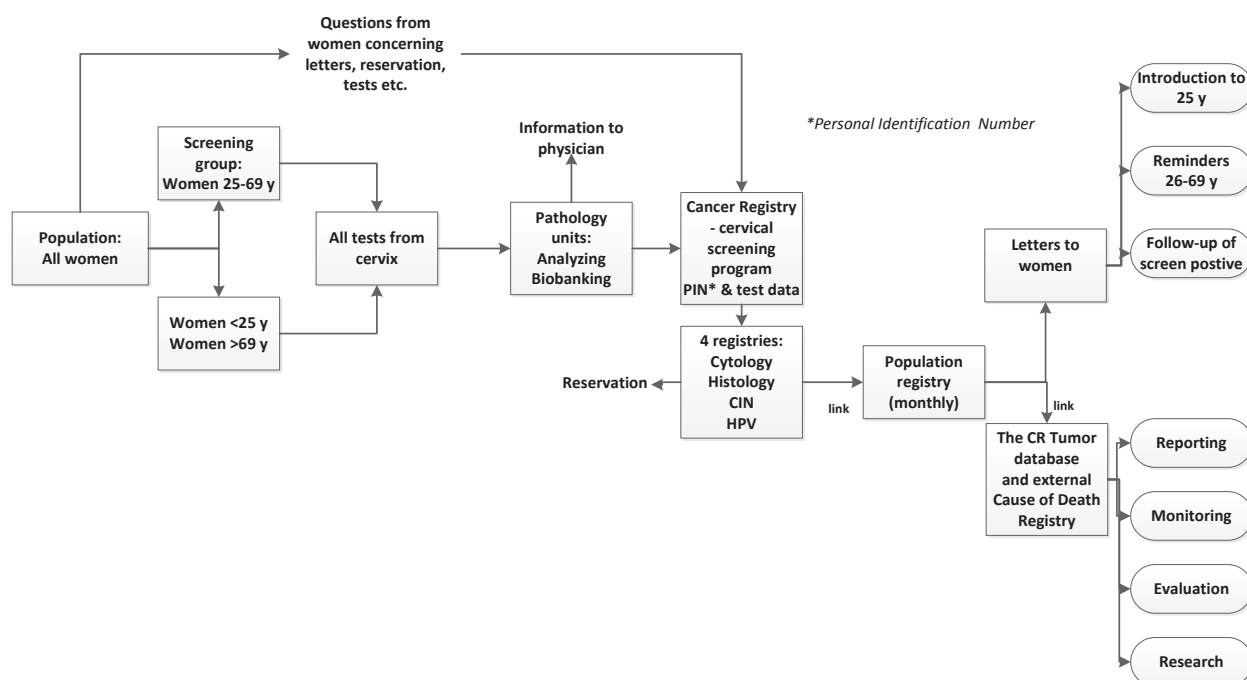


Figure 3
Flow chart of the Norwegian Cervical Cancer Screening Programme

Table 2

Key characteristics of the Nordic cervical cancer screening programmes. NORDCAN.

	Target group (y)	Screening interval	Smears per lifetime	Incidence rates 2008	Mortality rates 2008
Norway	25-69	3	15	8,7	2,1
Sweden	23-60	3 *	14	7,2	1,5
Denmark	23-59	3	13	11.2	2,1
Finland	30-60	5	7	4,2	1,2

*5-yearly at ages 50-60 years

Management of screen positive women

The Norwegian health authorities recommend women between 25 and 69 years to have a Pap smear taken every third year. Women with high grade cytology are directly referred for colposcopy and biopsy. Equivocal (ASC-US) and low grade (LSIL) cytology is the cut-off level for referral to a repeat or secondary smear and HPV testing after 6-12 months. If the secondary Pap smear is high grade, direct referral to colposcopy and biopsy is recommended. In the cases of negative HPV test in conjunction with a normal, unsatisfactory or ASC-US/LSIL

secondary smear, regular screening after three years is the suggested action. If the HPV test is positive in conjunction with a secondary Pap test being ASC-US or LSIL, this should lead to colposcopy with biopsies. In the cases of normal or unsatisfactory secondary cytology and a positive HPV test, the woman is recommended another Pap smear and a HPV test after a period of 12 months. The recommendations for triage and the different follow-up strategies will be revised within the next year. The current management of screen positive women and the triage algorithm is illustrated in Figure 4.

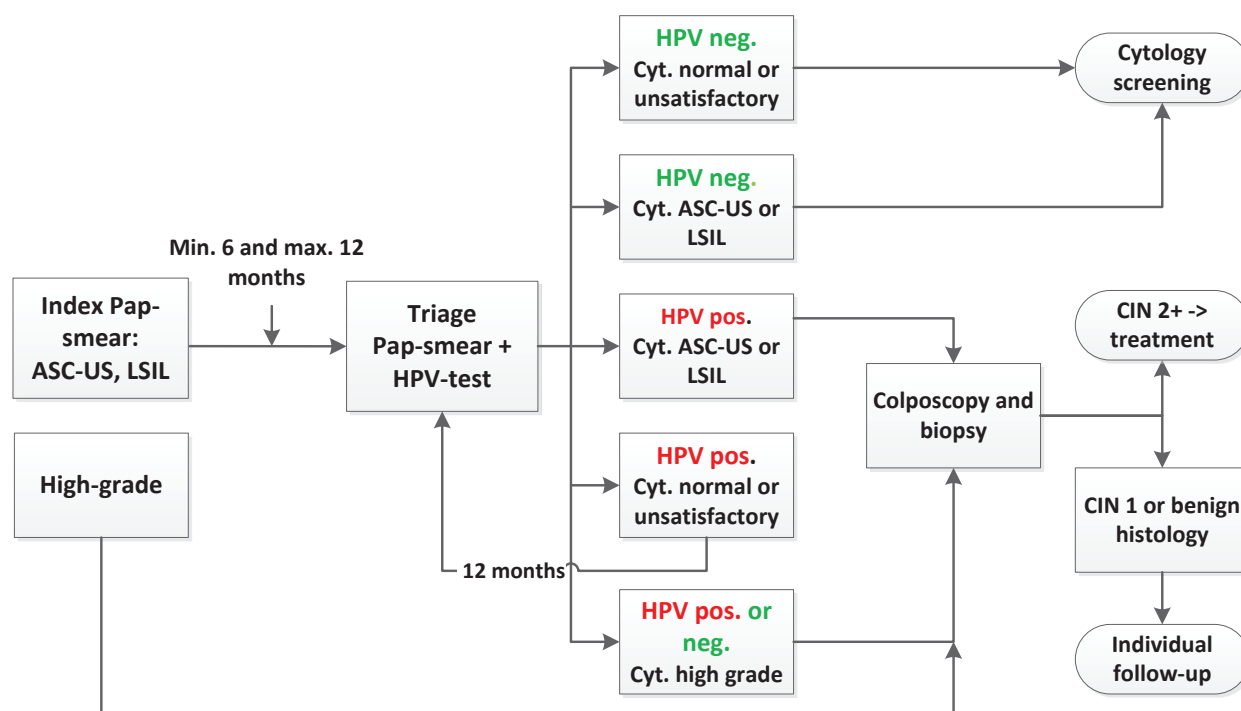


Figure 4

Management of screen positive women. Flow chart showing algorithm of triage with HPV testing.

If the woman is not followed up according to the recommended procedures, the Secretariat contacts, depending on the diagnosis, either the woman herself, the laboratory or the woman's doctor.

Reporting, monitoring and evaluation

The participating pathology laboratories and gynecology units receive individual feedback along with standards of comparisons through yearly reports from the Secretariat and the Advisory Board. These reports include data from cytology and histology diagnostics together with results from diagnostic and treatment procedures.

Performance or process measures or indicators monitoring activity and intensity, effectiveness, diagnostic assessment and treatment and laboratory results are monitored annually for providing early feedback in order to identify problems and to make necessary changes (Kreftregisteret, 2008). This is accomplished by linking the four cervical screening databases with the external Population and Cause of Death registries and with the internal cancer tumour registry of the CRN.

An audit by Bofin A et al (Bofin et al., 2007) of smear history in women with low-grade cytology before cervical cancer diagnosis was published in 2007. The authors showed that in a screening programme, a subgroup of smears may be diagnosed as unsatisfactory or low grade despite the presence of high grade findings that are detectable on reexamination. The following year, Haldorsen T et al (Haldorsen et al., 2008) published an evaluation of the programme which concluded that coordinated screening has contributed favourably in decreasing incidence and mortality rates as well as the number of tests taken. Furthermore, members of the Advisory Board evaluated in 2008 the preliminary experiences with HPV triaging and stated that there is a need for extended observation and further evaluation (Rådgivningsgruppen for Masseundersøkelsen mot livmorhalskreft, 2008). Hence, a second evaluation of HPV triaging is planned to be published in 2011.

However, it will be restricted by the current disability to use data from negative findings due to restrictions imposed by the Norwegian Data Inspectorate (see below).

Furthermore, the Secretariat completed an investigation of the possibility of lowering the upper age limit of screening and extending the screening intervals for women above 50 years. Based on data from the cervical screening registries, we concluded not to recommend any changes (Molden et al., 2008). A doctoral thesis by Nygård J in 2003, aimed at assessing the introduction of the coordinated cervical cancer screening programme and revealing possibilities to improve the guidelines, found that mailing recommendation letters only to women who did not take smears as recommended, provided a cost-effective solution (Nygård, 2005).

Results

The incidence and mortality rates of cervical cancer are presented above.

Coverage

A fundamental prerequisite for a successful screening programme is that women in the target population are actually screened. A population-based screening policy and organisation conforming to standards has to some extent had a positive effect on the coverage (Figure 5). Participation is highest in the age group 30 to 49 years and lowest in the oldest group (65-69 years). The positive effect which may be attributed to the organised and coordinated screening activities is a decrease (around 20 %) in the number of women under 25 years having had a Pap smear. Another possible explanation for this drop is that the Advisory Board actively has advised against regular screening for age-groups below 25 years. An additional positive effect is that after organising screening, participation by the oldest age group has increased by more than 20 % from the period of 1992-1995 to 2003-2006.

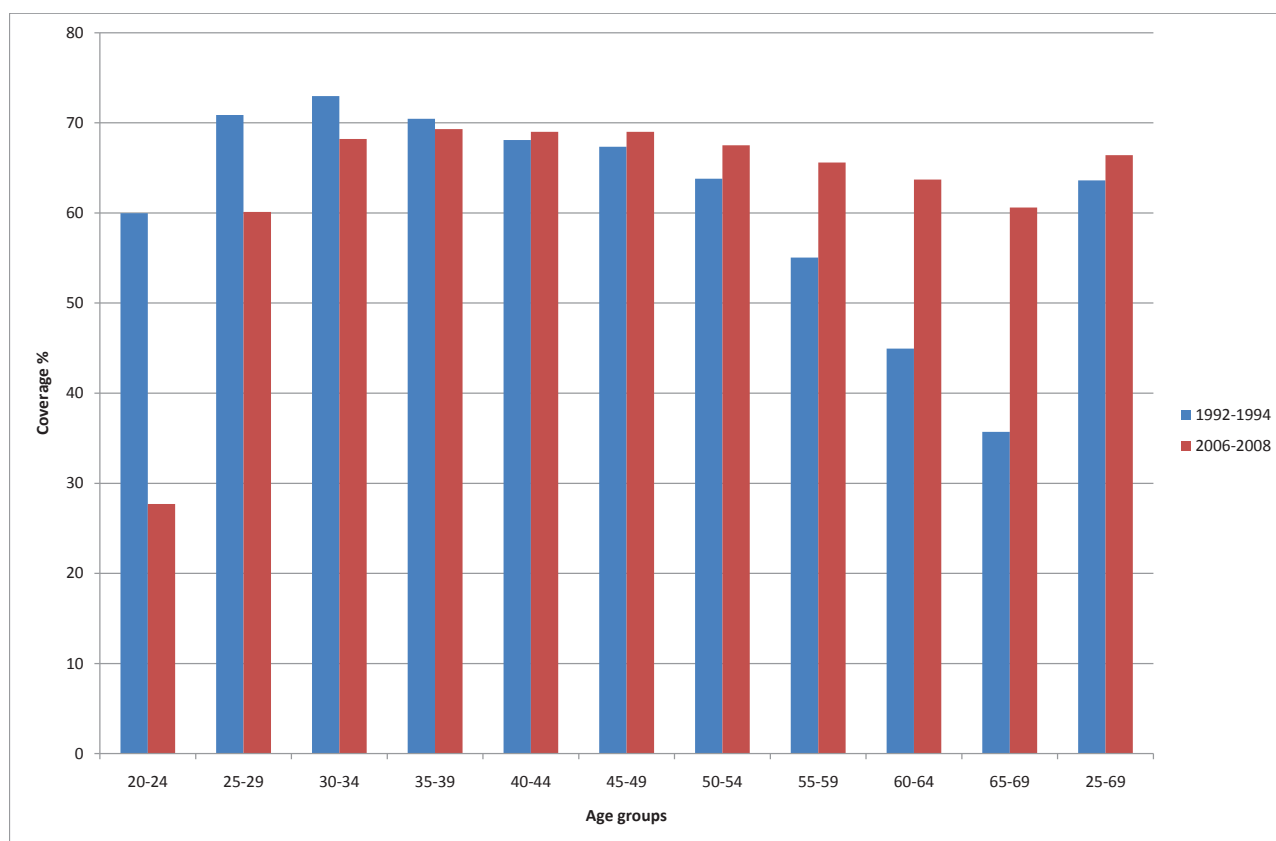


Figure 5
Coverage 1992-1994 and 2006-2008, before and after the introduction of organised screening.

Incidence, coverage and number of smears before and after the introduction of organised screening

The positive effect of organised screening on incidence and mortality of cervical cancer has been pointed out in several publications. Early follow up studies among those invited to screening have indicated that the decrease in cervical cancer incidence was particularly pronounced among women participating in organised screening programmes (Magnus et al., 1987; Johannesson et al., 1982; Hakama and Rasanen-Virtanen, 1976). Peto et al (Peto et al., 2004) concluded that after 1988 and the introduction of a national screening programme in the UK, the rising trends of cervical cancer incidence and mortality were reversed.

Figure 6 demonstrates the effect on incidence rate as well as coverage before and after the implementation of a nation-wide, population based screening programme in Norway in 1995.

The effect of streamlining cervical screening on the reduction of the total number of smears has also been demonstrated (Briet et al., 2010).

The same trend is observed in Norway after introduction of organised screening (Figure 7).

The total number of Pap smears has been reduced by approximately 100 000 tests per year from around 542 000 test in 1994 to 430 000 tests in 2008 (Kreftregisteret, 2008).

In 2007, we found that only 81 (31%) out of 258 women diagnosed with cervical cancer (all age groups) had had a previous test three years before the date of diagnosis, and 105 and 154 out of 258 had had a Pap smear four and ten years before, respectively (Kreftregisteret, 2008).

Adverse effects of cervical screening

Information on positive and negative effects of screening does not reach everyone, and the group that is supposed to benefit the most, i.e. the women not having Pap smears taken, is disturbingly hard to reach (European Commission, 2008).

In Norway, there is still a lot of opportunistic screening, especially among women under 25 years. On the other hand, we know that women above the age of 60 are tested too infrequently,

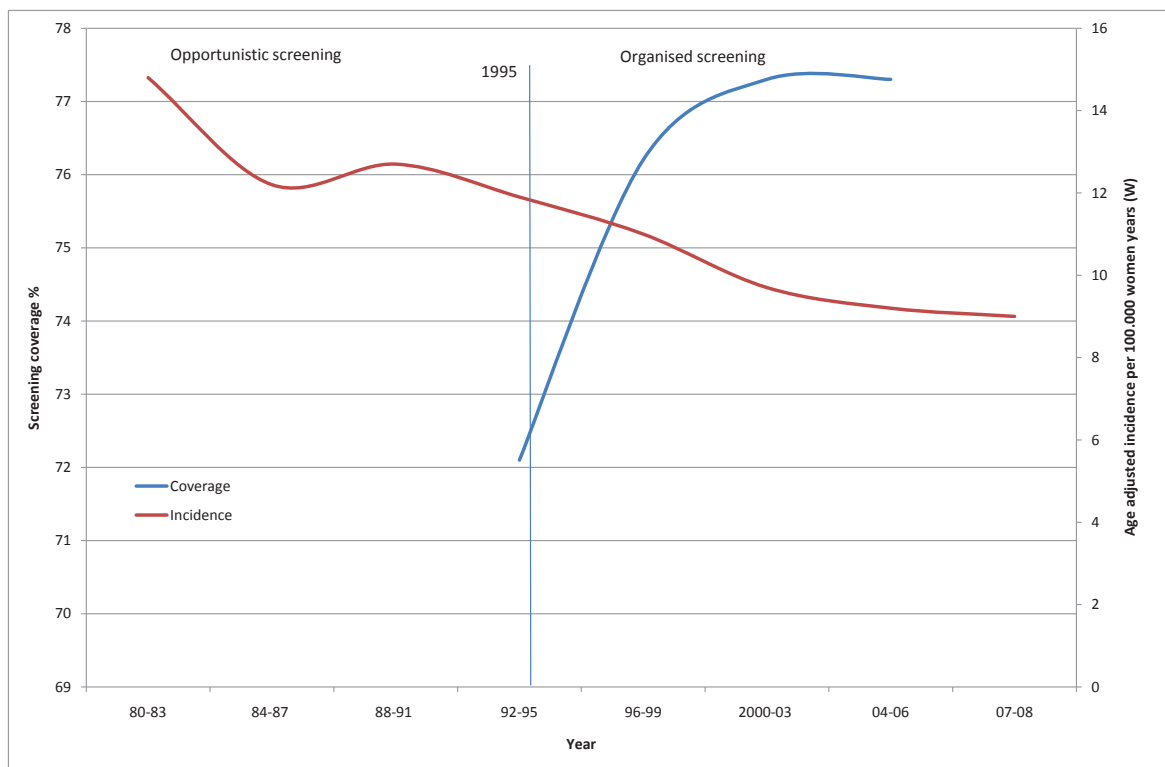


Figure 6
Cervical cancer incidence rates and coverage before and after organised screening (Cancer Registry of Norway, 2009).

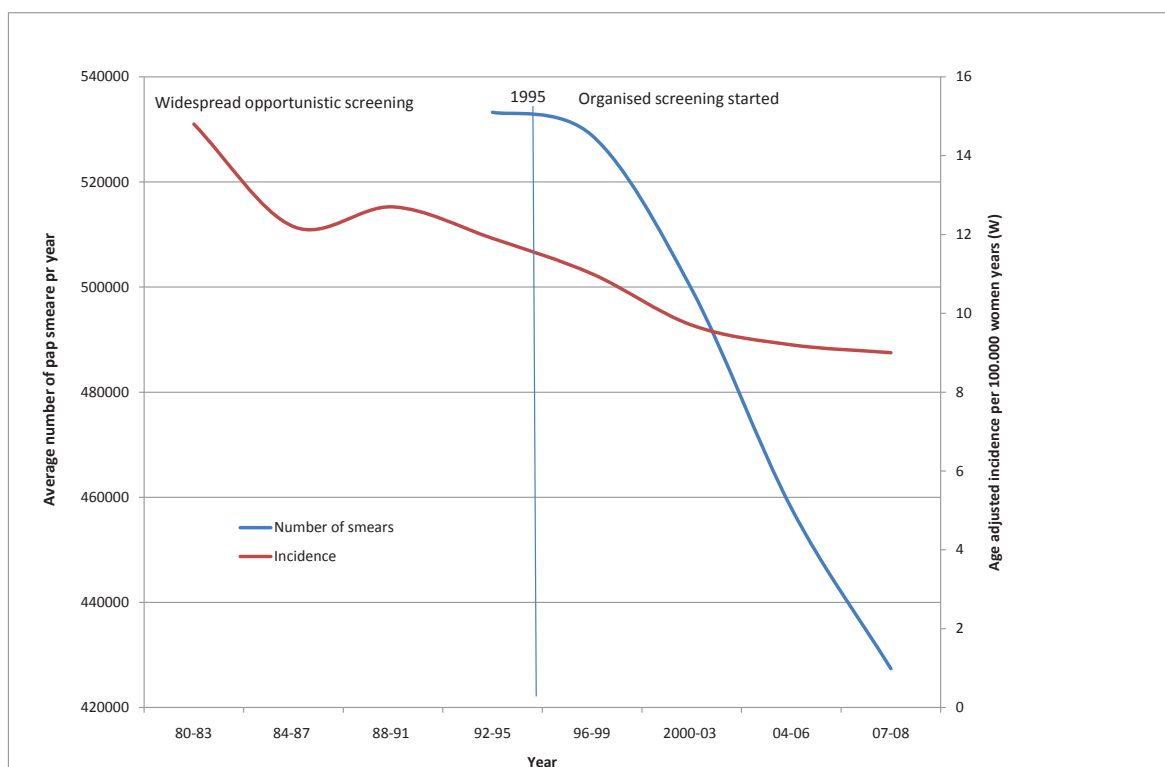


Figure 7
Cervical cancer incidence rates and number of Pap smears before and after organised screening (Cancer Registry of Norway, 2009)

although improvements in both groups have been demonstrated (Kreftregisteret, 2008; Haldorsen et al., 2008).

Cervical screening tests can turn out to be false positive or false negative which might have unfavourable implications. False negative tests give rise to harmful personal consequences by implying false reassurance. False positive tests can lead to unnecessary follow-up tests, leading to both human and financial costs. In Norway, all women diagnosed with CIN2+ are recommended treatment. Annually, about 3 000 conisations are performed (Kreftregisteret, 2008). It seems obvious that some women are overtreated, as the likelihood of CIN3 progression into invasive cancer is estimated to be around 30% (McCredie et al. 2008). Excision of part of the cervix might have negative long-term effects. Sjøborg et al. found that odds ratio for giving birth before week 37, 32 and 28 after conisation compared to a control group were 3.4, 4.6 and 12.4 respectively (Sjøborg et al. 2007). In another study, Albrechtsen S et al. investigated cervical conisation and influences on outcome in subsequent pregnancies (Albrechtsen et al. 2008). Like Sjøborg et al., they observed an increased risk of preterm delivery, especially in the early gestational age-groups in which the clinical significance is highest. The relative risk of delivery was 4.4 at 24-27 gestational weeks, 3.4 at 28-32 weeks, and 2.5 at 33-36 weeks.

Cost- Effectiveness

A cost-effectiveness analysis was not carried out prior to the commencement of the organised screening programme in 1995, and none has been made since. Internationally, different models of cost-effectiveness support the message that organised screening is more cost-effective than opportunistic screening (Goldie et al., 2006; Chow et al., 2010). Obviously, there is a great need for evaluating the cost-effectiveness of the Norwegian Cervical Cancer Screening Programme.

Future prospects

The Norwegian cervical cancer screening programme will face fundamental changes in the future.

Most importantly, new regulations for the collection and processing of personal health data in the CRN are announced, and will probably be introduced in 2011. Supposedly, this will alter the way the screening programme is organised and run. At present, there is no information available on the content of the announced new regulations, or how they will be operated.

In 2010, the Norwegian Data Inspectorate decided that the CRN is obliged to collect consent from all women screened in order to keep normal (negative) test results registered together with the personal identification data. If not, the CRN is forced to delete the personal identification attached to approximately 6 million negative tests from 1.5 million women. About 95% of the data recorded in the Cytology Register are from negative tests. The ultimate consequence of deleting 95% of these data is that the screening programme has to be terminated. This will also result in the loss of valuable data needed for research, quality assurance and evaluation.

Triaging with HPV testing was established as a part of the official screening programme in 2005, and has led to a rather heated debate of whether it should have been implemented in the first place and secondly if it should be continued or not. The main issue of these discussions is which kind of HPV tests, DNA or mRNA, including the number of genotypes tested, is the most efficient and suitable for screening. Recently, the Norwegian Directorate of Health suggested restrictions for HPV tests to be used within the screening programme. It is expected that the Ministry of Health and Care Services in the near future will prepare a final conclusion on this long lasting controversy.

In December 2010, the Norwegian Directorate of Health passed a proposal to the Ministry of Health recommending a pilot study evaluating the use of HPV tests instead of Pap test as the primary

screening tool. A prerequisite for converting to HPV based screening is that all laboratories involved have converted to liquid based cytology in due time. To augment transition, the health authorities introduced a reimbursement system for liquid based cytology in 2010.

From 2009, and subsequent to another long and heated debate, the Norwegian health authorities offered 12 year old girls free HPV vaccination. It's expected that HPV mass vaccination will affect the prevalence of genital HPV infections, cervical precancers and cancers in the future. This will have a tremendous effect on how future screening should be organised. Nevertheless, screening of both vaccinated and non-vaccinated women will be needed for many years to come and it will be of great importance to integrate primary (vaccine) and secondary (screening) prophylaxis to form a comprehensive and effective programme for preventing cervical cancer in the future.

Summary

Implementation of a nationally coordinated cervical cancer screening programme in Norway has contributed to a lower incidence and mortality of the disease, to a more rational use of tests and a somewhat better attendance, especially among women older than 50 years. The effectiveness of organised versus opportunistic screening has also been demonstrated. The existing screening programme is facing challenges including the risk of being terminated. Continuation of a nationally coordinated cervical screening programme is strongly recommended also in the future.

Acknowledgements

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HPV primary screening in Norway: Recommendations for a controlled population based implementation study

Ole-Erik Iversen, Bjørn Hagmar, and Olav Karsten Vintermyr

Background

Cervical cancer is the second most frequent cancer globally. Even in European countries with well functioning screening programmes, the disease incidence ranks number two after breast cancer in young women (< 45 years). Today, it is well recognised that cervical cancer is caused by persistent infection with high risk HPV types, among which HPV type 16 and 18 accounts for 70 % of all cases. At least 12-14 different HPV types have been shown to be oncogenic in humans.

Organized screening against cervical and breast cancer started in 1995. In contrast to the breast screening programme in which the major goal is to discover cancer at an early stage and to reduced mortality, cervical cancer screening also aims at reducing the incidence by detecting and treating severe precursor lesions (CIN 2 and CIN 3). There is solid scientific evidence that this strategy has been a success in many countries (McCredie *et al.*, 2008). For equivocal smears (ASCUS, LSIL and inadequate smears) HPV testing in triage was recommended in 2005 and with a planned evaluation period for 3 years. A final evaluation of the benefits of HPV testing in triage for equivocal smears is still pending, however.

The scientific evidence for replacing cytology with HPV test

The primary strength of cytology is its specificity for detection of CIN 2+, whereas its main drawback is a relatively low sensitivity (of 50-60 %) for detection of CIN 2+ (Cuzick *et al.*, 2006). The method may to some degree be subjective and reproducibility has also been shown to be suboptimal (Scott, 2002).

HPV testing, on the other hand, as a more objective and reproducible method has a reported sensitivity for detection of CIN 2+ of 90-95%, based on various recent randomized clinical trials from several European countries (Leinonen *et al.*, 2009; Bulkman *et al.*, 2007; Kitchener *et al.*, 2009; Naucner *et al.*, 2009; Ronco *et al.*, 2010). Consequently, population based piloting HPV primary screening was recently recommended within organized programmes as a new screening option in the EU guidelines for screening against cervical cancer (Arbyn *et al.*, 2010). Of particular importance, a negative HPV test result has a high negative predictive value for not having high grade cervical lesion so that the regular screening intervals may be increased without increasing the risk of CIN 2+ (Dillner *et al.*, 2008). Of notice, these European trials show very consistently that more CIN 2+ cases are detected in the first screening round of the HPV arm (as compared to the conventional cytology screening arm), but a reduced detection of CIN 2+ in the following second screening round. The clinical significance of this observation is that women who will need treatment could be detected at an earlier stage without apparently more women being treated in total. The high sensitivity of HPV testing for detection of CIN 2+ will be of particular significance in the near future when the HPV type 16/18 vaccinated cohorts of young women will enter ordinary screening age (25 year), because the prevalence of high grade cervical lesions will then presumably decrease drastically (Castle *et al.*, 2010). A partial cross protection from vaccination against other hrHPV types may further add to a reduction in severe HPV induced cervical lesions.

The prevalence of HPV infection has risen sharply in many countries over the last 20-30 years and organised and opportunistic screening has prevented a high number of cervical cancers (Peto *et al.*, 2004). In general, about 1 out of 3 premalignant cases (CIN 2+) will progress into invasive cancer if left untreated (McCredie *et al.*, 2008). In Norway alone 3000 conizations for CIN 2+ take place yearly. Thus, an estimated number in the order of 600 - 1200 cervical cancers are prevented each year by organized screening.

The process so far

In the fall 2008, the Advisory Board of the National Screening Programme unanimously voted to perform an evaluation of a potential introduction of HPV testing to replace cytology as the primary test for screening in Norway. Prof. Hagmar chaired a committee (Group I) which already the next spring concluded that there was sufficient scientific evidence, based on clinical trials from several countries, to advice a population based implementation study to be conducted in Norway. The group furthermore gave a clear recommendation to the health authorities that a detailed plan for HPV test in primary cervical screenig, including a cost effective analysis, should be made. The recommendations were accepted by the Health Directorate, leading to a second group (Group II) to be established in the fall of 2009, initially chaired by Hagmar and later by Prof. Vintermyr. The group finalized a detailed project description, including

a cost effective analysis, in November 2010. The proposed project was in December 2010 approved by the Health Directorate, which in turn made a recommendation to the Health Minister to have it considered for implementation in the trial population (Figure 1).

Details of the recommended population based implementation study

In accordance with the European Guidelines (Arbyn *et al.*, 2010) demonstrations projects similar to postmarketing surveillance of new drugs (Phase IV studies), population based implementation studies are the logical next step for new diagnostic or therapeutic methods. The primary targets for such a proposed implementation study are:

1. To quantify potential health benefits with primary HPV based screening compared to the present cytology based screening.
2. Compare the participant attendance rate before and after introduction of HPV test
3. Evaluate logistics in clinical practice, laboratories and the Central Screening Unit in the Cancer Registry.
4. Evaluate benefits in use of other resources in the programme
5. Gain experience in the spreadof relevant information to health personnel and the general public.

Details of the milestones for the proposed implementation study are presented in Figure 1.

Time (year)s from start	-3	-2	-1	1	3	6	8	10
	2010	2011	2012	2013	2015	2018	2020	2022
1. Application	↓							
2. Project group		↓						
3. Final application			↓					
4. Project start				↓				
5. Logistics and information				-----	-----	-----	-----	-----
6. Quality control				-----	-----	-----	-----	-----
7. Project evaluation								-----

Figure 1
Milestones for the proposed implementation study

Based on favourable experiences from introductory pilot studies prior to nationwide implementation in both cervical and breast cancer screening programmes, the very same strategy was proposed for this implementation study. In the study, 4 out of 19 Norwegian counties have been selected (Rogaland, Hordaland, Sør-Trøndelag og Nord-Trøndelag), covering about 1 mill out of 4,9 millions totally in Norway. Close to 100% of all cervical smears are being examined in their local university pathology facilities in these counties, all of which have extensive experience in HPV testing (Vintermyr *et al.*, 2008). All specimens are planned to be liquid based, allowing for possible reflex testing, biobanking and additional scientific projects. Biobanking of aliquotes will facilitate posthoc analyses, and evaluation of the clinical potential for new biomarkers. A special discussion has taken place regarding whether to stratify the follow-up of HPV positive women based

on HPV subtyping (HPV 16/18). Since results from randomised clinical trials on this issue is still insufficient and from the mere fact that HPV subtyping also adds further complexity into the screening algorithm, HPV subtyping has not yet been proposed as an integrated part of the screening programme.

The target population will be women aged 34-69 years. This means that they will in general have passed already three rounds of screening by cytology before entering the HPV based primary screening programme at 34 years of age. (Figure 2.). The total number of screening rounds after age 34 will thus be halved from 12 to 6. As can be seen from the milestones in the proposed project (Figure 2) a complete screening round of 6 years and 2 years for follow up is suggested before a final evaluation of the implementation study.

Screening algorithms

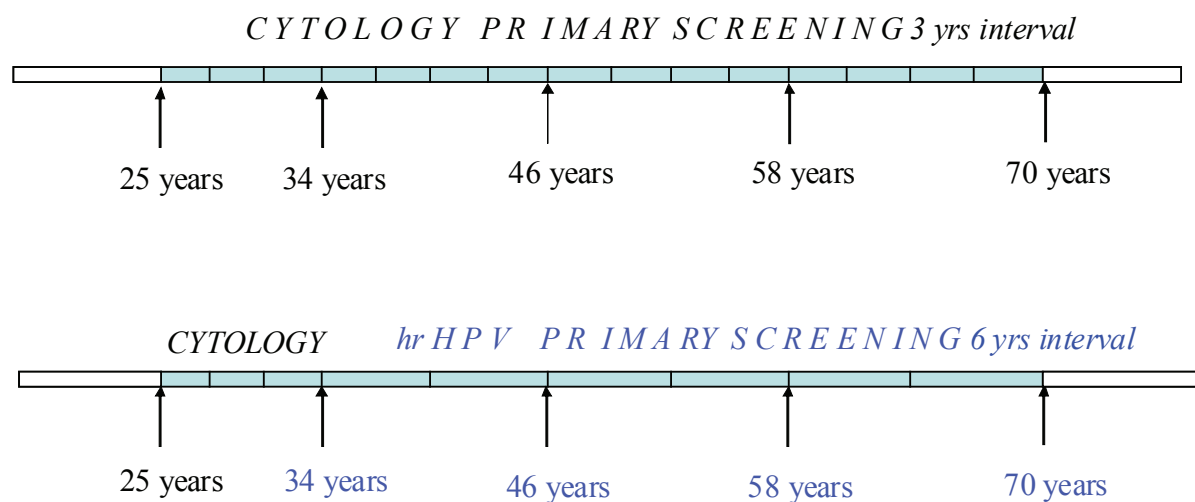


Figure 2

An overview of HPV versus cytology based primary cervical screening.

Follow up of HPV positive women

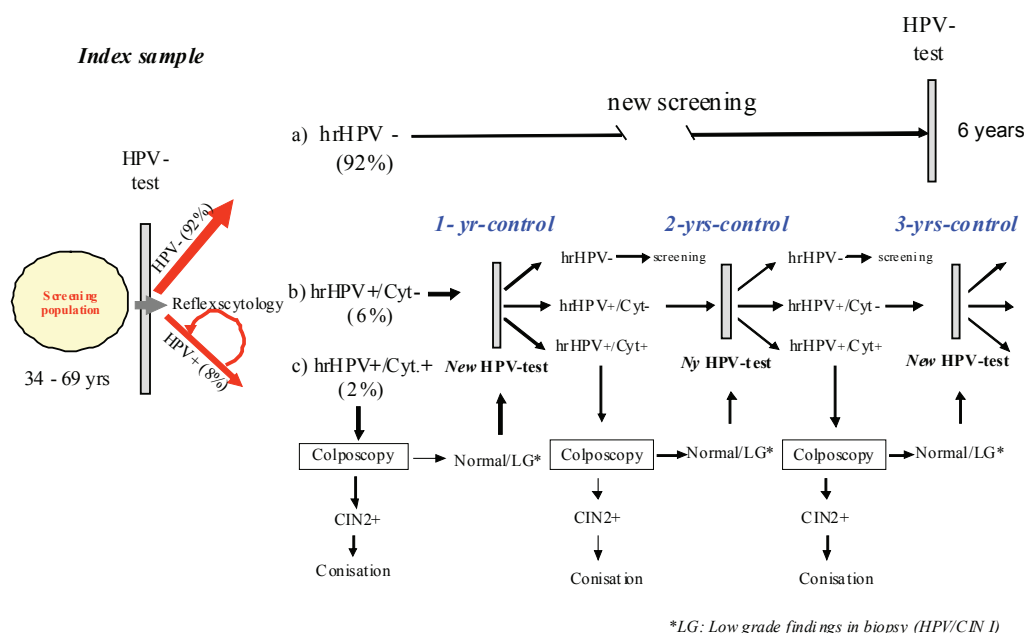


Figure 3
Follow up of HPV positive women

Based on whether the HPV tests are positive or negative a completely new follow up screening algorithm is proposed as shown in Figure 3. An average HPV positive rate of 8 % was used for all age groups in the HPV screening programme for cost-effectiveness analysis. This should be a very robust basis for calculation of costs.

A HPV test applicable for the programme must meet some well defined and strict criteria as regards test performance and documented performance in clinical trials (Meijer *et al.*, 2009). A minimum of the 12 most prevalent hrHPV types must be included in the test. A tender among providers of available HPV tests, meeting a set of strict performance criteria, will be recommended before a final decision on which specific HPV test to be selected for the implementation study. It is recommended that the same HPV test is used by all sites in the implementation study.

In countries having a well functioning cervical screening programme against cancer, a remaining main challenge for further improvements will be to increase the attendance rate, since the majority of cancers are seen in the minority (appr. 20 %) who do not attend the screening programme. HPV test based screening does have an added possibility for home

based self sampling. In this way unscreened women may be offered a simple self sampling kit suitable for mailing to the county laboratory for cervical screening (Gök *et al.*, 2010).

Results and experiences from the above mentioned implementation study will be presented in international scientific journals.

Cost- effectiveness analysis

HPV test in primary screening against cervical cancer will be cost effective when increasing the routine screening interval from 3 to 6 years as proposed in the presented implementation study. This has also been observed by others (Berkhof *et al.*, 2010). Moreover, and not the least, primary cervical screening based on HPV testing will prevent more women from having cervical cancer than a screening system based on cytology as of today.

Process in 2011 and further

As mentioned above, the Health Directorate supported the plan in December 2010. As of February 2011 the proposed project is currently under consideration in both the Health and Finance Departments in the Government. Hopefully a decision can be made before the National Budget will be presented in the fall of 2011.

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Impact of prophylactic HPV vaccine: Primary prevention of cervical cancer in Norway

Mari Nygård and Ole-Erik Iversen

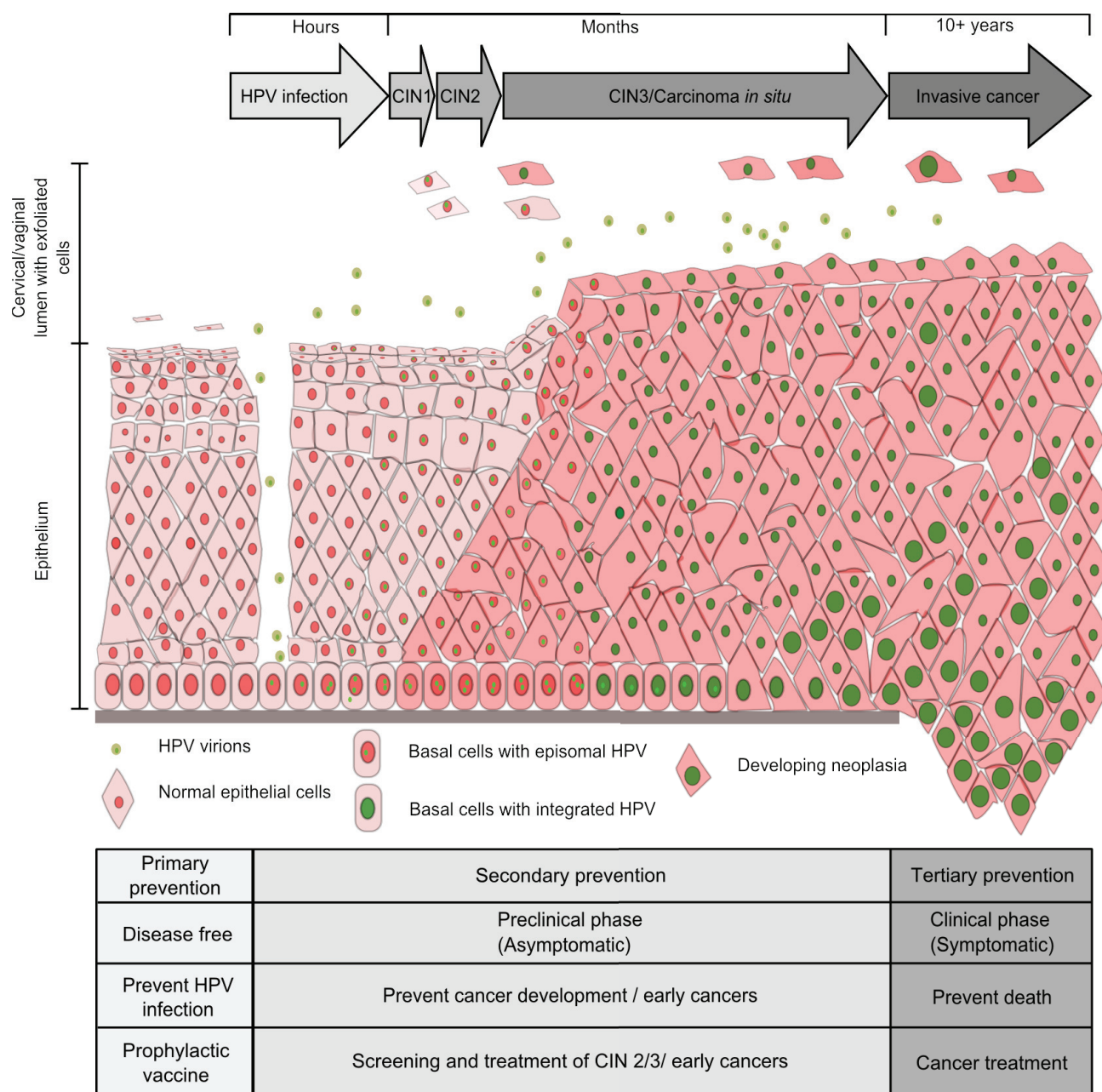
Cervical cancer: natural history and prevention

Cervical cancer is an infrequent end-stage of a series of changes that begin with infection with human papillomavirus (HPV) and range from minor cellular abnormalities to definitively pre-invasive lesions and invasive cancer. An HPV infection and its sequel in the population come in all sizes, from obvious cancers, down to symptomless but morphologically distinct intraepithelial lesions and infections that can be revealed only by a special microbiological test.

The natural history of cervical cancer is schematically depicted in Figure 1. Implicit is the notion that cervical cancer develops over a long period of time, starting with the infection with high risk (hr) types of HPV. HPV access the basal cells through micro-abrasions in the cervical epithelium (Woodman *et al.*, 2007). After infection, HPV may be found in episomal forms, integrated forms, or both. Viral DNA replicates from episomal forms to produce new progeny virions, that are encapsidated and shed in the cervical lumen. The integration of HPV DNA into the host cell genome can lead to cellular transformation and development of cervical intraepithelial neoplasia (CIN). CIN is characterized by abnormal cellular proliferation, abnormal epithelial maturation and cytological atypia. To diagnose CIN histologically, nuclear abnormality is required to be present in full thickness of the epithelium and is graded as I, II and III, (CIN I, II, and III). These changes are most likely to regress, specifically in CIN I & II, (Castle *et al.*, 2009; Nygård *et al.*, 2006). While infection with hr HPV

is necessary and indicates a biological onset of the disease, the HPV infection alone is insufficient for cancer development. Persistence of the infection over time increases the risk for further development of pre-invasive lesions (Kjaer *et al.*, 2010). Clinically, this stage is asymptomatic and cannot be diagnosed without screening. Left untreated, almost one third of these lesions progress to invasive cancer during the next 20 years (McCredie *et al.*, 2008). Along with cancer progression clinical symptoms appear, such as discharge, bleeding and pain. Appropriate treatment can cure the disease or postpone death, depending on the extent of the cancer stage at the time of diagnosis.

Obviously, cervical cancer is a disease which should be considered a continuum rather than dichotomous by its nature. Individual risk of being diagnosed with or dying from cervical cancer is dependent on where in the progress of natural history it has been diagnosed. If cancer is already present, the aim of the intervention is to postpone death; in the case of pre-invasive lesion, the intervention aims at stopping disease progression towards cancer. Intervention can also protect against the cause of the disease if given to the disease-free subjects. Measures for cervical cancer prevention have developed gradually, being closely linked to what is known about its natural history (Figure 1). Tertiary prevention refers to the treatment and rehabilitation of cancer patients in order to cure or improve quality of life. In cervical cancer the late-stage treatment is expensive and the outcome is poor. Since 1956 a five-year relative



Nygård & Enerly, 2011

Figure 1

Natural history of cervical cancer. Prevention of cervical cancer: aim and means of intervention.

survival rate of 10% has remained unchanged for patients with stage IV disease, while in 1997-2001 survival amongst patients with a stage I was >90% in Norway (Cancer Registry of Norway, 2007). In secondary prevention, through screening, individuals with asymptomatic pre-invasive lesions are identified (in pre-clinical phase of the disease) and treated to halt the process of cancer development. In organised programmes all women in defined age-groups are invited regularly to screening. Early diagnosis and

treatment of cervical disease has proved to be a successful population strategy to combat morbidity and mortality associated with cervical cancer (IARC, 2005). However, as a secondary prevention, screening does not target the cause of cervical cancer, which is, as recently established, an infection with hr HPV. Prophylactic vaccines against hr HPV are now available. Immunization with highly efficacious HPV virus like particle vaccines protect against infection with HPV6/11/ and/or 16/18.

A hierarchical approach to cervical cancer prevention in Norway is presented in Figure 2. About 300 new invasive cancer patients are treated yearly in Norway. Approximately 60% of them are in an early stage with a good prognosis. As secondary prevention, yearly 3 000 women at high risk for cervical cancer are treated to prevent CIN II/III progression to cancer.

In order to determine this high-risk group about 450 000 screening smears are taken yearly from women aged 25-69 years. As a primary prevention of cervical cancer, mass-vaccination against HPV types 16/18/6/11 started in Norway in 2009, and girls at the age of 12 were offered free vaccine. About 70% of the 1984 birth-cohort has been vaccinated.

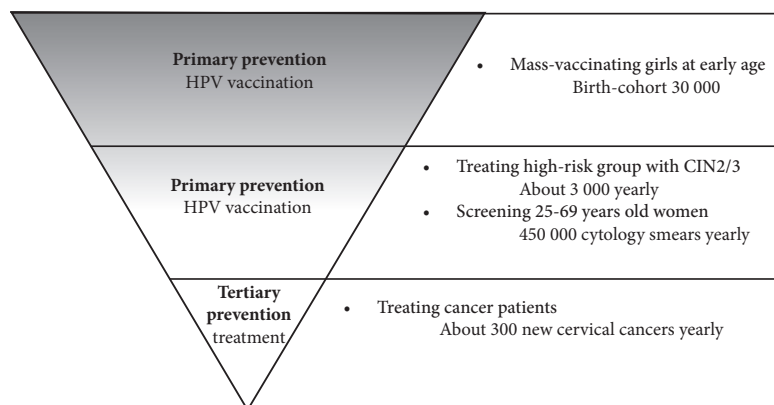
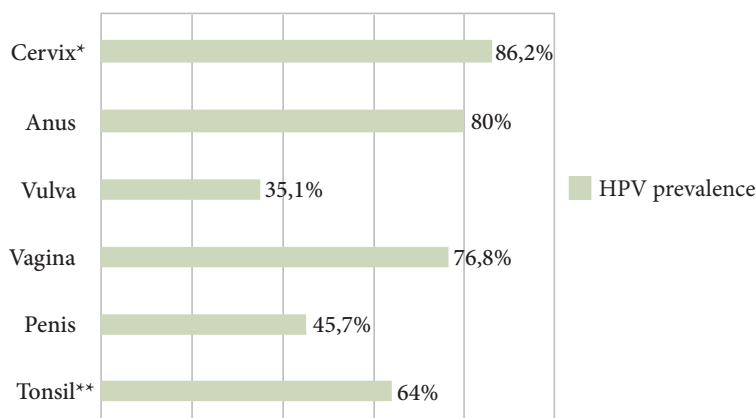


Figure 2
Application of the three levels of cancer control measures for cervical cancer control in Norway

Role of HPV in squamous cell cancers other than in cervix

Detected from virtually all cervical cancers and CIN II/III (De Vuyst *et al.*, 2009a; Smith *et al.*, 2007), infections with hr HPV are also associated with development of squamous cell cancers in other locations than the cervix. HPV is proposed to be responsible for 5% of the global cancer burden (Parkin, 2006).

HPV DNA is detected in different cancer types as summarised in Figure 3. About 40% and 80% of vulvar and vaginal cancers, respectively, are reported to be positive to hr HPV supporting the notion of mixed etiology of these cancers (De Vuyst *et al.*, 2009b). The causal role of the HPV infection in oropharyngeal cancer is currently debated (Gillespie *et al.*, 2009; Gillison *et al.*, 2008). Increase of both HPV positive tonsil and base of tongue cancers, has



* Smith *et al.*, 2007

** Norway only. Hannisdal *et al.*, 2010

Source: WHO/ICO Information Centre on HPV and Cervical Cancer, Human Papillomavirus and Related Cancers in Europe, Summary Report 2010.

Figure 3
Presence of HPV in different cancers in Europe

been reported in several recent studies (Attner *et al.*, 2010; Mork *et al.*, 2010; Nasman *et al.*, 2009; Shiboski *et al.*, 2005). The majority of the anal (over 70%) and penile cancers have been tested positive for HPV (Bleeker *et al.*, 2009; Hoots *et al.*, 2009).

HPV types detected in cervical cancers and pre-invasive lesions vary, being dependent on the geographical region and study sample type (general population *versus* high risk population). HPV16, the most common high risk type, has been reported to be present in 49-81% of pre-invasive lesions in cervix. HPV types 16 and 18 have been detected from 52-64% and 11-22% of cervical, 27-58% and 2-10% of vulvar and 46-77% and 3-27% of vaginal cancers, respectively (De Vuyst *et al.*, 2009a; De Vuyst *et al.*, 2009b; Garland *et al.*, 2009; Insinga *et al.*, 2008; Smith *et al.*, 2009; Smith *et al.*, 2007). HPV type 16 has been the most usual type detected from oro-pharyngeal, anal and penile cancers (Ang *et al.*, 2010; Bleeker *et al.*, 2009; Hoots *et al.*, 2009).

Overview of the Prophylactic HPV vaccines

Since the publication of the highly effective HPV16 monovalent prototype vaccine in 2002, (Koutsky *et al.*, 2002) two other prophylactic vaccines have been tested in Phase III trials and marketed. The bivalent vaccine protects against HPV16 and 18 (Paavonen *et al.*, 2009) and the quadrivalent also includes HPV6 and 11, types that cause about 90 % of genital warts (Munoz *et al.*, 2010). Although they share the virus-like particle principle, differences in production and clinical trial details of the two vaccines do not allow direct comparisons between them, regarding many aspects of performance (Stanley, 2008). Broadly, both vaccines have been shown to be highly efficacious in preventing 90-100% of the HPV16/18 related CIN II and CIN III, and adenocarcinoma *in situ*. In addition to trials in adolescent girls and women, the quadrivalent vaccine programme also includes boys and men (Stanley, 2008). Second generation HPV vaccines against several other hr HPV types, have been in clinical trials since 2007, and are considered to be protective for about 90%

of cervical cancer cases worldwide (Stanley, 2010). Duration of protection so far has been shown to be at least 9 years with the prototype HPV-16 vaccine, and immune memory has also been documented. Some cross-protection has been shown against closely related HPV types (eg HPV31 and 45) with both vaccines (Brown *et al.*, 2009; Paavonen *et al.*, 2009; Wheeler *et al.*, 2009). Replacement with other genotypes, known to exist in bacterial infections, are under surveillance, but considered unlikely after HPV vaccination.

Epidemiology of the sexually transmitted HPV infection in Norway: timing of the prophylactic vaccination

No evidence of HPV infection among virgins, but a high prevalence of genital HPV DNA in young women shortly after sexual debut implies that genital HPV transmission probability is extremely high among HPV naive populations (Andersson-Ellstrom *et al.*, 1996; Kim *et al.*, 2011). However, the period of infectiousness cannot be very long, because of the rapid clearance of the infection. Hence, the proportion of persons to be immunised has to be high and the vaccination must focus on the whole population, not only on the sexually transmitted disease core group. In Norway, 4-years cumulative incidence of HPV infection among young females, 16-28 years of age was 25% for HPV16 and 14% for HPV18 in 1998-2005 (Kim *et al.*, 2011). HPV16/18 prevalence among women less than 24 years of age was about 23% in 2007 (unpublished results) supporting the notion of the highly transmissible and rapidly clearable nature of HPV16/18 infection in young Norwegian females. Based on the literature, 52-67% of CIN II/III and 75-84% cervical cancer is attributable to infection with HPV16 /18 (Insinga *et al.*, 2008; Munoz *et al.*, 2003; Smith *et al.*, 2007). Given vaccines will eliminate all the HPV16/18 attributed CIN and cancer cases, assuming no cross-protection or replacement, the incidence rates would drop remarkably, as depicted in Figure 4.

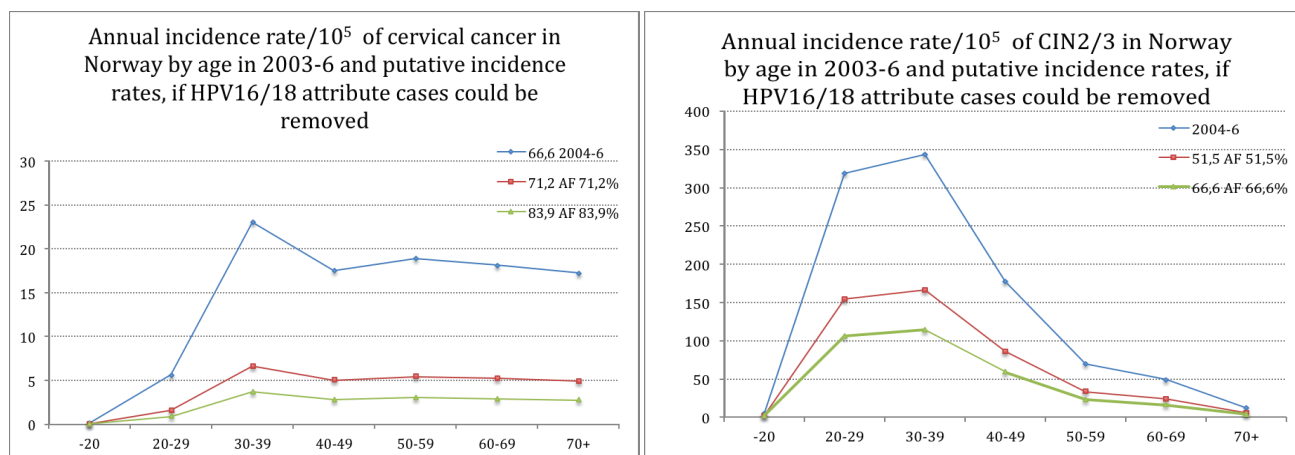


Figure 4

Annual incidence rates/10⁵ of CIN 2/3 and cervical cancer in Norway by age in 2004-2006 and putative incidence rates if HPV16/18 attributed cases could be removed.

Timing the prophylactic HPV immunisation shortly before sexual debut would be theoretically ideal for achieving best response and efficacy. However, it is difficult to define such an age precisely. Also, age at first intercourse has been subjected to change over time, well demonstrated by the questionnaire studies on sexual habits in Norway. The median age at first intercourse for males has been lowered from age of 19 for the birth cohorts 1927-1934 to age of 18 for the birth cohorts 1980-1984. This change was even larger for females, from 20 to 17 years of age, respectively (Stigum *et al.*, 2010).

From the perspective of executing the mass-vaccination programme, the cost-effectiveness of the programme increases if the vaccine is given to age-groups before onset of sexual life, i.e before time of exposure to HPV. A very recent questionnaire study in 2004-2005 among females 18-45 years of age collected information about HPV infection and related risk factors. Less than 3% of women reported age of first sexual intercourse before the age of 13, 10% reported their first sexual intercourse at the age of 14, and 66% before 17 years of age (Jensen *et al.*, 2011). Age 12, therefore seems to be justified, in the

Norwegian context, to launch the mass-vaccination programme for optimal effect in terms of cost and public health benefit. However, it is unfair to assume that on an individual level, an onset of the sexual life itself is equal to contracting HPV infection. Many studies have showed positive correlation between hr HPV positivity and increasing number of sexual partners. Therefore, on an individual level, vaccination could be considered at ages older than that recommended in the childhood vaccination programme. In fact, many countries provide, so called catch-up vaccination in the enrollment phase of the mass-vaccination programmes, in order to provide protection to girls in older age cohorts, albeit with lower cost-effective gain. Alternatively, in some countries the vaccine is subsidized if given before a certain age to stimulate immunization outside the programme reducing therefore health inequalities between families who can and those who cannot afford this vaccine. Recently, immunization of women up to age 45 was reported to be highly effective (Munoz *et al.*, 2009).

Generally, absolute numbers of patients with HPV related cancers is low, including anal, penile,

oropharyngeal and oral cavity cancers. Men who have sex with men and in particular HIV positive men are at high risk, even higher than the risk of cervical cancer in an unscreened population. Recently, an increase of HPV related oropharyngeal cancers have been documented in many countries, also in Norway (Blomberg *et al.*, 2011; Braakhuis *et al.*, 2009; Mork *et al.*, 2010; Shiboski *et al.*, 2005). Figure 5 depicts the temporal changes in crude incidence of cervical SCC in women and oropharyngeal SCC in men through a period of 1954-2008 in Norway. In boys, antibody titers are slightly higher after HPV vaccination than

in girls of similar age. Clinical protective efficacy was recently reported also for men (Giuliano *et al.*, 2011). So far, few countries have included boys in the vaccine recommendations. However, based on increasing disease burden, herd immunity aspects, better documentation of efficacy as well as reduced vaccine cost in the programmes; new cost effectiveness calculations should be made to update vaccination recommendations to eventually also include boys and men in the future.

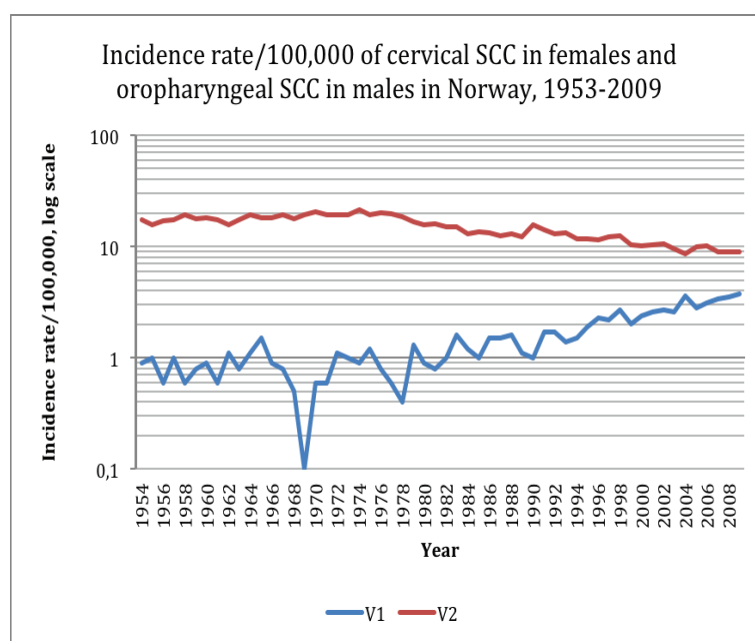


Figure 5
Annual incidence rates/ 10^5 of squamous cell cancer in oropharynx (males, v1) and squamous cell cancer in cervix (females, v2) in 1954-2009, Norway

Duration of vaccine effect

HPV vaccines became available in 2006, implying that documented duration of the vaccine efficacy is limited to the time of follow-up of the efficacy trial, i.e. about 4 years. The prototype HPV16 vaccine is the only one so far shown to be highly effective up to 9 years (Koutsky, 2009). Of particular importance was the finding that protection against HPV18 associated lesions was high even though only 60% of the women had measurable anti-HPV antibodies (Joura *et al.*, 2008), indicating that presence of the vaccine induced immune memory cells. By vaccinating young girls at age 12, the effect

is expected only about 10 years ahead. Whether there will be need for booster is a question yet to be answered.

Side effects of the vaccine

In clinical trials, the quadrivalent HPV vaccine was well tolerated in adolescent girls, young women and women 24-45 years of age. Fever, nausea and dizziness were the most common systemic adverse experiences, as measured in 1-14 days post-vaccination. Injection site adversities were measured in 1-5 days post-vaccination: pain and swelling occurred in 84% and 26%, respectively. These side-effects were mainly responsible for the slight increase

in adverse events in the vaccine group (Villa, 2007). Serious adverse events were recorded in <1% of women 24-45 years of age (Munoz *et al.*, 2009) and among 102 of 21 464 total subjects who received both quadrivalent vaccine and placebo (including 9-26-year-females and 9-15-year males). The most frequent serious adverse events were headache, gastroenteritis, appendicitis and pelvic inflammatory disease, rhinitis, vertigo, pulmonary tuberculosis, anemia, pyelonephritis, ectopic pregnancy and hepatitis, but none were vaccine-related. Slade *et al.* reported a study on vaccine safety on post-licensure period, following the distribution of more than 23 million quadrivalent HPV vaccine doses in the United States as of December 31, 2008. Data from the US Vaccine Adverse Event Reporting System for the 2.5 years following licensure were analyzed. The most frequent serious symptoms reported were headache followed by nausea, dizziness, vomiting, pyrexia, fatigue and syncope. Medically important serious events included 8 reports of anaphylactic reaction (1%), 9 deep vein thrombosis (1.2%), 31 Guillan Barré Syndrom (4%), 25 hypersensitivity (2.5%), 10 transverse myelitis (1.3%), 6 pancreatitis (0.8%), 14 pulmonary embolism (1.8%), 23 death (3%), 68 convulsion (8.8%), 30 urticaria (3.9%), and 9 autoimmune disorder (1.2%). The post-licensure safety profile was broadly consistent with safety data from pre-licensure trials, and most of the adverse event rates were not greater than the background rates and as compared with other vaccines (Slade *et al.*, 2009). However, the continuous surveillance of adverse effects is of utmost importance to document the safety profile of any vaccine.

HPV type replacement and cross-protection

The impact of successful vaccination against HPV16/18 might introduce a so-called ecological niche for the non-targeted hrHPVs as shown in theoretical studies on bacterial vaccines (Lipsitch, 1997; McLean and Blower, 1993). According to considerations of evolutionary biologists, the equilibrium of different strains or sero-types of the same infectious agent in the population is a dynamic state and results from competition between

the different types. Consequently, implementation of vaccination is expected to be followed by perturbation of the equilibrium between two or more types (Ewald, 1993; May and Nowak, 1995; McLean, 1995; Nowak and May, 1994). However, the presence of several HPV types in one person suggests little competition between HPV types, and therefore this scenario is likely not-applicable. In fact, several recent reports rather support evidence of cross-protection for non-vaccine included types (Ault, 2007; Paavonen *et al.*, 2009).

Discussion

Cervical cancer is an infrequent long-term complication of otherwise transient and common HPV infection. To control cervical cancer, screening programmes are shown to be effective. However, there are several drawbacks of this strategy. Screening inevitably causes concerns about the health among women who perceive themselves as healthy. This concern is surely justified by the benefits, but is still a cost. Further, successful disease control can be achieved only by screening women regularly, in three year intervals, through a period of 45 years. This constitutes 15 screening visits per women, life-long, given that all visits are normal. Unfortunately, a screening test is, by nature imperfect, and cannot separate with 100% precision, those at risk. Consequently, several screening positives will be disease free; as well some who are ill will be screened as disease free. Another aspect is screening attendance and in Norway about 20% of women don't follow the recommendations to take a screening test. The fact that 50% of cancers are rising from this population makes it extremely important to motivate women to regularly attend screening. In spite of all these obstacles, mass-screening for cervical cancer is one of the most cost-effective prevention measures available in fighting cancer. The biggest advantage of the screening strategy is that preventive action is not applied on women with low risk of cancer. A woman with CIN II/III only needs to be treated, presumably appealing decision both for the women and doctor. Those who are not at higher risk do not need to be

treated as they can be assured at being low risk until next recommended screening round. The fact that screening is organised within the existing medical organisation also helps to bridge the separation of clinical service and public health. As in classical medicine, the doctors concern is directed to help those with complains, and not those with increased risk for disease. The acceptance of preventive responsibility by clinicians is prerequisite to keep prevention within the mainstream of medicine.

However, cervical cancer screening contributes only little to overall control of all HPV related diseases. Availability of prophylactic vaccine, a primary prevention, therefore opens alternative possibilities to prevent both cervical and other HPV-related cancers by eliminating the widespread cause, an infection with HPV. While HPV is an immediate cause of cancers, sexual behaviour determines the exposure to HPV. It has been stated that changes in sexual behaviour represents the biggest shift in social norms in the 20th century. The epidemiologic pattern of HPV infection in the population is a reflection of the sexual behaviour in given socio-cultural circumstances, and is both socially conditioned as well as depending on personal choices. Furthermore, increase of HPV induced tonsillar and anal cancers in men are in line in what is known regarding changes in sexual behaviour. Therefore, to provide vaccination both for males and females is both morally and medically justified if the goal is to prevent HPV related cancers, including cervical cancer. Theoretically, vaccinating both girls and boys against HPV would be a radical and powerful approach, which would lead to rapid decrease in HPV infections. Obviously, this expected gain in health would be observable only in many years ahead, and justifying the cost of vaccination of both sexes has proved to be difficult.

Obtaining societal acceptance for a vaccine can be challenging. Population-wide preventive measures offer disappointingly little immediate benefit to the individual, which reduces the motivation to be vaccinated. Therefore, rarely occurring possible side effects of vaccination should be carefully considered. The safety profile of the vaccine is thoroughly reviewed and continues to be in focus in post-licensure studies. Reports from clinical and post-licensure studies, however, show only minor vaccine-related localised side-effects. It should be underlined, that lack of evidence is not evidence of its non-existence, and careful monitoring of long-term side-effects of vaccination is of major importance. Currently in Norway the childhood vaccination programme offers vaccine only for 12 year old girls. This strategy does not aim to eradicate relevant HPV types as only 50% of the population at risk are targeted, and about 65% are effectively vaccinated. Neither is this strategy aimed at protection from HPV related diseases occurring in males. In cervical cancer prevention, however, the expected gains can be observable already in 2015-2017 by documenting reduction of HPV-related cellular abnormalities in young women attending to screening. However, how to combine primary and secondary prevention of cervical cancer effectively remains to be determined.

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Colorectal cancer screening in Norway

Geir Hoff and Michael Bretthauer

Colorectal cancer (CRC) is the second most incident cancer in Norway. Each year, more than 3500 individuals are diagnosed with the disease (Cancer in Norway 2008) (Figure 1). Although there have been improvements in therapy of CRC, the prognosis of patients with CRC is still poor, with 5-year relative survival around 60% (NORDCAN, Engholm *et al.* 2009). There are no early symptoms or specific clinical signs for CRC, and we know very little about lifestyle-related risk factors. However, we know that the majority of CRC cases arise from benign precursor lesions in the large bowel, the so-called adenomas. Therefore, CRC is considered an interesting cancer with regard to screening, both for prevention and early detection of the disease. For a long time, Norway has been in the forefront of colorectal cancer screening research. This review outlines colorectal cancer activities in Norway.

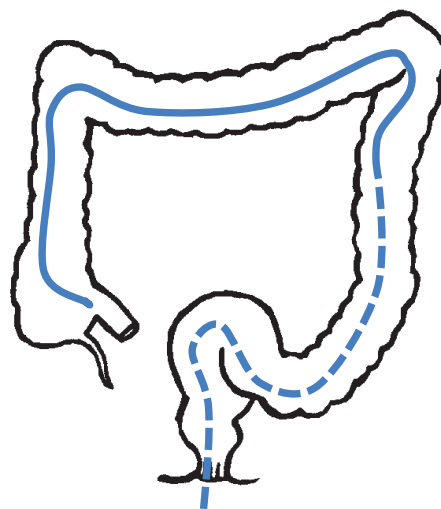
Norway was a feasibility trial using a guaiac-based faecal occult blood test (gFOBT) on a small population sample (n=754) performed by Jan Dybdahl in Bergen in 1982 (Dybdahl *et al.*, 1984). The attendance rate was 55%, and one case of colorectal cancer (CRC) was diagnosed among 413 persons tested. In 1983 another small-scale screening study in Telemark county (n=400 invited), using flexible sigmoidoscopy (FS) as screening modality, obtained 81% attendance and revealed one case of CRC and two cases of intramucosal carcinoma among 324 attendees (Hoff *et al.*, 1985). This study, the Telemark Polyp Study no. I (TPS-I) showed a statistically significant 80% reduction in incidence of CRC at 13-year follow-up (Thiis-Evensen *et al.*, 1999a). The TPS-I study was the first ever randomised controlled trial (RCT) on endoscopy screening for CRC worldwide (Figure 2).

History of colorectal cancer screening studies in Norway

The first study on colorectal cancer screening in

Figure 2

Current endoscopy screening methods comprise colonoscopy ("gold standard" endoscopy screening as it may visualize the entire large bowel) and flexible sigmoidoscopy ("half-way colonoscopy" with a shorter reach endoscope and much simpler bowel cleansing procedure prior to examination). Colonoscopy reach: Combined drawn and interrupted lines. Flexible sigmoidoscopy reach: interrupted line.



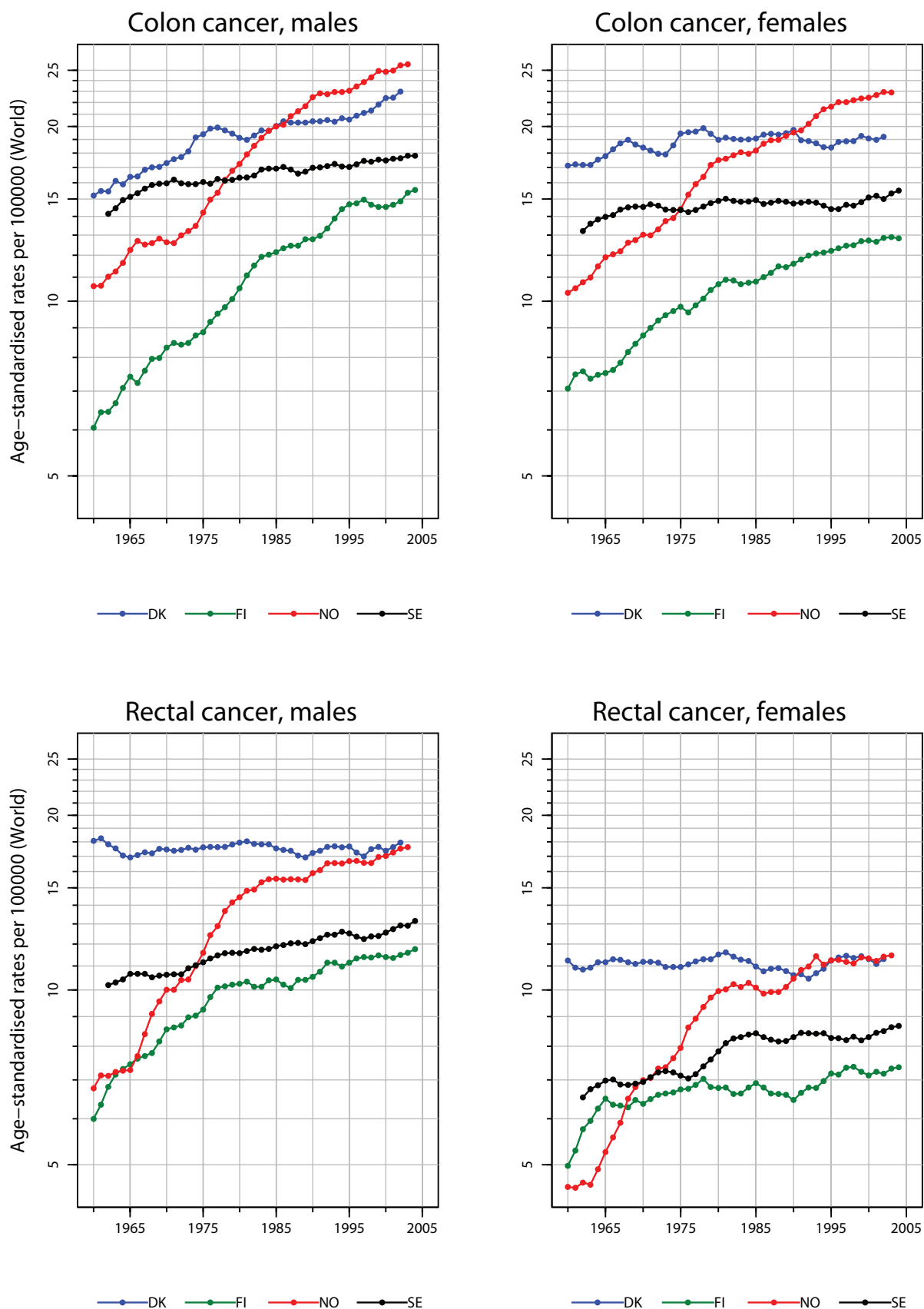


Figure 1
Age-adjusted incidence rates for colorectal cancer in four Nordic countries 1965-2005. Denmark (DK), Finland (FI), Norway (NO), Sweden (SE). From (Larsen and Bray, 2010)

A colonoscopy screening trial initiative in the late 1980s in Norway and early 1990s in the US failed to materialise. Instead, a small-scale trial on colonoscopy screening was started in Telemark in 1996 as a continuation of the TPS-I study. A 62% attendance rate was achieved. Follow-up results regarding the effect of the screening intervention on incidence and mortality of CRC are expected in 2011. In 1999, the large-scale Norwegian Colorectal Cancer Prevention (NORCCAP) study was launched. During the period 1999-2001, more than 12 000 individuals were screened with FS in two areas in Norway, with an attendance rate of 67%. In 2009, preliminary results from the NORCCAP study showed a 27%

non-significant CRC mortality reduction at 7-year follow-up (intention-to-screen analysis), and CRC mortality was significantly reduced by 59% for those attending (Hoff *et al.*, 2009a). 10-year follow-up results are expected in 2012.

The first ever RCT on colonoscopy screening in the world was launched in 2009 (the Nordic-European Initiative on Colorectal Cancer, NordICC) with coordinating centre in Oslo and screening centres in Poland and the Netherlands. Norway joined with one centre in Kristiansand from January 2011. Thus, since the early 1980s, Norway has pioneered research on endoscopy screening for CRC.

Table 1
Effects of gFOBT and flexible sigmoidoscopy screening on CRC mortality (intention-to-screen analyses) in randomised trials.

Study	No. of individuals in screening and control groups	Mean follow-up time	Absolute risk reduction (CRC deaths per 100 000 person years)	Relative risk ratio (95%CI)
FOBT				
UK (Hardcastle <i>et al.</i> , 1996)	76466/76384	11 years	11/100 000	0.87 (0.78-0.97)
Denmark (Kronborg <i>et al.</i> , 1996)	30967/30966	17 years	16/100 000	0.84 (0.71-0.99)
USA (Mandel <i>et al.</i> , 2000)	31157/15394	18 years	27/100 000	0.75 (0.62-0.91)
Sweden (Lindholm <i>et al.</i> , 2008)	34144/31164	15.5 years	11/100 000	0.84 (0.71-0.99)
Flex-Sig*				
UK (Atkin <i>et al.</i> , 2010)	57099/112939	11 years	14/100 000	0.69 (0.59-0.82)
Norway (Hoff <i>et al.</i> , 2009a)	13823/41913	6 years	10/100 000**	0.73 (0.47 -1.13)
Norway (Thiis-Evensen <i>et al.</i> , 1999a)	400/399	11 years	46/100.000**	0.33***

*flexible sigmoidoscopy

** approx. estimate from data given in the paper

*** CI not reported

Table 2

Characteristics of FOBT and flexible sigmoidoscopy screening

FOBT	Flexible Sigmoidoscopy
50-70% compliance	30-70% compliance
80% false positive tests	No false positive tests
Annual or biennial screening	Screening every 5-10 years
*No cancer incidence reduction	23% colorectal cancer incidence reduction
15-20% colorectal cancer mortality reduction	30% colorectal cancer mortality reduction
5% screening positive require colonoscopy	5-20% screening positive require colonoscopy
Declining interest with time and screening rounds	Endoscopy screening gaining popularity

*Although FOBT is a screening method not designed for adenoma detection, a CRC incidence reduction was found in one RCT where the accumulated rate of colonoscopy with polypectomy on detection of adenomas approached 40% due to use of rehydrated FOBT tests and a very high rate of false positive tests (Mandel *et al.*, 2000)

Evidence for CRC screening

The World Health Organisation recommends that screening programmes should be set up only when their efficacy has been proven in RCTs, and the EU Commission only recommends programmatic screening – not opportunistic screening which offers limited possibilities for quality assurance and evaluation (Advisory Committee on Cancer Prevention, 2000). For CRC screening, we now have follow-up results from randomised trials for FOBT screening (Hardcastle *et al.*, 1996; Kronborg *et al.*, 1996; Mandel *et al.*, 2000) showing a 15-20% mortality reduction, and more recently, for FS screening showing a 30% reduction in mortality and 23% in incidence (Tables 1 and 2)(Atkin *et al.*, 2010; Bretthauer, 2010; Hoff *et al.*, 2009a).

Apart from FOBT and flexible sigmoidoscopy there are no RCT results on any other CRC screening modalities like colonoscopy, CT colonography and molecular markers in stool or blood. Although colonoscopy screening has been recommended for a number of years in the United States and many European countries, it is only recently that a randomised trial on colonoscopy screening was launched – the Nordic-European Initiative on Colorectal Cancer with its coordinating secretariat in Oslo (www.nordicc.com).

In Europe, opportunistic colonoscopy screening is now offered in Germany, Poland, Austria, Luxembourg, the Czech Republic, Greece and Cyprus (Pox *et al.*, 2007; Zavoral *et al.*, 2009; Benson *et al.*, 2008; Majek *et al.*, 2010). Although the need for good quality randomised trials and evidence-based medicine is declared and taught, we do not always do as we preach (Table 3) (Hoff, 2010; Wilson and Jungner, 1968).

With screening, we are aiming to offer a health service, partly with highly invasive methods, to presumptively healthy people who may not even have asked for this service. No one would be allowed to market a new drug or treatment without extensive testing which includes randomised trials. Then it is hard to understand why standards for scientific proof should be set lower for screening services for a presumptively healthy population than for treatments for patients who do seek our advice “to the best of our ability and considering limited evidence”. It is understandable that patients are willing to accept limited evidence for the benefit of a health service when they are ill, but they should not accept a more extensive use of shortcuts on evidence for preventive and screening services.

Table 3

European countries with regional or nationwide colorectal cancer screening (from (Zavoral et al., 2009), (Pox et al., 2007), (Majek et al., 2010), (Stock and Brenner, 2010), and (Benson et al., 2008)) (year of starting).

	FOBT	Flexible sigmoidoscopy	Colonoscopy
Austria	X (1980)		X (2005)
Belgium	X (2009)		
Bulgaria	X		
Cyprus	X		X
Czech Republic	X (2001)		X
Denmark	X (2005)		
Finland	X		
France	X (2003)		
Germany	X (1976)		X (2002)
Greece	X		X
Hungary	X		
Italy	X (2000)	X	X (2000)
Latvia	X		
Luxembourg			X
Poland			X (2000)
Portugal	X		
Romania	X		
Slovak Republic	X		X
Slovenia	X		
Spain	X (2000)		
Sweden	X (2008)		
United Kingdom	X (2006)	*X (2011)	

*Recently decided after publication of UK randomized trial on flexible sigmoidoscopy screening (Atkin *et al.*, 2010)

Based on a simplified model regarding flexible sigmoidoscopy as a “half-way” colonoscopy, FS screening has been compared to performing mammography screening of one breast only – the preventive effect of endoscopy screening being considered to be merely a function of length of bowel

examined – irrespective of left- or right-sided colonic segments. Baxter *et al.* challenged this by showing a CRC mortality reducing effect of colonoscopy for left-sided CRC only (Baxter *et al.*, 2009). It has later been confirmed by Brenner *et al.* that prevalence of left-sided, but not right-sided advanced neoplasia,

was strongly reduced within a 10-year period after colonoscopy (Brenner *et al.*, 2010). If these findings can be confirmed, then colonoscopy screening may be of less benefit than expected in a public health perspective – maybe more comparable to flexible sigmoidoscopy requiring a less demanding bowel cleansing procedure. In that case, flexible sigmoidoscopy screening, with a higher attendance rate than for colonoscopy screening, may emerge more effective for CRC prevention than colonoscopy screening. However, this remains to be demonstrated. In 2010, shortly after publication of 11-year follow-up of a FS screening trial (Atkin *et al.*, 2010), the British government raised funding to incorporate FS screening in their on-going national FOBT screening programme.

Cost effectiveness

As we only have limited knowledge of the size of an effect of CRC screening, cost-effectiveness estimates will carry a considerable degree of uncertainty. Treatment of advanced CRC has become extremely expensive as new cytotoxic therapies are emerging. The more costly such treatment is, the more attractive will screening and down-staging of CRC become. It has been estimated that an additional seven months survival achieved with the new drugs will be accompanied by a 340-fold increase in drug costs (Schrag, 2004). This has led to estimates of colonoscopy screening being not only cost-effective and highly comparable to cervical and breast screening, but cost-saving compared to no screening (Sieg and Brenner, 2007).

Organisation of a screening programme

The EU Commission only recommends organised, programmatic screening (Advisory Committee on Cancer Prevention, 2000; Brenner *et al.*, 2010) that can be evaluated aiming for continuous quality improvement. Improving CRC screening involves not only having tests with high sensitivity and specificity, but the screening modalities must be user-friendly and require few repetitive rounds (ideally once-only) to secure high uptake to make an impact in a public health perspective. The trade-off between these requirements was well demonstrated in a recently published Dutch study with a 1:1:1 randomisation between gFOBT, immunochemical FOBT (iFOBT) and flexible sigmoidoscopy (Table 4) (Hol *et al.*, 2010).

Although the attendance rate was only 32% in the flexible sigmoidoscopy arm compared to 50% for gFOBT and 62% for iFOBT, the yield of advanced neoplasia per 100 invitees was significantly higher for a single round of flexible sigmoidoscopy screening than for either gFOBT or iFOBT. Considering current recommendations of less frequent rounds for flexible sigmoidoscopy (5-10-yearly) than for FOBT (annual or biennial), flexible sigmoidoscopy would clearly outperform gFOBT and iFOBT – at least in a Dutch public health perspective. This may turn out differently in other populations. National programmes should therefore have a responsibility to test screening modalities and attendance improvement strategies - continuously aiming to improve screening as a public health service.

Table 4

Randomised trial from the Netherlands showing compliance and “intention-to-screen” results of FOBT and flexible sigmoidoscopy screening (Hol *et al.*, 2010)

	gFOBT	iFOBT	Flexible sigmoidoscopy
No. invited	5004	5007	5000
Attendance (%)	50	62	32
Advanced lesions per invitee (%)	0.6	1.5	2.4

Combination strategies have been suggested. In the NORCCAP trial, the intervention arm was randomised 1:1 between flexible sigmoidoscopy only and flexible sigmoidoscopy combined with iFOBT (Gondal *et al.*, 2003). The attendance rate was 4% lower in the FOBT arm, but iFOBT alone detected four of 20 screen-detected CRCs. Intention-to-screen analysis, however, showed no increased yield of 'high-risk adenoma' or 'any neoplasia' in the combined group. A Veterans Affairs Cooperative Study group reported that flexible sigmoidoscopy would detect 70.3% of all subjects with advanced neoplasia – increasing to 75.8% if adding a one-time screening with FOBT (Lieberman and Weiss, 2001). This 5% increase must be weighed against an expected drop in attendance rate. If attendance rate is not expected to be unduly compromised, then a combined flexible sigmoidoscopy and iFOBT strategy may be a good alternative to gold-standard colonoscopy or repetitive rounds of tests like FOBT depending on intermittent bleeding from ulcerated or eroded neoplastic surfaces. A US Preventive Services Task Force evaluation also concluded with a combined strategy being a good alternative to colonoscopy screening (Zauber *et al.*, 2008). Based on current knowledge, and acknowledging the Dutch attendance rates of 30-40% for FS with a potential to reach the Norwegian 60% level, the best CRC screening option at present seems to be FS after a single enema administered on site on attendance. The addition of FOBT would certainly have to be considered, but a 5% increase in detection rate of advanced adenomas must be weighed against a quantifiably expected or observed drop in attendance.

There is a multitude of screening modalities for CRC and more will come. This should be a blessing – forcing us to provide platforms for programme-based research to provide data and improvements on screening provisions much in demand from target populations and health care providers. According to

an unpublished survey in 2007 by the International Digestive Cancer Alliance (IDCA) there were 6 out of 39 European states not having a national CRC screening programme or at least a pilot for such a programme. These were Russia, Ukraine, Moldova, Estonia, Malta and Norway. Norway is in the world "top-ten" league on CRC incidence and higher than any of these countries. The Norwegian national budget for 2011 now allows launching a pilot on CRC screening in two hospital areas. A choice of screening modalities may presently be of less importance than acceptance that national programmes must be given responsibility for continuously improving screening services including randomisation of screening modalities and strategies to improve population coverage.

Quality assurance

The EU Commission is concerned about poor quality screening and advice quality assurance at all levels – from invitation procedures down to treatment and follow-up of CRC patients (2000). Whichever primary screening modality is chosen, a high proportion of the population will be subjected to invasive endoscopic procedures either as a primary screening tool or secondary through work-up of screen-positives and later surveillance (Figure 3). Complications from colonoscopy are rare. In a recent report from a screening and surveillance programme the most serious were perforations in 0.19 per 1000 and bleeding requiring hospitalisation in 1.59 per 1000 examinations (Ko *et al.*, 2010). The generally accepted rate of perforation is less than 1 in 1000 screening colonoscopies (<0.1%), while for FS it should be less than 1 in 25 000-50 000 (Valori *et al.*, 2010). There is considerable variation between endoscopists in their performance regarding caecal intubation and polyp detection rates and their ability to perform painless colonoscopies (Bretthauer *et al.*, 2003; Hoff *et al.*, 2006; Seip *et al.*, 2010). Being subjected to an endoscopist with a low detection rate for adenomas is associated with an increased risk of future CRC (Kaminski *et al.*, 2010). Therefore, quality

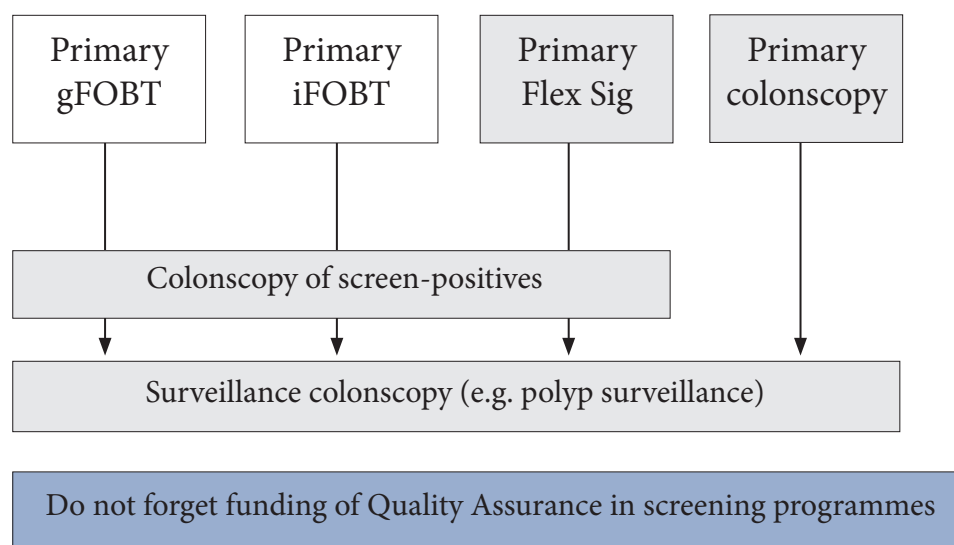


Figure 3
The importance of high quality endoscopy whichever primary screening modality is chosen

assurance does matter for major endpoints of the screening service.

The Gastronet programme for improvement of colonoscopy services in Norway was established in 2003, but has since expanded to include Warsaw, Poland. Iceland and Latvia are expected to join in 2011 (www.kreftregisteret.no/gastronet). Much of the requirements in endoscopy quality assurance is incorporated in a software especially developed for CRC screening programmes and trials (Hoff *et al.*, 2009b).

Unwanted effects of CRC screening services

Any screening programme involves screening of many for the benefit of few. Increasing the attention to un-healthy behaviour in a presumably healthy population may arouse unnecessary anxiety and time expenditure for the vast majority of the screening population. This concern finds little support in the literature of screening using FOBT, FS or colonoscopy (Lindholm *et al.*, 1997; Wardle *et al.*, 1999; Thiis-Evensen *et al.*, 1999b). FOBT may cause some temporary increased anxiety (Lindholm *et al.*, 1997), but endoscopy screening largely disclosing

findings immediately for the attendee while lying on the coach does not allow time for unnecessary worry to arise (Thiis-Evensen *et al.*, 1999b).

There is a possibility that people attending screening programmes might feel that they do not need a healthy lifestyle. There is some documentation for this regarding CRC screening (Hoff *et al.*, 2001; Larsen *et al.*, 2007) as well as screening for lung cancer (van der Aalst *et al.*, 2010a). For possible screening effects on lifestyle the overall evidence is conflicting and insufficient to conclude (van der Aalst *et al.*, 2010b), but combining screening with educational efforts on lifestyle advice seems particularly sensible for lifestyle-related diseases like CRC and lung cancer.

Eight out of ten positive FOBT screening tests are false positive for CRC, triggering unnecessary invasive investigation by colonoscopy. FS screening with tissue sampling of lesions has no false positives. Adenomatous polyps discovered at FS are easily classified into low-risk and high-risk lesions. Five percent of FS-screened individuals have high-risk lesions – the same percentage expected to test positive with iFOBT. It is, however, easier to

advocate work-up colonoscopy of 5% of FS screenees categorised as high-risk, than 5% of FOBT screenees – 80% of which are false positive.

Although endoscopy screening services may be organised separately from services for symptomatic patients, usually it will be integrated impinging on resources that should primarily serve symptomatic patients. In the USA, half of all colonoscopies are performed as part of screening services (Seeff *et al.*, 2004). Part of the quality assurance of CRC screening should therefore be to monitor its effects on the services for symptomatic patients. On the other hand, it may be that introduction of screening may improve the service of symptomatic patients as suggested recently for mammography screening indirectly improving outcome of treatment for breast cancer by establishment of multidisciplinary teams and improved logistics developed initially within the screening programme (Kalager *et al.*, 2010).

Conclusion

Many screening programmes have been implemented with the best of intentions and great conviction of taking health services into a new dimension of health-promoting preventive medicine. Quantification of the benefits and harms of screening are increasingly in demand – not least from the target population which too often appear not convinced that “there is anything in it for them” and not worth the personal effort to attend for screening. In the era of evidence-based medicine, results from well-designed randomised trials are increasingly in demand. Organised screening programmes should be considered as natural platforms for testing out new screening modalities – continuously aiming at optimising the screening service provided.

Abbreviations

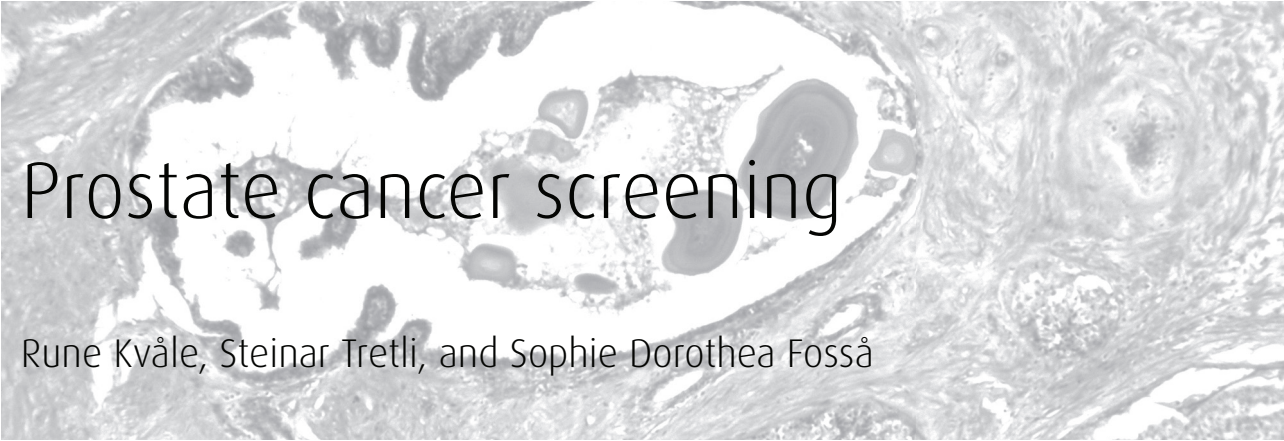
- CRC: Colorectal cancer
- FOBT: Fecal occult blood test
 - gFOBT: Guaiac-based test for detection of occult blood in stools (fecal occult blood test)
 - iFOBT: As above, but based on immunochemical methodology to detect human occult blood only (i.e. not sensitive for intake of red meat and less sensitive to other reasons for false positive testing)
- FS: Flexible sigmoidoscopy
- IDCA: International Digestive Cancer Alliance
- NORCCAP: Norwegian Colorectal Cancer Prevention trial. A randomised trial on flexible sigmoidoscopy screening carried out in Norway 1999-2001
- NordICC: Nordic-European Initiative on Colorectal Cancer. A randomised trial on colonoscopy screening which started in 2009
- RCT: Randomised controlled trial
- TPS-I: Telemark Polyp Study no I. A two-stage randomised trial in Telemark, Norway –first using once only flexible sigmoidoscopy (1983) and then once only colonoscopy on an expanded sample of the population 13 years later (1996)

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Prostate cancer screening

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Epidemiology

Prostate cancer is the second most common cancer in men worldwide, with approximately 900 000 new cases diagnosed per year (14% of new cancer cases) (Ferlay et al., 2010). Subsequent to widespread testing with prostate specific antigen (PSA), a considerable increase in prostate cancer incidence has been observed in many high-resource countries (Bray et al., 2010). The most prominent increase was seen in the United States where incidence rates doubled from 1986 to 1992 (Potosky et al., 1995). There are considerable variations in the incidence between ethnic populations and countries around the world (Ferlay et al., 2010). The highest incidence rates are found in the black population of the U.S., while the lowest rates are found in populations of Asian origin (Miller et al., 1996). It has been suggested that the differences between ethnic populations may be explained by genetic differences associated with testosterone metabolism (Shibata and Whittemore, 1997), although changes in the environment and diagnostic activity are also likely contribute.

Migrant studies have shown that when people from low-incidence countries move to high-incidence areas, incidence rates increase substantially (Haenszel and Kurihara, 1968; King and Haenszel, 1973). These observations are in part explained by the “exposure” to different health care systems with different awareness to prostate-related symptoms and different levels of diagnostic activity, but are also thought to be related to alterations in life style habits such as dietary changes.

The mortality rates have begun to decline in a number of countries from the early-1990s and onwards (Bray et al., 2010; Oliver et al., 2001; Baade et al., 2009). In 2008, prostate cancer accounted for around 6% of all cancer deaths among men worldwide, with an estimated 258 000 registered deaths. Mortality rates are highest in the Caribbean and in sub-Saharan Africa, very low in Asia and intermediate in Europe and Oceania (Ferlay et al., 2010).

Survival and mortality in prostate cancer epidemiology

Mortality rate: Number of deaths of a disease in a defined population over a given time period divided by the total person-time at risk during that period.

Survival rate: The percentage of men with a disease who survive a disease for a specified length of time. For example, if the 5-year survival of a cancer rate is 20%, this means that 20 out of 100 people initially diagnosed with that cancer would be alive after 5 years.

To distinguish mortality from survival is particularly important for the understanding of prostate cancer epidemiology. An increase in the five-year survival rates for cancer is often used to measure improvement in cancer management and health care. However, earlier detection of a cancer (i.e. caused by screening) will advance the date of diagnosis to a previous point in time. As a consequence, the estimated survival time will increase, even if there is no postponement of death. The mortality rate is not influenced by this bias (lead time bias).

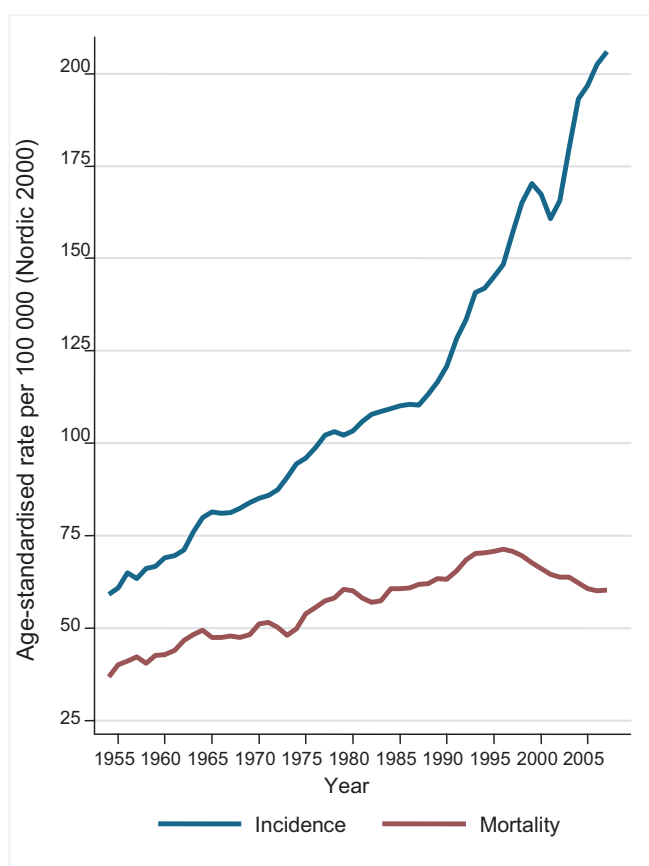


Figure 1
Age-standardised incidence and mortality rates of prostate cancer in Norway by period. Smoothed using 3-year averages (Source: NORDCAN, Engholm et al. 2009)

In Norway an average of approximately 4000 new cases were diagnosed per year in the period 2004-2008, making prostate cancer the most common cancer diagnosed in men (30% of all new cancer cases in men) (Engholm et al., 2009). Coinciding with the increase in PSA-testing of asymptomatic men throughout the early 1990s, the incidence of prostate cancer has almost doubled in Norway (Figure 1). Currently, the life time risk of being diagnosed with prostate cancer before the age of 75 in Norway (assuming the absence of competing causes of death) is 12.5%. Prostate cancer mortality rates in Norway are among the highest in the world (Quinn and Babb, 2002), and the reason for this is unknown. An average of approximately 1050 persons died from prostate cancer per year in the period 2004-2008, which corresponds to around 20% of all cancer deaths in men. The life time risk of dying from prostate cancer before the age of 75 is approximately 1.4% (Engholm et al., 2009). Mortality from prostate cancer has decreased since 1996 (Kvåle et al., 2007) (Figure 1). The reasons for the decrease in mortality are not clear.

Tumour biology

Prostate cancer is a heterogeneous disease with large inter-individual variations in tumour progression rates. The largest clinical challenge is to separate aggressive from non-aggressive tumours, many of the latter ones not requiring treatment for many years. Thus, the outcome of localised prostate cancer may be favourable even without treatment (Johansson et al., 1997). This clinical experience is supported by autopsy studies which have shown that there is a high prevalence of latent and probably indolent prostate cancers that remain undetected during life (Lundberg and Berge, 1970; Guileyardo et al., 1980). Other autopsies of men from Detroit showed that the rate of latent prostate cancer increased markedly with age, with the proportion of prostate cancers detected ranging from around 40% in men aged 50-59 to around 70% in men aged 70-79 (Sakr et al., 1996). These figures are in contrast to the reported 1.4% risk of dying from prostate cancer before the age of 75 in Norway, illustrating the substantial potential for increased detection of nonlethal

tumours by extended diagnostic activities. The incidence of prostate cancer will therefore increase as a consequence of increased diagnostic activity, although many of these screen-detected tumours would never have developed into clinically relevant disease if they remained undetected. Hence, a major challenge of population-based PSA screening is to avoid detection of clinically indolent cases of prostate cancer.

The Prostate specific antigen (PSA) test

PSA is a serine protease belonging to the family of glandular kallikrein-related peptidases and the physiological role of PSA is considered to be liquefying of the seminal fluid (Lilja, 1985). It is produced in prostate epithelial glandular cells, and only a small fraction enters the circulating blood under normal circumstances. As the PSA test is prostate-specific but not cancer-specific, patients with benign enlargement of the prostate (benign prostatic hyperplasia (BPH)) may have elevations of PSA in the same range as those PSA levels that may be elevated as a result of cancer (Schröder, 2009). PSA testing for diagnosis and follow-up was introduced in the U.S. in the early 1980s, and has been increasingly used in Norway since the late 1980s. A PSA value of less than 4.0 ng/mL has

traditionally been considered to be normal. However, results from the control arm in the Prostate Cancer Prevention Trial (PCPT) have shed light on some of the problems related to the use of this cut-off value for detection of Prostate cancer (Thompson et al., 2005). Today it is accepted that no cut-off value can be identified where both sensitivity and specificity of the PSA test are at completely satisfactory levels (Table 1). Importantly, a significant number of potentially aggressive cancers (with high Gleason scores) have been reported in patients with PSA values within the traditional normal range.

In order to enhance the predictive value of PSA as a tumour marker, different molecular sub-forms of PSA (free (fPSA) / total PSA (tPSA) - ratio), and PSA kinetics (PSA-velocity, PSA-doubling time) have been studied. By using the ratio of fPSA to tPSA in addition to tPSA, information can be gained as to separate men with BPH from those with prostate cancer, and the cancer detection rate increases (Roddam et al., 2005). However, as the magnitude of its effect has varied between studies and its ability to provide useful predictions of prostate cancer diagnosis may be limited, the clinical importance of %fPSA has been debated (Lilja et al., 2007).

Table 1
Sensitivity and specificity for prostate cancer, by cut-points of PSA
(Modified after Thompson *et al.* , 2005)

PSA ng/mL	Any cancer vs. no cancer	
	Sensitivity (%)	Specificity (%)
1.1	83.4	38.9
1.6	67.0	58.7
2.1	52.6	72.5
2.6	40.5	81.1
3.1	32.2	86.7
4.1	20.5	93.8
6.1	4.6	98.5
8.1	1.7	99.4
10.1	0.9	99.7

There is also limited evidence supporting that pre-treatment PSA kinetics provide better predictive diagnostic and prognostic information than the absolute PSA level alone (O'Brien et al., 2009; Ulmert et al., 2008; Vickers et al., 2009).

Biopsy techniques and strategies also considerably influence the risk of diagnosing prostate cancer at specific PSA values. Throughout the PSA-era the ultrasound-guided biopsy strategy has evolved. The original "sextant" biopsy technique implied six biopsy cores, containing a comparatively large amount of centrally located tissue (transition zone). By increasing the routine number of biopsies to 10-12, and directing biopsies laterally in the prostate, additional positive biopsies are found (Eichler et al., 2006).

The effectiveness of PSA-screening

Results from previous descriptive studies concerning the relation between population-based PSA testing and mortality from prostate cancer have been inconsistent. A significant reduction in prostate cancer mortality was found in Tyrol (risk ratio of 0.81, 95% confidence interval: 0.68 - 0.98) after PSA testing had been offered to all men aged 45-74 years free of charge, unlike in other parts of Austria (Oberaigner et al., 2006). Similarly, a more notable decline in mortality in the U.S. compared with the U.K. over the period 1994-2004 was observed concurrently with a high intensity of PSA-screening amongst the U.S. population (Collin et al., 2008). In contrast, another U.S. study reported a more rapid uptake of PSA testing in Seattle compared to Connecticut, but found no difference between these two states in prostate cancer-specific mortality among men aged 65 or older after 15 years of follow-up (Lu-Yao et al., 2008). A study from Canada reporting incidence and mortality changes in different health areas, found no association between the incidence levels of prostate cancer (as proxies for PSA-testing frequency) and subsequent decreases in prostate cancer mortality (Coldman et al., 2003). Case-control studies have also failed to demonstrate

a consistent association between PSA screening and a reduction in the risk of death from prostate cancer (Concato et al., 2006; Weinmann et al., 2005).

The results from two randomised studies on prostate cancer screening among asymptomatic men, one from the U.S (PLCO) and one from Europe (ERSPC) have been published in 2009 (Schröder et al., 2009; Andriole et al., 2009). After a median follow-up of nine years the ERSPC reported a relative prostate cancer mortality reduction of 20% in men who were randomised to the PSA screening arm. The reduction of prostate specific mortality was 31% after adjusting for contamination and non-attendance (Roobol et al., 2009). In contrast, the PLCO study was not able to show any mortality benefits from combined screening with PSA testing and DRE during a median follow-up of 11 years. However, the PLCO trial was smaller (PLCO: 76693 participants (age 55-74 years), ERSPC: 162243 participants (age 55-69 years)) and thus less mature, despite a longer median follow-up time than the ERSPC trial. This aspect, together with the fact that 52% of the individuals in the control group had undergone a PSA test within the first five years of follow-up may have contributed to the negative findings.

One of the key findings when considering the balance between the benefits and harms of population-based prostate cancer screening is the risk of overdetected (the detection of a cancer that will not progress to clinically relevant disease during a man's lifetime) and overtreatment (treatment of men whose prostate cancer never will threaten their lives). According to the ERSPC trial, 1410 men would need to be screened with an average of 1.7 screening visits per subjects during a 9 years period in order to prevent one death from prostate cancer. Of these 1410 men about 220 men showed a positive PSA test. After further examinations 48 (the number needed to treat (NNT)) men with screen-detected prostate cancer would have to be treated, as compared to the control group, to save one life.

However, as the NNT to avoid metastatic disease in one man was 24, the absolute risk reduction may become more favourable with longer observation time. In the much smaller Göteborg randomised population-based screening study (Hugosson et al., 2010), which had a median follow-up of 14 years, most of the benefit from screening occurred after 10 years. This also indicates that the final effectiveness of population based PSA screening can only be evaluated after very long observation times. The number needed to screen in this trial (NNS) was 293, and the number needed to be diagnosed to prevent one death from prostate cancer was 12. However, even if we consider the results from the most beneficial trials such as the Göteborg study, the absolute mortality decrease is likely to be rather small. According to the data from this study, screening may reduce prostate cancer mortality from nine to four men per 1000 men at 14 years of follow-up. Further, for each prostate cancer death avoided, 11 men may be diagnosed without any beneficial prospects of life prolongation. Consequently, many men may unnecessarily be afflicted with anxiety and severe treatment related side-effects.

If restricted to selected groups, PSA screening may be more beneficial. A recently published paper indicates that the benefit of screening may be larger among men in good health (Crawford et al., 2011). In this study a reanalysis of the data from the PLCO trial was performed after stratifying the data by comorbidity. A significant decrease in the risk of prostate-cancer specific mortality was observed in those with few or no comorbidity. The NNS was 723 and the NNT was only five. Among men with several comorbidities there was a trend towards increase in prostate-specific mortality in the screening group. Selective or stratified screening may also prove to be effective in men who belong to families with increased occurrence of prostate cancer. Studies have indicated that the predictive value of PSA screening is high in BRCA mutation carriers and that the cancers detected in these men are clinically

significant, supporting the rationale for screening in such men (Mitra et al., 2011). Due to on average younger age at onset of hereditary prostate cancer, and thus less age-related comorbidity, the potential benefit of early diagnosis and treatment with curative intent may increase. Yet, the known side-effects of treatment may be less acceptable for younger patients.

As the treatment of prostate cancer is afflicted with severe long-term side effects, the risk of overdiagnosis and overtreatment should always be considered when an asymptomatic man asks for a PSA-test. Men should not be screened before they have obtained information about the potential benefits, the uncertainties and risks of PSA-testing. According to Sanda et al (Sanda et al., 2008) and Pardo et al (Pardo et al., 2010) radical prostatectomy is after 2-3 years, dependent on pre-treatment function and surgical technique, followed by sexual and urinary dysfunction in 50%-80% and 15-30% of the patients respectively. Correspondingly, the comparable figures after radiotherapy range between 30%-50% and 10%-15%. Lack of energy and reduced vitality are adverse effects in men on androgen deprivation treatment. Thus, the prevalence of the treatment-related toxicity must be balanced against an increased probability of surviving from prostate cancer. In recent years, selective delayed intervention (active surveillance) for low-risk prostate cancer has been promoted as a treatment strategy to reduce over-treatment of indolent cancers (Roemeling et al., 2007; Klotz et al., 2010). Preliminary results are promising, but longer follow-up is required before this treatment modality can be accepted for patients with highly selected tumours.

Concluding remarks

There is some evidence supporting a beneficial effect of screening with PSA on prostate cancer mortality. However, the crucial question whether the benefits of population-based PSA screening on mortality outweigh the physical and psychological harm caused by the test and the following treatment

is still unanswered. Improved diagnostic methods will hopefully be developed to better separate the indolent from the aggressive prostate cancer tumours in the years to come. Modifications of today's treatments may also reduce side effects in patients undergoing treatment.

Reflecting the present knowledge about prostate cancer screening, the European Association of Urology (EAU) has formulated a position statement regarding prostate cancer screening in Europe (Abrahamsson et al., 2009) (quotation from the first paragraph): "Prostate cancer is a major health problem and one of the main causes of male cancer death.

However, current published data are insufficient to recommend the adoption of population screening for prostate cancer as a public health policy because of the significant overtreatment that would result. Before screening is considered by national health authorities, the level of current opportunistic screening as well as issues of overdiagnosis, overtreatment, quality of life, cost, and cost-effectiveness should be taken into account."

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