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Report

Costs of cancer in the Nordic countries

A comparative study of health care costs and public income loss compensation payments related to cancer in the Nordic countries in 2007

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ABSTRACT

Abstract heading

This study provides estimates and comparison of costs of cancer in the Nordic countries. It covers costs of hospital treatment, prescription drugs, and screening programs for breast and cervical cancer (health care costs); and public expenditures related to sickness absenteeism and early retirement (income loss compensation payments). The study focuses both on the costs of cancer in the Nordic countries as a whole and on per capita cost in each country. At the Nordic level the main focus is on differences between cancer sites. The main focus in the comparative part of the study is on cross-country differences for all cancer diagnoses. Differences in *treatment* cost- and activity levels are decomposed according to differences in cancer prevalence, service patterns and unit costs between *cancer sites* for the Nordic countries as a whole and between the *six Nordic countries*. Country differences in cost of screening programs are related to differences in screening policy concerning target groups. Country differences in public expenditure on income loss compensation payments are viewed in light of differences in rules and compensation levels for sickness benefits and disability pensions. The study also provide crude estimates of future treatment costs of cancer in the Nordic countries based on projections of present treatment costs by utilizing estimated cost per five-year prevalence in 2007 and predicted cancer prevalence in 2025.

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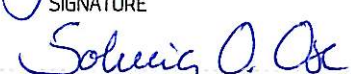

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Preface

This study is initiated and financed by the Nordic Cancer Union (NCU). For NCU the contractor has been the Norwegian Cancer Society, represented by Ole Alexander Opdalshei and John Stigum. SINTEF has been the contractor for the participating parties in the study consortium, with the National Institute for Health and Welfare (THL), Karolinska Institutet (KI), Dansk Sundhedsinstitut (DSI), Landspítali - The National University Hospital of Iceland and Ministry of Health Affairs, Faroe Islands as subcontractors.

The work has been performed in collaboration of participants of all six Nordic countries. Each country has been responsible for providing the data for their own country. SINTEF has prepared the data for analysis. All the countries have been involved in all phases of the project, from the preparation of data collection, via assessment of data reliability and comparability and decisions regarding presentation of results, and in commenting on report drafts. SINTEF has however had the main responsibility of writing the report and is responsible for any errors in the presentation and discussion of results.

The participants from each of the countries have been:

Finland: Mikko Peltola, Kirsi Kautiainen and Unto Häkkinen, National Institute for Health and Welfare (THL)

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Norway: Vidar Halsteinli, Thomas Halvorsen, Birgitte Kalseth, Kjartan Anthun and Jorid Kalseth, SINTEF

We would like to thank Harri Vertio, Secretery general of the Cancer Society of Finland, Professor Pekka Rissanen, University of Tampere, and Professor Jon Magnussen, Norwegian University of Science and Technology (NTNU) for reading and commenting on an earlier draft of the report. We would also like to thank Professor Stein Kaasa, Head of Clinic of Oncology, St. Olavs Hospital, for taking the time to advise us on important aspects of the data collection and for discussing results. Last, but not least, we would like to thank Freddie Bray, Bjørn Møller and Anahita Rahimi at the Cancer Registry of Norway for preparing the predictions of future cancer prevalence used in the projections of future cancer treatment costs and also Hans Storm at the Danish Cancer Society for contributing in the preparation of the prevalence study.

Trondheim, May 2011

Jorid Kalseth
Project leader, SINTEF

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Summary

This study provides estimates and comparison of costs of cancer, applying a common approach and methodology, in all of the Nordic countries. It covers costs of hospital treatment and prescription drugs (treatment costs), screening programs for breast and cervical cancer, and public expenditures related to sickness absenteeism and early retirement (income loss compensation payments – ILCP). Treatment costs and screening costs are in sum health care costs. The estimated yearly treatment costs are combined with data on five-year prevalence from the NORDCAN-database of the Association of Nordic Cancer Registries to calculate estimates of treatment costs per prevalence. These estimates are combined with predictions of future cancer prevalence performed by the Cancer Registry of Norway to make projections of treatment costs to the year 2025.

Main results:

- The yearly treatment costs associated with cancer in the Nordic countries, including hospitals costs and costs of prescription drugs, is estimated to be about 3 billion Euros or 121 Euro per capita in 2007. The estimated cancer-related hospital costs amount to 8.3 percent of total hospital costs in the Nordic countries in 2007.
- The yearly costs of screening programs for breast and cervical cancer are estimated to about 220 million Euros, or 9 Euro per capita. Of these, 60 percent is related to screening for breast cancer and 40 percent to screening for cervical cancer.
- Public expenditures on sickness benefits and disability pensions are estimated to about 770 million Euros in 2007, or 31 Euro per capita. Thus the size of the estimated yearly cancer-related public expenditures on income loss compensation payments is ¼ of the estimated yearly cancer-related treatment costs.
- The three largest sites in terms of treatment costs are breast cancer (13 percent of treatment costs), colorectal cancer (12 percent) and prostate cancer (11 percent). The costs shares of the three cancer sites can be compared to their respective shares of five-year prevalence of 19 percent for breast cancer, 12 percent for colorectal cancer and 23 percent for prostate cancer.
- Breast cancer is also the largest site in terms of public expenditures on sickness benefits and disability pensions, accounting for 28 percent of estimated expenditures.
- The main impression from the results of country comparisons of treatment costs of cancer is that the overall differences in per capita cancer-related costs are relatively modest. Norway is found to have the highest per capita estimated treatment costs, eight percent above Denmark. Apart from Norway, the estimated differences in per capita treatment costs are within the range of about 12 percent.
- Country differences in per capita treatment costs can be related to both differences in cancer prevalence, activity levels and composition, and unit costs.
- Country differences in program screening costs are large, reflecting country differences in screening programs regarding screening frequency and age-groups covered.
- The estimated country differences in cancer-related public expenditures on sickness benefits and disability pension are substantial, with Norway on the high side and Iceland on the low side. Iceland has a mandatory insurance scheme administered by the labour unions contributing to low public expenditures.
- Assuming unaltered cost per prevalence for cancer sites, the cancer-related treatment costs can be expected to increase by 28 percent until 2025 due to increasing cancer prevalence in the future. This amount to an annual growth of 1.3 percent or 0.9 percent per capita. This estimate does not take into account future changes in treatment costs due to innovations in technology, cancer therapy and organization of treatment, and may be on the low side.
- Of the large cancer sites, skin, colorectal and prostate cancer are predicted to increase most.

Results at the Nordic level

The estimated cancer-related *treatment* costs (hospital and prescription drugs) for the Nordic countries in 2007 amounts to 121 Euro per capita. The estimated cost of screening programs for cervical and breast cancer is nine Euro per capita, representing six percent of estimated cancer-related health care costs. Based on data on health care costs from the System of Health Accounts (SHA), the estimated cancer-related health care costs amount to about four percent of total health care costs for the Nordic countries and the estimated costs of hospital treatment for cancer patients amount to about 8.3 percent of total hospital costs. The estimated public expenditure on income loss compensation payment (ILCP) due to cancer-related illness and disability amounts to 27 Euro per capita for the Nordic countries in total.

The estimated treatment costs for specific cancer sites reflect both differences in prevalence and in relative treatment costs per prevalence. The highest costs are found for breast, colorectal and prostate cancer, reflecting to a large degree the fact that these are the three largest groups in terms of five-year prevalence. Looking at the estimated treatment costs per prevalence, the 11 cancer sites identified in the study can be grouped in three: the sites with highest costs (above 10 000 Euro per five-year prevalence) are acute leukemia, lung, and Non-Hodgkin lymphoma; the cancer sites with medium costs (between 5 000 and 8 000) are colorectal, breast, cervix uteri, and kidney-bladder; and the four sites with lowest costs (below 4 000 Euro per five-year prevalence) are prostate, corpus uteri, testis, and skin cancer (inclusive of non-melanoma).

The results document differences in the treatment setting between cancer sites. Measured by the cost share for prescription drugs, the highest share of drug treatment outside of hospitals are found for prostate cancer. The lowest share is found for colorectal cancer. Prostate cancer is also found to have a high share of outpatient treatment. The highest shares of outpatient activity are found for breast and skin cancer. Colorectal cancer, on the other hand, is found to have a high share of inpatient activity, together with lung, kidney-bladder and acute leukemia. These sites are characterized by long average length of stays. Testis, cervix uteri and breast cancer are the cancer sites associated with the highest public expenditures on sickness benefits and disability pensions relative to treatment costs.

Country comparisons

The comparative part of the study focused on estimates for all cancer sites. Turning first to the estimated per capita treatment costs (hospital and prescription drugs), the results show highest cost levels in Norway, followed by Denmark. The estimated difference in cost per capita between Norway and Denmark is less than ten percent. The estimated costs levels for the other Nordic countries are about 15-20 percent below the estimate for Norway.

Country differences in estimated treatment costs per capita can be decomposed according to several sources of variance: cancer prevalence; diagnostic composition (case-mix) of cancer prevalence (since cost per prevalence differs between cancer sites); level and composition of activity; and unit costs in cancer treatment.

Higher costs in Norway compared to the Nordic average are mostly related to relatively high unit costs (cost per activity). Norway is fairly close to the Nordic average in most other aspects such as prevalence, activity etc.
Denmark has a relatively cost-demanding cancer prevalence diagnostic composition (high share of cancer sites with relatively high cost per prevalence), but has relatively low activity levels per prevalence when the diagnostic composition is taken into account.

Sweden has the highest five-year prevalence rate and the least cost-demanding prevalence composition. Sweden has low activity levels per prevalence and high unit costs, even when the prevalence case-mix is taken into account.

In contrast to Sweden, Finland has a relatively low five-year prevalence rate, but a relatively cost-demanding cancer prevalence diagnostic composition. Below average estimated costs per capita for Finland can be attributed to low unit costs, since the activity level is high. A considerable amount of the activity identified for Finland occurs within their health centers. To what extent this may represent an upward bias on the (relative)

activity and cost level, and a downward bias on Finnish unit costs, is unknown. Assuming half of the activity in the health centers should be considered as hospital care, the activity level per prevalence for Finland would be more in line with the level observed for Norway, taking the composition of cancer prevalence into account.

Iceland has a considerably lower prevalence rate than the Nordic average contributing to low per capita costs. Iceland has a cost-demanding cancer prevalence diagnostic composition and a relatively high level of activity, and has average cost per prevalence when the cancer prevalence diagnostic composition is taken into account.

Prevalence data are missing for the Faroe Islands. However the Faroe Islands has low cancer incidence rates. Thus even though the costs per capita may be in line with the other Nordic countries, costs and activity per prevalence are probably high.

In estimating the costs of screening programs for cervix uteri and breast cancer, a common Nordic average health care related unit-cost is used. The estimated costs thus reflect screening numbers. No information on screening activity was provided for Denmark. For breast cancer screening it is Sweden, followed by Iceland, that have the highest costs per capita, 70-80 percent above the costs in Finland and Norway. The Faroe Islands does not have a screening program for breast cancer. Iceland has the highest per capita cost of cervical cancer, followed by Norway, Sweden, the Faroe Islands, and finally Finland. Finland stands out with a much lower screening rate for cervical cancer than the other countries; with only 30 percent of the Icelandic rate and 50 percent of the Faroese rate. The estimated differences do seem to be in accordance with country differences in screening programs in terms of the targeted age groups and screening frequency. The screening numbers indicate country differences in the relative weight of the two programs; Norway and Iceland having relatively higher screening rates for cervical cancer compared to breast cancer than Finland and Sweden.

When it comes to estimated public expenditures on ILCP three observations are particularly striking[1]. First, Norway clearly has the highest per capita public ILCP related to cancer, twice the rate found in Finland and the Faroe Islands. Thus Norway also has high ILCP expenditures compared to treatment costs. The high per capita expenditure in Norway relates not only to a high number of sickness days and persons receiving disability pensions (due to cancer), but also to high compensation levels, especially for sickness benefits. This is in accordance with what is observed for the population in general. Second, Iceland has low public expenditures and publicly paid sickness benefits and pensions therefore play a limited role in Iceland. Instead they rely heavily on the labor organizations' sickness- and pension funds which are regarded as part of the public social insurance. Third, disability pensions make up the larger part of public ILCP expenditures in all countries except for Sweden. In Sweden a high share of ILCP expenditures on cancer take the form of sickness benefits. The number of paid sickness days is very high in Sweden and the number of persons receiving disability pensions (or rather sickness and activity allowance) is low. The likely explanation for this result is that there is no time limit for receiving sickness benefits due to chronic illnesses in Sweden as opposed to the other Nordic countries.

Future cancer prevalence and cost

In 2007 almost 390 000 persons living in the Nordic countries had been diagnosed with cancer within the last five years. This number amounts to 1.5 percent of the total population of 25 million in the Nordic countries. Cancer incidence and prevalence are expected to rise in the years to come. Based on predictions performed by the Cancer Registry of Norway (Rahimi et al. 2010), the five-year prevalence is expected to increase to 470 000, amounting to 1.9 percent of the population, in the year 2025. We project present treatment costs by utilizing estimated cost per five-year prevalence in 2007 and predicted cancer prevalence in 2025. Assuming constant treatment costs per prevalence for each cancer site identified in the study, the treatment costs of cancer in 2025 will be 28 percent higher in real terms than in 2007 due to the increase in cancer prevalence in the Nordic countries.

[1] Information on public expenditureon ILCP due to cancer was not readily accesible for Denmark.

The predicted increase in cancer prevalence varies much between cancer sites. Of the 11 cancer sites identified in the study, skin, colorectal and prostate cancer are predicted to increase most. These are large sites measured by five-year prevalence in 2007. The largest cancer site in 2007 in terms of estimated treatment costs, breast cancer, is predicted to have a more moderate increase. Lung cancer, which is the forth largest site in terms of estimated costs in 2007, also is predicted to have a modest increase. With unchanged cost per prevalence, the prevalence predictions indicates that colorectal cancer will pass breast cancer as the largest site in terms of treatment costs at the Nordic level by 2025.

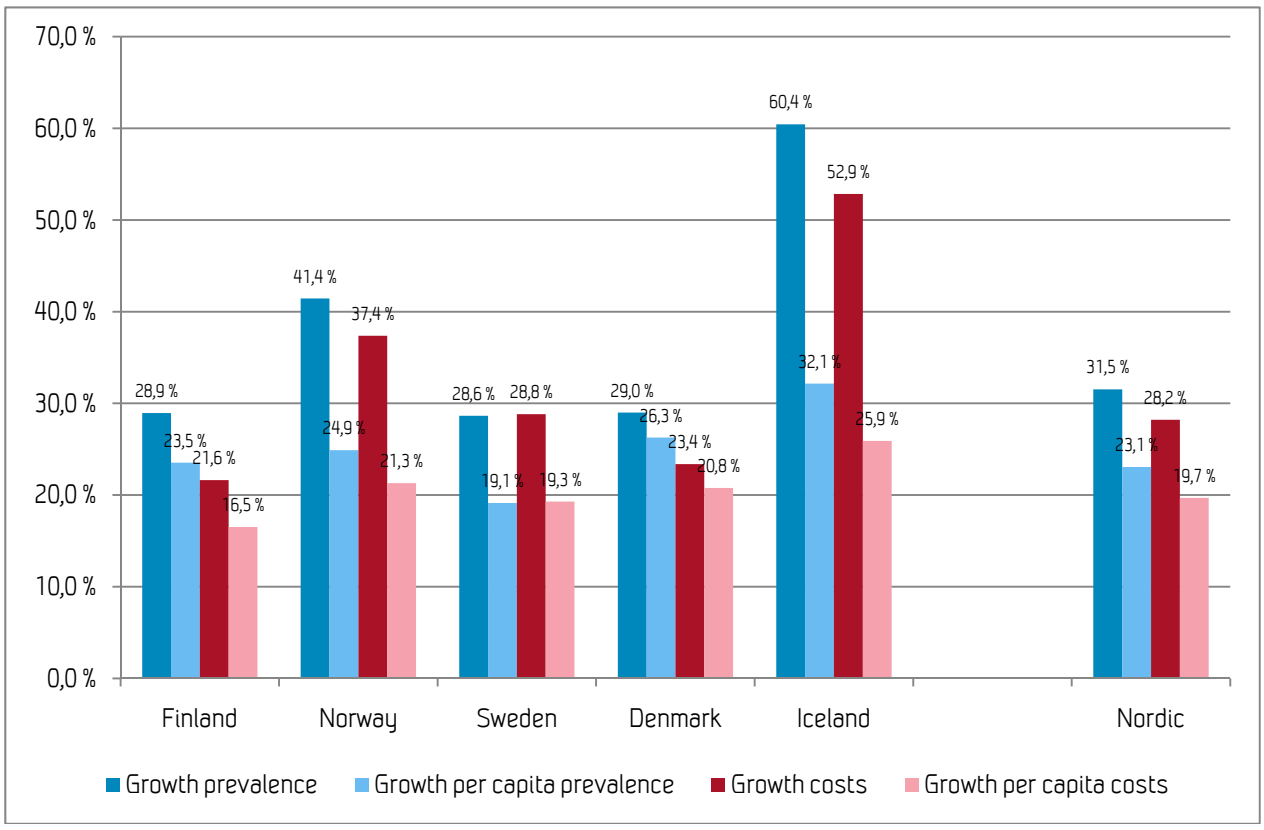

Figure 1 Estimated percentage growth in absolute and per capita five-year prevalence and treatment costs 2007-2025. By country and in total for the Nordic countries.

The Nordic countries can be expected to face different developments in cancer prevalence and costs (Figure 1). This is partly related to differences in expected population growth, as can be seen by comparing predicted growth in absolute and per capita numbers. Even though Iceland and Norway also have the highest predicted per capita growth, country differences in per capita growth is considerably smaller than the growth in absolute numbers. Differences in estimated growth in cancer prevalence and treatment costs are related to changing composition of five-year prevalence on cancer sites, reflecting site specific differences in estimated costs per prevalence in 2007. For all countries, except for Sweden, total cancer costs are expected to increase less than total five-year prevalence, i.e. sites with relatively low costs per prevalence are, on average, predicted to increase more than sites with high costs per prevalence.

At the Nordic level the projected cancer costs implies a yearly real growth rate of 1.3 percent, equivalent to 0.9 percent for the cost per capita. This indicates the necessary yearly growth in gross domestic product in order to finance the projected increase in cancer-related costs *due to increasing cancer prevalence* in the Nordic countries. The estimated yearly growth rate is below a OECD estimate for the yearly growth of GDP until 2025 (1.6-1.8 percent) for the Euro-area (Hervé et al. 2008). The projections of future treatment-related cancer costs

based solely only predicted changes in cancer prevalence may be on the low side since new developments in cancer treatment may be costly. Previous estimates of future growth in cancer-related costs for Sweden and Finland are considerably higher, partly because they are based on assumptions of higher growth in prevalence, but mostly because they incorporate more expensive cancer treatments in the future. Based on expert opinions a three percent increase in yearly costs due to more expensive treatments was assumed in the Finnish study. Adding a three percent increase in per capita cost would double the treatment costs in 2025 compared to 2007.

It is difficult to anticipate future developments of cancer treatment and thus the related costs. Advances in diagnostic tools, surgical procedures, treatment approaches and the organization of cancer treatment may pull costs in both directions. One significant cost driver during the last decade has been the sharp increase in costs of cancer drugs. The yearly growth rate for drug costs is expected to be much lower in the future (Jönson and Wilking 2010). Projections of the treatment cost of cancer based on predictions of future prevalence provide a useful point of departure for assessing future developments in costs.

Further research

To our knowledge, this study is the first systematic comparison of cancer costs between the Nordic countries based on a collection of comparable national data. The study does not cover cancer-related costs of primary health care, long-term care and social services at the municipal level. With changing responsibilities and organization of cancer treatment and care, including these costs should be a priority in further research. Indirect costs of cancer for patients, relatives and society at large are also important parts of the economic burden of cancer which are not included in the present study. The results however points to interesting differences between countries at the macro level and also to future developments, which hopefully can inspire further research digging in more detail into differences and developments in treatment patterns and distribution of costs for the entire course of illness.

1 Introduction

Cancer rates in the Nordic countries are on the rise and are destined to rise further in coming years due to changing population structures and increasing population sizes. The cancer-burden levies major tolls on patients and their families in terms of disability and premature mortality. It also incurs high costs on the societies at large. In the whole of Europe cancer is responsible for about one in every four deaths, and is almost double this rate for the age-group 45-64 years (Albreht et al. 2008, 1451).

For policy and planning purposes it is of interest to know:

- What is the magnitude and what are the characteristics of cancer costs?
- Are there differences between cancer sites?
- If so, how do these differences influence future challenges?

The Nordic countries share major similarities in regard to their political systems, welfare systems and health care systems. Hence, knowledge about cost differences and factors influencing these, are of interest for policy development and planning at the national level. The comparative aspect adds additional insight:

- To what extent and why do cancer costs vary between the Nordic countries?

This study aims to estimate and compare cancer-related costs across the Nordic countries and to provide estimates on future costs. The main focus in the study is on health care costs. The study covers treatment costs, in terms of inpatient and outpatient hospital treatment and costs of prescription drugs, and costs of screening programs for breast and cervical cancer. Cancer also imposes an economic burden in terms of sickness absenteeism and early retirements. In order to shed light on country differences in the public income loss compensation payments (ILCP) related to cancer, public expenditures on sickness benefits and disability pensions are also considered. Moreover, for a number of important cancer sites the health care costs and public expenditures on ILCP are also broken down and estimated.

From a methodological perspective it can be argued that the Nordic countries are especially well suited for comparison since they share many institutional, cultural, socio-economic, and demographic traits. Hence, it is less likely that assessments of the differences in cost-structures, and assessments of the relationship between organization and costs, are severely biased by underlying differences between countries. A further argument in favor of a Nordic comparison is that cancer registries in the Nordic countries collaborate to ensure joint standardization of registration and classification of incidence and prevalence (Møller et al. 2002). In fact, a survey of Nordic cancer registries confirms that only minor differences exist between registries and it is therefore possible to make consistent data comparisons between the Nordic countries (Lund et al. 2000).

Except for Wilking et al (2009), who provide very crude estimates of health care costs related to cancer in European countries, we have not been able to identify previous comparative studies of cancer-related costs in the Nordic countries. However, country specific studies have been undertaken. Engblom & Engblom (2003) and more recent updates (Cancerfonden 2006), estimate costs related to cancer in Sweden. Mäklin and Rissanen (2006) and more recent updates (Hermanson et al 2010) estimate cancer-related costs in Finland. The findings of these studies cannot, however, easily be compared as they apply different methodological approaches and focus on different measures. Our study comes closest to the previous Finnish studies in terms of methodology applied.

Several studies have been undertaken outside of the Nordic countries, most of which deals with costs of specific cancer types. However studies that estimate total costs related to all cancer types can be found. For instance, Koopmanschap et al. (1994) estimate both current and future costs associated with several cancer types in the Netherlands; Chang (2004) et al. likewise estimate the costs tied to several cancer types in the USA between 1999

and 2000; Access Economics (2007) estimates the cost of cancer in New South Wales; Department of Health (2007) and Featherstone and Witham (2010) estimates current and future costs cost of cancer in the UK; Mariotto et al. (2011) estimate current and future costs of cancer in the USA.. Other studies could be mentioned, but what seems clear from our review of the literature is that there are not many studies that estimate total costs related to all cancer types and few studies that compare cost structures between countries,. To our knowledge, this study is the first systematic comparison of cancer costs between the Nordic countries based on a collection of comparable national data.

1.1 Background

The following section provides a brief background on some important dimensions of the systems for cancer management in the Nordic countries.

National cancer plans and national treatment guidelines

The World Health Organization (2002) advocates that the most rational means to efficient cancer control is to utilize national cancer control programs. Denmark, the Faroe Islands and Norway are the Nordic countries that currently have national cancer plans in place.

Norway became the first country in the World to implement a national cancer plan in1998. This plan was later superseded by a second strategy that came into effect in 2006. Both of these plans describe national objectives for prevention, screening, diagnostic activity, treatment, rehabilitation, cancer research, and competence development. Moreover, the most recent plan discusses in greater detail how routines for the introduction of new technologies, treatments, diagnostic procedures etc, can be strengthened (Norwegian Directorate of Health 2004). Access to key personnel within cancer care has increased substantially in recent years. This has occurred largely as a result of initiatives introduced in the first national cancer plan.

The first cancer plan in Denmark came into effect in 2000. Its main objective was to highlight existing opportunities for strengthening treatment in order to reduce cancer mortality rates. The second cancer plan, which was constituted in 2005, also had a strong focus on improvements in cancer treatment. In the years after the second plan came into force, important progress has been made to develop integrated patient pathways as an organizational and clinical standard.The third cancer plan, which came in 2010, emphasizes the importance of high quality along the entire patient pathway, with special focus on the early and final stages of the pathway, ie. the parts proceeding and following diagnosis and treatment; prevention, early detection, rehabilitation and palliative care.
The Faroe Islands introduced their first cancer plan in 2009. The plan contains an assessment of the current situation and suggests a number of initiatives within prevention, screening, diagnostic activity, treatment, rehabilitation, palliative treatment and cancer research that should be implemented in the years to come. The cancer plan also contains a discussion of how plans for the future can best be drawn up.

Most Nordic countries provide national guidelines for the treatment of the most common cancer types. Sweden introduced national clinical guidelines for breast-cancer, prostatic cancer and colorectal cancer in 2007. The guidelines describe the current situation and suggest a number of initiatives within prevention, screening, diagnostic activity, treatment, rehabilitation and palliative treatment. The guidelines also contain recommendations regarding the prioritization of measures as well as a list of measures that should not be conducted routinely (a "no-do" list). The guidelines include recommendations about resource allocation between groups with different needs and across sub-sectors in health services. A revision of the guidelines is under way and will be published in 2013. National guidelines for several cancer sites and for palliative treatment are also in place in Finland and Norway. Although the Faroe Islands relies mostly on the Danish national guidelines, Faroese general practitioners do not normally make use of such guidelines. The Faroese health care system also lacks routines for systematically updating - and implementing - new treatment guidelines. Iceland also relies on

adapting guidelines developed elsewhere. For cancer treatment Iceland's guidelines have been adapted mainly from guidelines with a Scandinavian origin.

Cancer prevention

All Nordic countries have cancer prevention policies. One example of this is the measures taken to reduce smoking. In this area preventive initiatives can be found in every Nordic county. Smoking has, for instance, been banned in most workplaces and in many public places. Taxes have also been raised on tobacco in most countries.

A number of other initiatives can also be found. These initiatives include national schemes aimed at increasing physical activity, improving diets and reducing alcohol consumption among the population; enhancing capacity to carry out 'self examinations'; increasing cervical cancer vaccination; and enhancing radiation protection (linked, for example, to indoor radon exposure).

Screening

By examining large parts of the population for cancer before there are any symptoms, health authorities hope to gain significant positive public health-outcomes. The first screening programs in the Nordic countries were initiated in the early 1960s. The programs were at first typically introduced as trials (pilots) in one or more counties or municipalities, and later expanded to become nationwide. At the present (2011) the Faroe Islands have one screening program for cancer (cervical cancer); Iceland, Sweden and Norway have two screening programs (cervical and breast cancer); and Finland and Denmark have three screening programs (cervical, breast and colorectal cancer). Screening activities are also performed outside publicly mandated screening programs, so called "wild" or "opportunistic" screening, e.g. PSA-test for prostate cancer.

Treatment and rehabilitation

Developments in cancer treatment and rehabilitation in the Nordic countries largely follow patterns seen in the rest of Europe. Cancer treatment has become multimodal – involving combinations of surgery, radiotherapy and a range of anti tumor agents being used to fight the disease. Multimodal treatment approaches also require the use of multidisciplinary teams involving specialists such as surgeons, pathologists, radiotherapists, and other groups of highly trained personnel (Wilking et al. 2009). Since the Faroe Islands have a rather small population they are not able to support such a variety of professionals and the necessary infrastructure. The consequence is therefore that most cancer patients undergo hospital treatment abroad. The other Nordic countries are able to provide cancer treatment domestically. Some countries do, however, experience shortages of certain groups of personnel. Finland, for instance, currently has a shortage of oncologists, chemotherapy nurses, radiologists and pathologists (Hermanson et al. 2010). This situation causes delays in diagnostics and in the administration of treatment.

The continual development of new and more efficient drugs and other treatments (e.g. minimally invasive surgery) has enabled shortened treatment schedules, reduced treatment side-effects, and has generally improved the quality of life for cancer patients. This has also led to more use of outpatient treatments relative to expensive hospitalization. One dimension of this development is increasing use of home-based services. Nearly all Nordic countries offer specially adapted home-based services for certain groups of cancer patients. This form of care is being stepped up in most Nordic countries, and it is therefore expected that home-based services will grow in importance in the years to come.

Organization and financing

Preventive measures and screening activities are organized under primary care in Finland. After cancer is detected diagnosis and treatment become the responsibility of specialized hospitals - either on an inpatient basis or in the form of ambulatory care. Follow-ups after treatment are given under ambulatory care, but also increasingly in a primary care setting. Cancer treatment in Finland is mainly publicly financed by the

municipalities. In Finland the municipalities are responsible for providing both primary and specialized health care. Patients also pay user charges for primary care and ambulatory care visits. Medication received within a hospital setting is financed through the municipalities. Co-payments are also normal for medicines in outpatient care, but these expenses are reimbursed by the Social Insurance Institution. It is a concern that this may create perverse incentives for municipalities to shift patients on expensive medication from an inpatient to an outpatient setting in order to reduce expenditures.

In Sweden it is the county councils' responsibility to provide cancer treatment to their inhabitants. Due to the highly specialized, complex and multidisciplinary nature of cancer treatment, a regional collaboration was established in the 1970s. As a result there are today six Regional Oncology Centres (RUCs) whose activities are coordinated by the university hospitals. The collaboration between the RUCs is, however, based on a voluntary agreement between the county councils within each region, without the involvement of the national government. The RUCs are also responsible for administering the cancer register and the development of treatment programs and guidelines for each region. Furthermore, the RUCs are also involved in some research based on clinical trials and epidemiology analyses.

Cancer treatment in Sweden is one of many public services financed mainly through regional taxes and to some extent intergovernmental grants. Smaller user charges are also paid at different rates for inpatients, outpatients and in primary care. For specialist visits there is a higher fee. For patients with high degrees of utilization there is an expenditure-ceiling for all out-patient visits. For specialist visits there is an additional (maximum) fee. Any consultations thereafter are free of charge. The same principle also applies for co-payments for prescription drugs, but with a higher maximum outlay-ceiling. The county councils are formally responsible for financing medication; hence they also carry the major part of the cost associated with medication.

In Norway it is the responsibility of the regional health authorities to organize the specialist health care services in their regions, while primary care is the responsibility of the municipalities. After cancer is found treatment is supplied either on an inpatient basis or in the form of ambulatory care. While complex treatment is centralized within the regions, simpler treatments, follow-ups, rehabilitation and palliative treatment are often decentralized.

Cancer treatment in Norway is financed by the regional health authorities and the regional health authorities are in turn financed through intergovernmental grants. These grants consist of two parts. One part is a need-based grant which covers 60 percent of the expenses, and the other part is an activity-based fund that is supposed to cover the remaining 40 percent of the expenses. Health services in Norway are by and large financed through public taxation schemes; hence user charges are not extensively used. Out of pocket payments for outpatients and in primary care are, in any case, limited by an annual expenditure-ceiling. The same principle also applies to co-payments for drugs.

Cancer treatment in Denmark is for the most part provided in public hospitals. Provision of specialist and most primary health care services are the responsibility of five regions in Denmark. The regions are financed through intergovernmental grants – the main grant (77 percent in 2010) is needs-based, the other grant is activity based (three percent in 2010). There are also grants from the municipalities where one part is based on the number of inhabitants (eight percent in 2010) and one part based on activity (12 percent in 2010).

The Ministry of Health decides the organization of health services in Iceland. Landspitali University Hospital (LUH) in Reykjavik is the only university hospital in Iceland and also the only tertiary care hospital. It is also the community hospital of the capital area where 63 percent of the population resides. LUH provides services in all major medical specialties as well as education and training to students in all major branches of health services. LUH is also the major provider of cancer treatment in Iceland. There are several smaller hospitals outside Reykjavik. Akureyri Regional Hospital, in the north of the country, is the largest among these. This hospital also provides some limited cancer treatment. Other rural hospitals are considerably smaller and often organized in conjunction with local primary care centers.

While hospitals and primary health care centers are funded directly by the government, services provided by private practitioners (specialist doctors, dentists, physiotherapists and others) are paid for by the Icelandic Health Insurance Agency and by user co-payments. Approximately 83 percent of health care services are financed through taxes. The remaining 17 percent are financed through user charges. There are no user charges for inpatient hospital care. Out of pocket charges are used in connection with outpatient hospital services and visits to private practitioners. No user charges are paid by children, the elderly, the unemployed, or the disabled. The same groups are also entitled to lower co-payments for medication. No co-payment is generally charged for chronic disease medication. Discount cards are issued when the amount of co-payment exceeds a certain annual limit.

In the Faroe Islands the organization of health care services is decided by the Faroe Islands' home rule. The organization of hospital services, specialist fields, and primary health services largely follows the pattern of the Danish system. This also applies to the organization of nursing homes, home nurses, home help, and dental treatment. All practicing physicians on the Faroe Islands are public employees and their services are either administered by municipal authorities or by the state authorities. Physiotherapy services are either provided through hospitals or by privately practicing physiotherapists. All pharmacies are run by public authorities.

Health services in the Faroe Islands are mainly financed by public authorities. The citizens of Faroe Islands contribute to the financing of the health services through insurance schemes. There are no user charges for treatment in the Faroe Islands. Medication is also partly financed through the same insurance scheme, but also partly financed by user charges in the form of co-payments. Pensioners are reimbursed medication outlays exceeding a certain amount. The same applies to some other groups that qualify to receive sponsored medication according to the Social Security Act.

The Faroese health care system is currently experiencing a severe shortage of specialists. There is, for instance, no oncologist in the Faroe Islands now. There are also too few radiologists, surgeons, and GPs. Consultant arrangements with hospitals abroad and telemedicine solutions may, however, help to relieve this situation in the future.

Rules concerning sickness absenteeism

In principle, all Nordic countries will provide compensation to employees for loss of income due to serious sicknesses such as cancer. There are, on the one hand, similarities in the type of criteria that the Nordic countries apply to decide who are entitled to such compensation. Besides a requirement of employment, all countries have, for example, rules on how long employees can receive sickness benefits; rules that define a period during which sickness benefits are covered by the employer; and rules regarding the level of compensation based on income, etc. There are, on the other hand, large variations between the Nordic countries in the content of these rules. For instance - Denmark, Faroe Islands and Norway will fully compensate income losses up to a maximum income ceiling, while in Finland and Sweden income loss is not fully compensated (NOSOSCO 2009: 101). Nor do the countries have the same requirements regarding previous employment. The requirement to receive sickness benefits in the Faroe Islands, for example, is paid work for at least 20 hours during a five week period, while in Finland the requirement is paid work for three months, or 55 days consecutively (ibid.: 100). Likewise, the employer period varies considerably between the countries, from two days in the Faroe Islands up to 10 days or more in the other countries (ibid.). Different rules also apply for disability pensions, for instance regarding the reference income or the basis of calculating pensions, both for basic pensions and employment based pensions.

The examples mentioned above refer only to a small selection of the rules governing sickness absenteeism and disability pensions. The statutory frameworks covering sickness absenteeism and early retirement in the Nordic countries are too complex to be treated in any detail here, and all elements of a more complete description would, in any case, not necessarily be very relevant. What is important to bear in mind in the context of the present study is that the differences in the content of the rules generate differences in public expenditures on ILCP related to cancer. These rules will have a large effect not only on the level of sickness and disability

compensation and the public's share of these expenditures, but they will also have an impact on the number of cancer patients entitled to receive sickness benefits and disability pensions.

1.2 More on the aims of the study and the organization of the report

The main aims of the study are to:

1. Estimate Nordic and country specific annual health care costs and public expenditures on income loss compensation payments (ILCP) related to cancer.
2. Estimate annual health care costs and public expenditures on ILCP in a selection of cancer sites specifically.
3. Assess factors that might explain differences in health care cost at the national level, e.g. differences in cancer prevalence, service delivery patterns and/or organization of services.
4. Assess the extent to which differences in public expenditure levels on ILCP are associated with differences in social security systems and transfer levels.
5. Provide crude estimates on future treatment costs based on predictions of future prevalence.

The study focuses both on the costs of cancer in the Nordic countries as a whole (chapter 4) and on a comparative approach where the basic concept is the per capita cost in each country (chapter 5). Chapter 4 provides estimates of total Nordic health care costs and public expenditures on ILCP related to cancer. The main focus is, however, on differences between cancer sites. Taking advantage of the information for all six countries will give more robust estimates on differences between cancer sites than single country estimates. The main focus in chapter 5 is on cross-country differences for all cancer diagnoses. However, it also takes into account differences in prevalence and costs for different cancer sites in the comparison of health care costs of cancer between the Nordic countries. Estimation of annual cancer-related treatment costs at the Nordic level and by country form, together with predications of future prevalence, the basis for making predictions on future developments in treatment costs of cancer.

We have identified and calculated (estimated) health care costs and public expenditures on ILCP related to cancer at the macro level in each country in the year 2007. Data and methods are presented in chapter 2. Background data on cancer prevalence and composition in the Nordic countries is presented in chapter 3. Differences in *treatment* cost- and activity levels is discussed in relation to differences in cancer prevalence, service patterns and unit costs between *cancer sites* for the Nordic countries as a whole (chapter 4) and between the *six Nordic countries* (chapter 5.1). Country differences in cost of screening programs are discussed in relation to differences in screening policy concerning target groups and screening frequency (Chapter 5.2). Country differences in public expenditure on ILCP are discussed in relation to differences in rules and compensation levels for sickness benefits and disability pensions (Chapter 5.3). Crude estimates of future treatment costs of cancer in the Nordic countries based on projections of present treatment costs by utilizing estimated cost per five-year prevalence in 2007 and predicted cancer prevalence in 2025 are presented in chapter 6. Predictions on future prevalence is provided by the Norwegian Cancer Registry (Rahimi et al 2010), and is for the year 2025. Finally, the main results are summarized and discussed in chapter 7.

2 Data and methods

The task of estimating the costs of cancer in the Nordic countries raises several methodological issues. These relate to which epidemiological approach to apply; the choice of cost perspective and determining the types of costs to include; how to calculate costs; and the identification of cancer patients for cost calculation purposes. The cross-country comparison of costs also involves the methodological issue of how to present and interpret differences in estimated costs.

2.1 Epidemiological approach

Costs related to a specific illness can be estimated using different epidemiological data and this will have a bearing on the empirical approaches:

- *The prevalence-based approach*: Identify all types of activities/costs induced by cancer during a specific period (e.g. a year).
- *The incidence-based approach*: Identify all types of activities/costs induced by cancer over the life span for persons diagnosed with cancer for the first time during a specific period (e.g. a year).

We have used the *prevalence approach* which implies that the different cancer-related costs are identified within a specific year, i.e. including, for each cost type, costs accrued in the chosen year irrespective of at which point in the course of illness the patients are. This enables the estimation of the yearly costs at the country level and in total for the Nordic countries. The prevalence approach requires less data and fewer assumptions about the course of the illness or survival rates than the *incidence-based approach* (Segel 2006). Furthermore, gathering cost data on the full course of the illness for all types of cancer and in all of the six Nordic countries is logistically very difficult in terms of data availability and time used. This excluded the use of the incidence-approach in the present study.

The prevalence approach is a suitable approach for estimating yearly costs accrued by the health care system or public expenditures on income loss compensation payments related to cancer, which is the main purpose of this study. The incidence-approach is preferable if the purpose is to calculate potential gains of prevention in terms of costs saved for every averted cancer case or to identify the time-pattern of costs. Incidence-based estimates tend to be lower due to discounting of future costs. The differences between estimates resulting from each approach should be smaller the shorter the course of the illness and the higher the share of lifetime costs related to the first year(s) of illness.

2.2 Perspective: Cost types

The relevant cost types depend in general on the perspective taken in the study; whether it is, for instance, a societal perspective, health care system perspective or a financial perspective (Segel 2006). The *cost of illness* (COI) literature identifies three main types of costs to society: direct costs, indirect costs and intangible costs (Cooper and Rice 1976, Hodgson and Meiners 1982, Tarricone 2006). *Direct costs* relate to health care costs and other costs such as transportation costs for the patients and informal care. *Indirect costs* equal the value of the production loss due to illness, and cover costs related to sickness absenteeism, disability retirement and mortality. While *intangible costs* relate to, for example, the patient's psychological pain and discomfort. This last cost type is difficult to assess and is typically not included in COI-studies.

In this study we have chosen to assess the cost of cancer from a *health system perspective* (estimating direct health care costs) as well as a *public financial perspective* (focusing on public expenditures on income loss

compensation payments). The COI approach (taking a societal perspective) has been considered. However, given the main aim of the study, and in light of the methodological controversies and time and resource demands tied to the COI-approach (Shiell at al. 1987, Heijink et al. 2006), the chosen approach has been deemed to be the most adequate.

The different perspectives do not matter much when estimating the health care costs of cancer as we include both public and private expenditures in the calculation of health care costs. Private expenditures for health care costs are mainly fees paid by the patients. However, the choice of perspective matters a lot when estimating indirect costs or the production losses due to morbidity and mortality. In this study we calculate the *public expenditures* on income loss compensation payments (ILCP) related to sickness absenteeism and disability retirement. Mortality costs typically dominate traditional COI calculations. The indirect societal costs of cancer identified in COI-studies are higher than the public expenditures on ILCP, even if we exclude productivity losses related to mortality. This is because public expenditures do not cover all costs relating to sick leave and disability. Some of the costs are carried by employers, some of the costs fall upon other social security arrangements, and many of the costs will be carried by the patients themselves and their families. The estimates for public expenditures on ILCP will be informative with regards to the level of such expenditures related to cancer in each country as well as to illustrate differences between cancer sites. COI-studies applying the human capital approach have been criticized for discriminating against the elderly, disabled and those outside the labor market and instead favoring high income earners. The criticism of the bias of the COI-study in favor of high income earners also applies to the public expenditures on ILCP when the level of income loss compensation is tied to personal income. Then the age and sex composition of the cancer sites will affect the public expenditures on ILCP. Differences in organization, financing, and rules of sickness benefits and disability pensions will affect the variation in public expenditures on ILCP between countries. We decompose the total expenditures, identifying both the number of days/persons for which ILCP is paid for and the average compensation level.

Cost types for health care for cancer patients can be identified by studying the different stages of the clinical pathway (NCU 2004). The first phase involves detection and diagnosis of cancer and preparation of treatment. The next phase involves treatment which is usually in the form of surgery, and/or radiation therapy and/or medication. The third phase covers rehabilitation and restoring of health, including years of controls in many instances. This phase either ends the clinical pathway when the patient is cured, or the cancer recurs and the patient enters into a new sequence of treatment or into a phase of palliation and the cessation of life. The costs of diagnosis, treatment and rehabilitation are typically huge, especially in the most intense phase of treatment, but also at the end of life (palliative, terminal care). These are typically hospital costs, but primary health care and long term care institutions may also be involved. The health care costs also cover any cost of medication treatment not given within hospitals. The pattern of costs will depend on the organization of cancer care.

Health care costs can also cover activities related to prevention and research. Such costs are often included if they are part of the health services. Costs tied to screening programs for breast and cervical cancers are included in the present study. In the year of study full-scale colorectal screening was not carried out in any of the Nordic countries and is therefore not included[2]. Research costs related to cancer are not specifically identified.

The following cost/expenditure types are included in the study:

Health care costs

- Treatment costs:
  - Hospital treatment
  - Medication outside hospitals (prescription drugs)
- Screening programs for breast cancer and cervical cancer

[2] In 2007 the colorectal screening program coverd 35 percent of the targeted population in Finland. There also was a pilot in Denmark.

Public expenditures on income loss compensation payments (ILCP)

- Sickness benefits
- Disability pensions

Although costs related to outpatient primary care are relevant, it is has not been possible to collect data in most countries. However, assuming other countries are similar to Norway (the only country for which national data was available), outpatient primary care is likely to play a limited role in cancer treatment in the Nordic countries. Indeed, data from Norway indicates that only about one percent of costs are related to outpatient primary care for cancer patients. Similarly, data on the cancer-related costs of long term care (institution or home care) in the municipalities has not been available. However data on inpatient activity for cancer patients at health centres in Finland is included. It is therefore important to be mindful of possible differences in the organization of cancer treatment and palliative care when patterns in the cross-country comparisons are interpreted.

2.3 Identification of cancer patients

Cancer patients and related costs are mainly identified by *primary diagnosis* according to the ICD-10 classification (C00-97 Malignant neoplasms) or ICPC-2 (specific list of codes for cancer). The table below describes the specific cancer sites that have been selected for separate analysis. The selected sites cover large and small sites in terms of prevalence, and also differ according to age and sex characteristic of patients, as well as treatment costs.

Table 1 Identification of cancer patients

Nr	Cancer types	ICD-10	ICPC-2
1	**All sites**	**C00-C97**	See * below
2	Colorectal	C18-21	D75
3	Lung, trachea	C33-C34	R84
4	Skin (incl. non-melanoma)	C43-C44 + C46.0	S77
5	Breast	C50	X76
6	Cervix uteri	C53	X75
7	Corpus uteri	C54	X77
8	Prostate	C61	Y77
9	Testis	C62	Y78
10	Kidney, bladder	C64-C68	U75, U76, U77
11	Non-Hodgkin Lymphoma	C82-C85 + C96	B72
12	Acute leukemia	C91.0+C92.0+C93.0+C94.0+C95.0	B73

*A79, B72, B73, D74, D75, D76, D77, F74, H75, K72, L71, N74, R84, R85, S77, T71, T73, U75, U76, U77, W72, X75, X76, X77, Y77, Y78

2.4 Data

A brief description of data sources and cost estimates for the different cost types as well as other data used in the project is given in Table 2. A more detailed description of data is presented appendix A1. Data for year 2007 are collected.

Table 2 Data sources and cost estimates

Health care costs	
Hospital treatment	Hospital treatment comprises *inpatient-, day patient-* and *outpatient* activities, and the main data sources are national patient registers. Day patients are defined as inpatients admitted and discharged the same day, i.e. having a length of stay (LOS) equal to 0. In calculating the number of bed-days (for all discharges) the day for admission is counted. A cancer patient is defined as a patient with a cancer diagnosis as the primary diagnosis, or; as a patient with a z-procedure code (Z510 Radiotherapy session, Z511 Chemotherapy session for neoplasm, Z515 Palliative care) as the primary diagnosis where there is a cancer diagnosis as a secondary diagnosis. Diagnosis Related Groups (DRG) forms the basis for cost calculations. *Cost estimate* $=\sum_k$ *#discharges/visits in DRG-group* $_k$ * *cost-weight for DRG-group* $_k$ * *national unit cost* *k=diagnostic group k*
Prescription drugs	Data on costs for prescribed drugs are collected from national registers. Cost estimates are based on pharmacy retail price in each country. *Cost estimate* $= \sum$ *pharmacy retail price for medication for cancer patients*
Screening program for breast and cervical cancer	Information on screening activity for breast and cervical cancer is mainly collected from the national cancer registries. The average of country specific estimates of unit costs for breast cancer and cervical cancer respectively, capturing the direct health care cost of performing tests, is used for all countries. *Cost estimate = #screened/tests * common Nordic unit cost*[3]
Public expenditures on income loss compensation payment (ILCP):	
Sickness absenteeism	Data is collected from social insurance institutions in each country, covering publicly refunded sickness benefits. *Cost estimate = publicly refunded sickness benefits for cancer patients*
Disability pensions	Data is collected from social insurance institutions in each country, covering publicly paid disability pensions. *Cost estimate = publicly paid disability pensions for cancer patients*
Other:	
Deflators	Costs/expenditures are measured in 2007 Euros at Finnish price levels, i.e. each country's cost/expenditure estimates are converted to be comparable to the Finnish data using deflators capturing both differences in money value and price/cost levels between the countries. Three different deflators are used: 1. Hospital costs: Kittelsen et al. (2009) 2. Prescription drugs: Exchange rates (OECD) 3. Other costs: GDP-PPP (OECD)
Population size	National bureau of statistics in each country.

[3] See section A.1.4 in the appendix for details.

Prevalence numbers	Data is collected from the database in the NORDCAN project: http://www-dep.iarc.fr/NORDCAN/english/frame.asp (Engholm, Ferlay, Christensen, Bray, Gjerstoff, Klint et al. 2008), owned by the Association of Nordic Cancer Registries (ANCR). Five-year prevalence is used as the primary approximation of the number of cancer patients.

One should bear in mind the following limitations of data:

- Hospital treatment: To some extent the registration of patients as day patients or outpatients varies between the six countries.
- Hospital treatment: For the Faroe Islands, outpatient activity only includes activities performed at Danish hospitals.
- Prescription drugs: The possibility to identify drug costs related to cancer in the data varies between countries. Different approaches are applied.
- Prescription drugs: Data only provides information on the costs of prescription drugs by cancer site for Finland and Sweden. For Norway data on the distribution of costs on cancer sites from the first half of 2009 is used to distribute the total medication costs for cancer on cancer sites in 2007.
- Screening: A common Nordic unit cost is roughly estimated based on available, previous national estimates, covering health care costs of screening. We have not been able to collect data on screening activity or costs for Denmark.
- Sickness absenteeism: The costs do not cover sick pay from employers or from collective funds or private insurance. The data for Denmark does not allow identification of cancer patients.
- Disability pensions: The costs do not cover payments from collective funds or private insurance. The data for Denmark does not allow identification of cancer patients.
- Estimate of total Nordic treatment costs: Data on cancer sites for day patient and outpatient in Iceland are estimated assuming the same distribution on cancer sites as for inpatients activity and costs respectively. The distribution of prescription drugs for Iceland is estimated assuming the same distribution on cancer sites as for outpatient costs.
- Estimate of total Nordic screening costs and public expenditures on ILCP: Missing data on screening, sickness benefits and disability pensions for Denmark are estimated based on average cost/expenditures per five-year prevalence for the other Nordic countries.

2.5 Decomposition of costs

The data and calculations described in the previous section gives estimates on cancer-related treatment costs, screening costs and public expenditures on income loss compensation payments by country and cancer site. In order to compare cost and expenditure levels among countries, per capita costs and expenditures are calculated. The estimates of costs and expenditures are combined with estimates on activity and data on prevalence (treatment costs) for the purpose of decomposing costs and expenditures in separate potential sources of variation.

2.5.1 Treatment costs

Differences in the *cost per capita* between *countries* or between *cancer sites* can be related to differences in *cost per person with cancer* (prevalence) and/or differences in *prevalence rates*:

Decomposition I

Cost per capita = Cost per prevalence × *prevalence per capita*

Cost per prevalence is used synonymously with *cost per patient*, and prevalence per capita is synonymous with the *raw prevalence rate*. The decomposition of cost per capita can in theory be made for all cost (and expenditure)

types. The link between different prevalence rates and screening costs and public expenditures on ILCP are more complex than for treatment costs. Thus this decomposition is only done for treatment costs.

Differences in treatment costs per prevalence can be due to both differences in service levels and unit costs:

Decomposition II

Cost per prevalence = Activity per prevalence × cost per activity

Treatment activity composes several activity measures covering hospital inpatient, day patient and outpatient activity (see chapter2.4). Since the cost per unit of activity varies with treatment type (inpatient activity being relatively more expensive than outpatient activity) the activity profile also influences the estimated treatment cost of each cancer site and each country. To get around the problem of having more than one type of hospital activity, we have used the calculated cost per bed-day (inpatients and day patients) and cost per outpatient visits for *all cancer sites* for the (*sum of the) Nordic countries* as weights in aggregating bed-days and outpatient visits to one activity measure for each cancer site and each country[4]. Thus the (weighted) activity measure for cancer site *j* or country *i* used in the decomposition of treatment costs is calculated in the following way:

$$(Weighted)activity_{i\ or\ j} = Cost\ per\ bedday \times \#bed\ days_{i\ or\ j} + Cost\ per\ outpatient\ visit \times \#outpatient\ visits_{i\ or\ j}$$

j=cancer site, i=country

Cost per bed-day and per outpatient visit is calculated as the sum over all cancer sites at the Nordic level.
Thus the (weighted) activity measure actually shows the estimated costs per site or per country if the cost per bed-day and per outpatient visit was equal for all sites and all countries. In order to be able to decompose the total treatment costs (including prescribed drugs) the *cost of prescription drugs are added* to the cost of outpatient visits.

Standardization: taking into account differences in cancer prevalence case-mix

The calculated total cost per prevalence for each country is also affected by the country specific composition of prevalence in different cancer sites (cancer prevalence case-mix). When cost per prevalence differs between cancer sites, the higher (lower) the share of prevalence on sites with relatively high cost per prevalence, the higher (lower) the cost per prevalence for cancer in total. Taking the prevalence case-mix into account the calculated cost per prevalence can be decomposed into:

Cost per prevalence = Standardized cost per prevalence × index for cancer prevalence case-mix

The cancer prevalence *case-mix index* for country *i* is calculated the following way[5]:

[4] Since the amount of day patients, and the estimated unit costs, varies much between the countries, and the measured weighted activity, especially for Norway and Iceland are very sensitive to whether day patients are specified as a separate activity, we have chosen to calculate the weighted activity based on sum bed-days and a common unit cost for inpatient and day patient activity.

[5] We identify 11 specific cancer sites in the study. Prevalence and costs of other cancer diagnoses are calculated residually, as the difference between cost for all cancer diagnoses and the sum costs for the 11 cancer sites specified..

$$Case\ mix\ index\ (CMI)_i = \frac{\sum_j AC_j \times P_{ji}}{\sum_j AC_j \times \frac{P_j}{P} \times P_i}$$

AC_j = Average Nordic cost per prevalence for cancer site *j*
P_{ij}=Prevalence for cancer site *j* in country *i*
P_j=Prevalence for cancer site *j* at the Nordic level
P_i=Total prevalence for country *i*
P= Total prevalence at the Nordic level

The prevalence *case-mix index* is thus calculated as the sum costs for country *i* with average Nordic cost per prevalence for each cancer site *j* divided by sum costs with average cost per prevalence for each cancer site with same diagnosis distribution (share for cancer sites) as the Nordic average.

The standardized cost per prevalence for country *i* is calculated the following way:

$$Standardized\ cost\ per\ prevalence_i = \frac{C_i}{CMI_i \times P_i}$$

C_i=Total treatment costs for country *i*
C= Total treatment costs at the Nordic level
$CMI_i \times P_i$ = standardized prevalence

The standardized cost per prevalence is thus the sum costs divided by the standardized prevalence.

For the purpose of comparing total cost per prevalence between countries, it can be argued that the standardized measure is the appropriate measure to use. It follows that the use of a standardized measure will in turn affect the decomposition of per capita costs:

Cost per capita = Standardized cost per prevalence × *Standardized prevalence per capita*

A similar decomposition can be made for activity per prevalence. The total decomposition of treatment cost per capita is summarized below:

Decomposition of treatment cost per capita:	
A=B*C =B*C2*D=B2*C2	Cost per capita
Not standardized:	
B	Prevalence rate (prevalence per capita)
C=Ca*Cb	Cost per prevalence
Ca	Activity per prevalence
Cb	Cost per activity
Standardized:	
D	Cancer prevalence case-mix index
B2=B×D	Standardized prevalence rate
C2 =C2a×C2b=C/D	Standardized cost per prevalence
C2a=Ca/D	Standardized activity per prevalence
C2b=Cb	Cost per activity

2.5.2 Screening programs

For screening programs the following decomposition of cost per capita is carried out:

Cost per capita = Cost per activity × activity per capita

The decomposition is carried out for breast cancer and cervical cancer separately. A common Nordic cost per activity is used.

2.5.3 Public expenditures on ILCP

For public expenditures on ILCP the following decomposition of expenditures per capita is carried out:

Expenditures per capita = Expenditure per activity × activity per capita

The decomposition for sickness benefits and disability pensions is carried out separately[6].

[6] Activity is sickness days and disability pensioners. respectively

2.6 Estimation of future treatment costs

In calculating an estimate of future treatment costs a very simple approach is taken:

$$\textit{Future costs} = \sum_j \textit{Cost per prevalence 2007} \times \textit{Predicted future prevalence}$$

The estimate is based on information on costs per cancer and predicted future prevalence for separate cancer sites.

3 Cancer prevalence in the Nordic countries

"For most cancer sites, cases surviving 5 years from diagnosis experience thereafter the same survival as the general population, so most of the workload is therefore due to medical acts within these first 5 years" (Pisani et al. 2002).

Cancer costs are highly correlated to the number of cancer patients. Prevalence numbers are equal to the number patients previously diagnosed with cancer. However, patients diagnosed and having received adequate treatment can recover, and in that respect, leave the cancer patient category. In this study *five-year prevalence* is used as the primary approximation of the number of cancer patients, assuming that these patients on average represent those diagnosed with a cancer that is associated with some type of cancer-related costs identified at the macro level within a given year. This assumption is mostly to give an intuitive background to the prevalence numbers that are used in the decomposition of treatment costs. The five-year alternative is a variable discretionary chosen. In this chapter different prevalence rates are shown both for the Nordic countries in total and for each country. The intention is both to give some background information on the prevalence of cancer, but also to address the importance of the choice of prevalence rate for differences in estimated cost per prevalence between cancer sites and between countries[7].

3.1 Prevalence in total

In 2007 more than 900 000 persons living in the Nordic countries had cancer or had previously been diagnosed with cancer. Of these, almost 390 000 persons had been diagnosed with cancer within the last five years. This number amounts to 1.5 percent of the total population of 25 million. Of these, nearly 100 000 had developed cancer within the last year, which amounts to approximately 0.4 percent of the total population. Figure 2 shows the prevalence rates for the Nordic countries in total in 2007 for one-year, three-year, five-year, ten-year and total prevalence .

[7] It is important to remember that treatment costs are estimated without the use of prevalence data, and are based on identification of cancer patients in national patient registers and prescription drug databases.

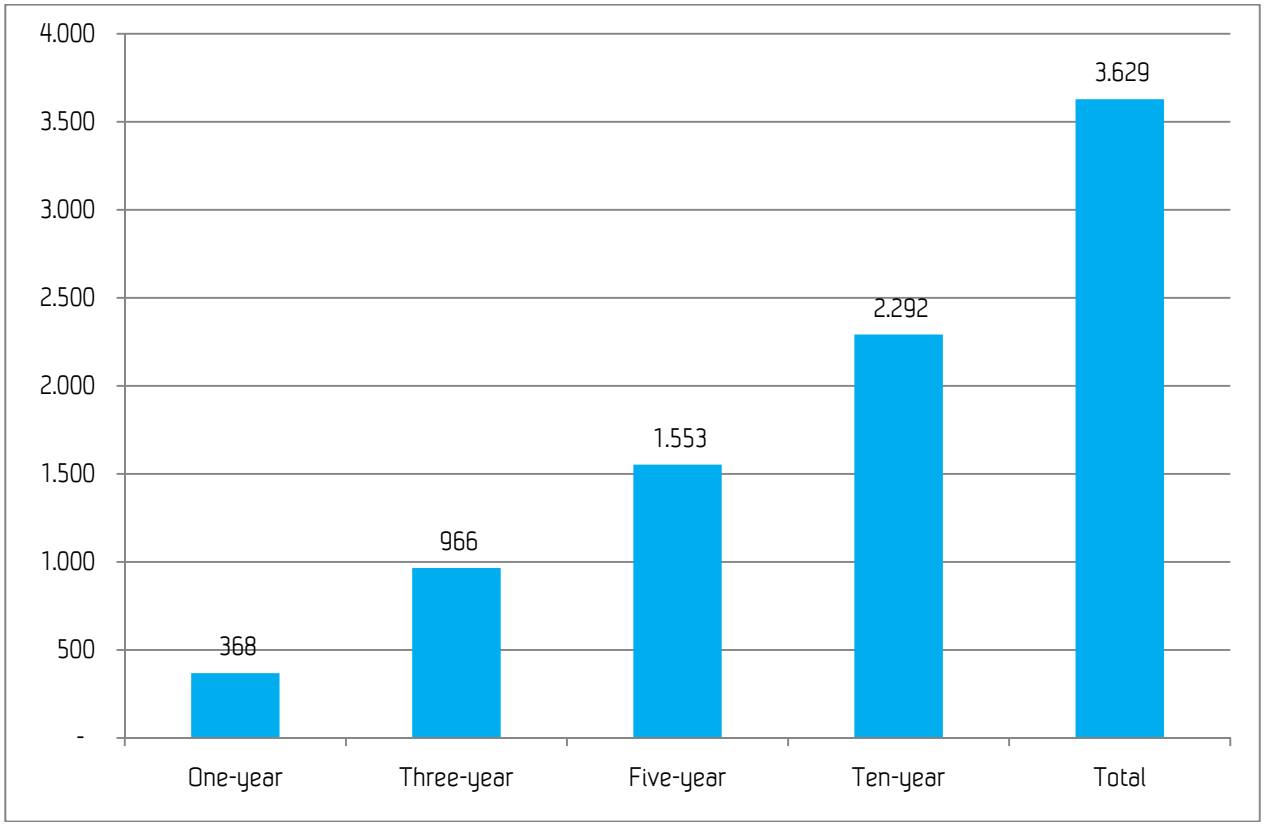

Figure 2 Prevalence per 100 000 capita (all sites but non-melanoma skin cancer). Nordic countries (excl. the Faroe Islands). 2007. Source: NORDCAN (ANCR)

The distribution (percent) of the five-year prevalence number by cancer site in 2007 is shown in Figure 3. Prostate cancer is the most frequent type of cancer in the Nordic countries measured by the five-year prevalence, amounting to almost ¼ of the total number, followed by breast cancer (19 percent), and colorectal and skin cancer (both 12 percent). If the cost per prevalence differs between cancer sites, the distribution of costs will deviate from the pattern displayed for the prevalence composition.

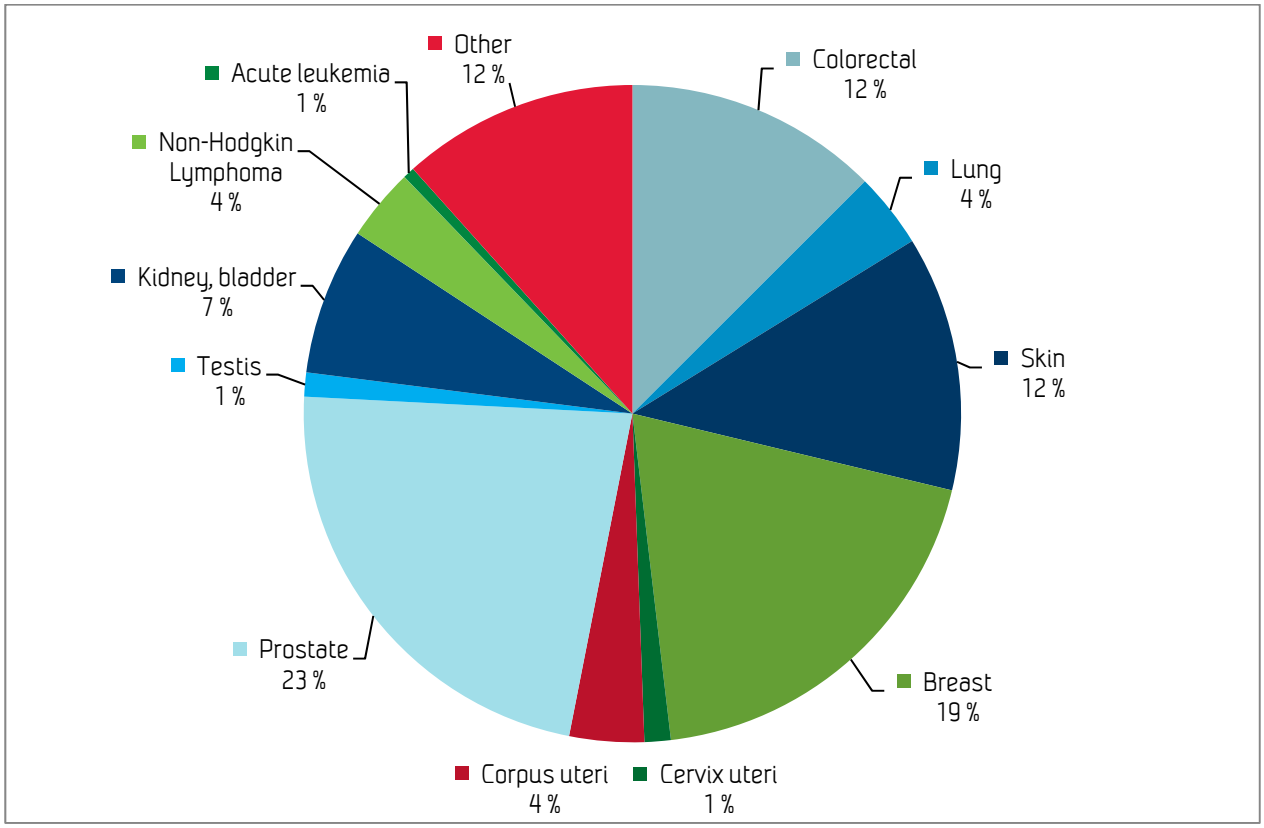

Figure 3 Five-year prevalence by cancer site. Percent. Nordic countries (excl. the Faroe Islands). 2007. Source: NORDCAN (ANCR)

Survival rates differ to some extent between cancer sites. Such differences will in turn affect the five-year prevalence pattern compared to the one-year prevalence pattern. For instance, lung cancer has relatively low survival rates and the difference between the one-year and the five-year prevalence will be lower than for other sites. For most of the selected sites the five-year prevalence is 3.5 to 4.5 times higher than the one-year prevalence. For lung cancer, however, the ratio is about 2. This will contribute to higher estimated relative costs per five-year prevalence than per one-year prevalence for lung cancer compared to other cancer diagnoses, since costs are estimated independent of prevalence rates.

3.2 Country differences

Differences in prevalence rates are important factors in assessing cancer cost differences between countries. Figure 4 shows the five-year prevalence rate (prevalence per 100 000 capita) for each country in 2007. The five-year prevalence rate was lowest in Iceland and highest in Sweden[8]. The Icelandic rate is 88 percent of the Finnish rate, which is the third lowest of the Nordic countries. Among the four largest countries, the difference in five-year prevalence rate is 11 percent at the most.

Figure 5 shows different relative (to Nordic average) prevalence rates according to the length persons have lived with a cancer diagnosis. Country differences vary with the choice of prevalence rate. The choice of five-year prevalence rather than, for example, one-year or three-year prevalence therefore influences country differences in the estimated cost per prevalence. The five-year prevalence rate for Denmark equals the Nordic mean. However

[8] Prevalence data is not available for the Faroe Islands. If we estimate the prevalence rate for the Faroe Islands on the basis of the incidence rate, it would be only 56 percent of the Swedish rate and 70 percent of the Icelandic rate, which is the second lowest.

Denmark clearly has the highest one-year prevalence rate. The opposite is the case for Sweden. Using five-year prevalence increases the relative cost (per prevalence) for Sweden and lowers the relative cost (per prevalence) for Denmark, compared to using the one-year prevalence.

Age is a major risk factor in developing cancer. Figure 6 shows that low prevalence rates in Iceland are related to a favorable age structure (young) in the population. The age-standardized total prevalence rate is highest for Iceland[9]. The same goes for Norway. A relatively older population contributes to high total prevalence in Sweden.

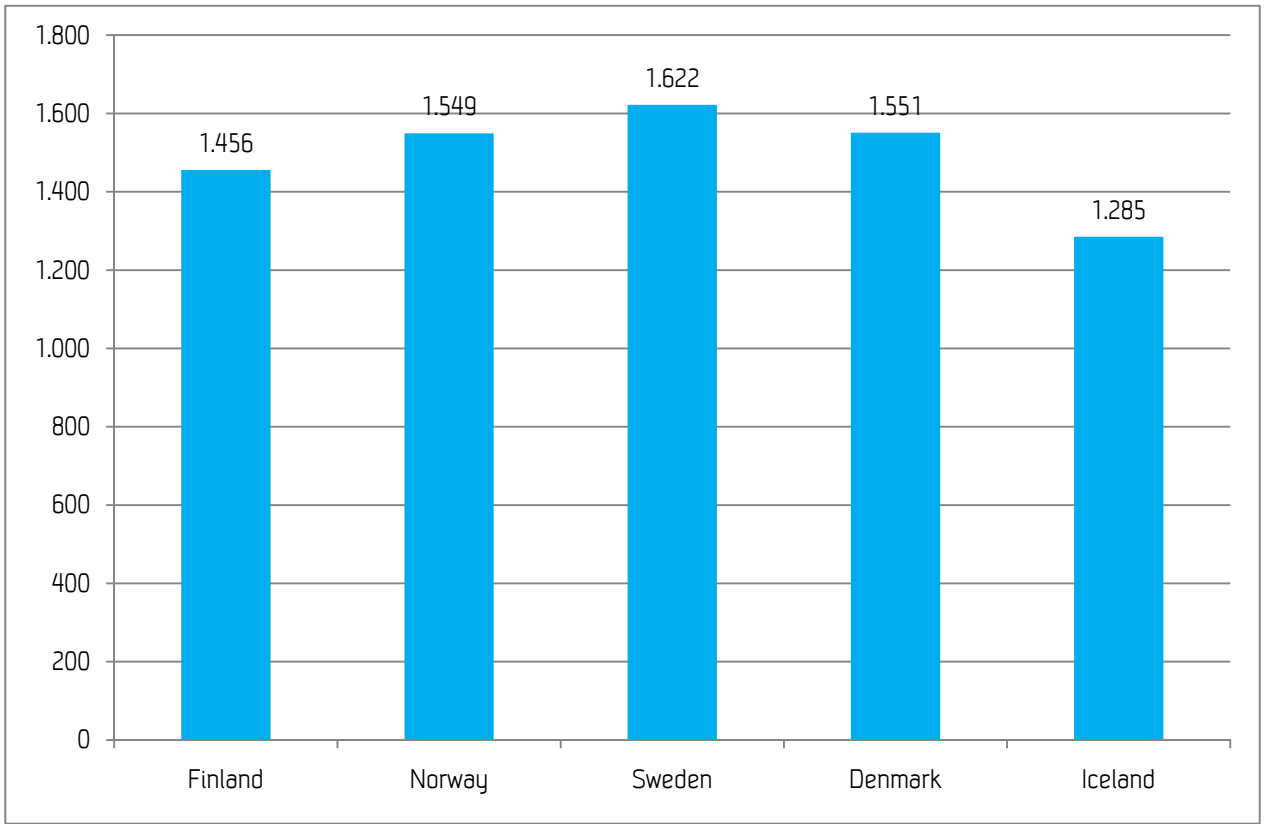

Figure 4 Five-year prevalence per 100 000 capita. Nordic countries except the Faroe Islands. 2007. Source: NORDCAN (ANCR)

[9] Low estimated prevalence for the Faroe Island is also partly related to a relatively young population, but also to a low age-standardized incidence rate.

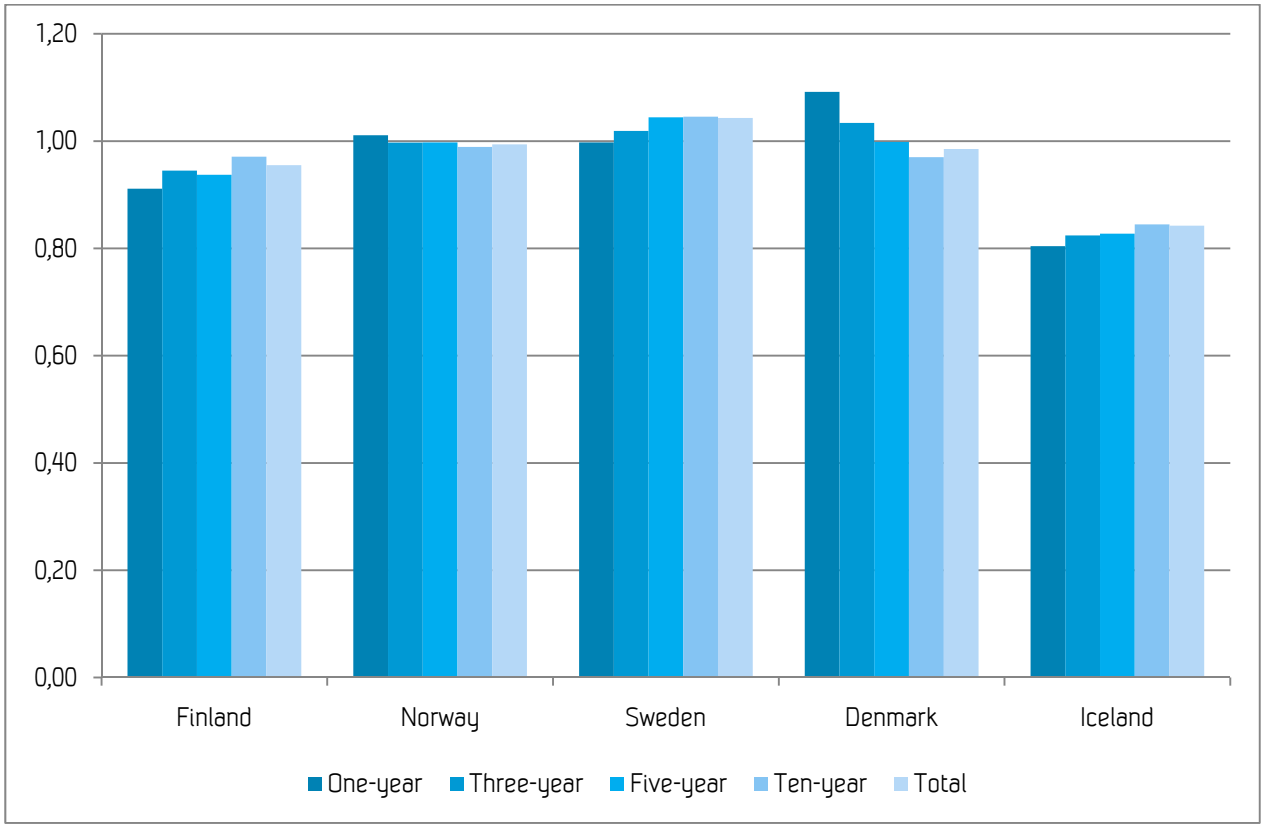

Figure 5 Relative prevalence rates (all sites but non-melanoma skin cancer). Nordic average=1. (excl. the Faroe Islands). 2007. Source: NORDCAN (ANCR)

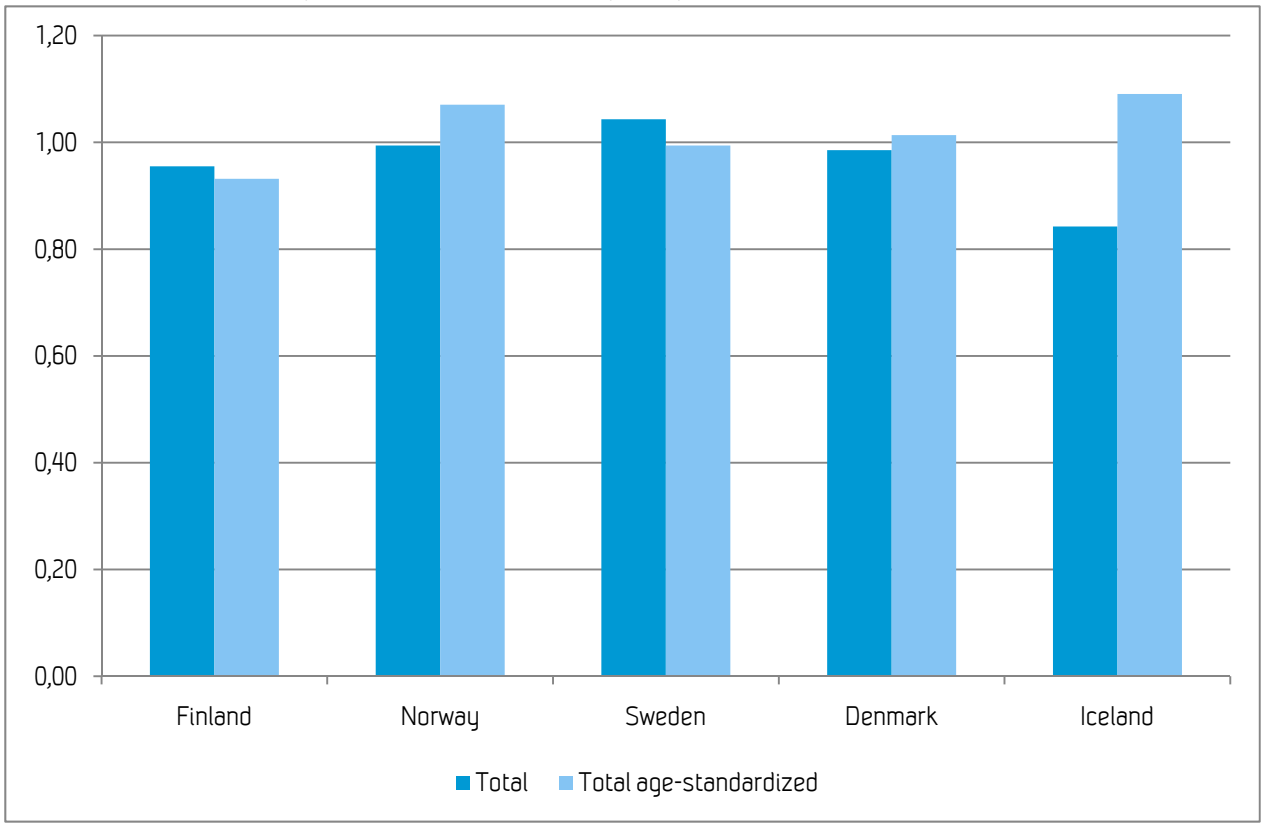

Figure 6 Total and total age-standardized prevalence rates (all sites but non-melanoma skin cancer). Relative to the Nordic average (=1). (excl. the Faroe Islands). 2007. Source: NORDCAN (ANCR)

When costs per prevalence vary between cancer sites the diagnostic composition of cancer prevalence is important for interpretations of differences in relative costs between countries. Figure 7 shows the five-year prevalence rate by cancer site and country. The data show relatively huge differences between the countries for many of the cancer sites. For cervix uteri, testis, kidney and bladder[10], lung and prostate cancer the highest rate is twice or more the lowest rate. Furthermore, the direction of country differences varies between cancer sites. The differences are partly due to different age structures. Based on data on *total* prevalence from the NORDCAN-database, for example, we find that the differences in total prevalence rates for prostate cancer between Finland, Sweden and Iceland are related to different age structures. However the very low rate for prostate cancer in Denmark is not related to age structure. Differences in age structure also contribute to differences in prevalence rates for breast cancer. All countries except Norway have similar age-standardized total prevalence rate.

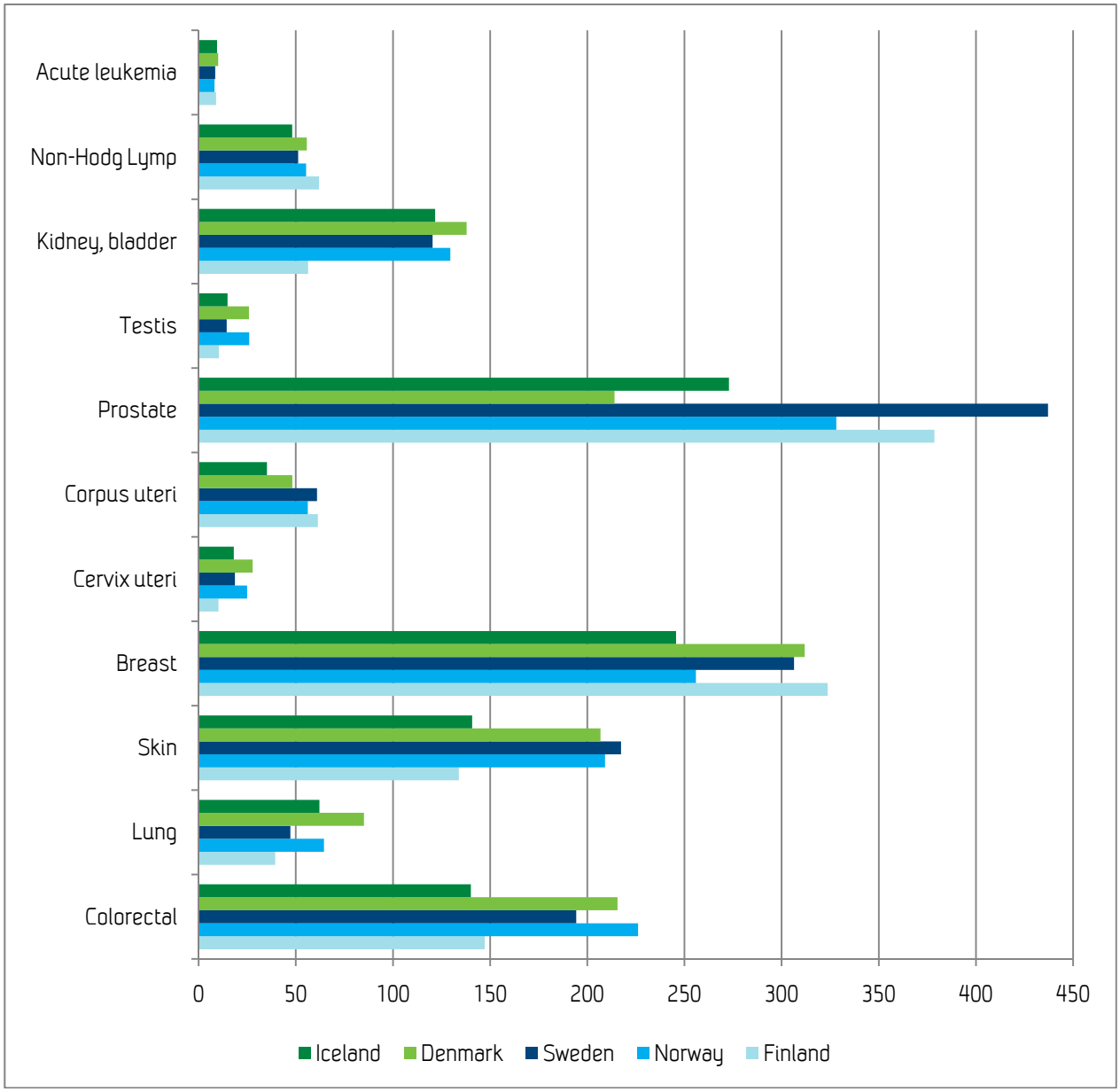

Figure 7 Five-year prevalence per 100 000 capita by cancer site and by country (excl. the Faroe Islands). 2007. Source: NORDCAN (ANCR)

[10] The observed country differences in prevalence for the category kidney-bladder is influenced by differences in coding practices, since the data for bladder tumors concerning non-invasive tumors is included in Denmark and not in Finland (http://www-dep.iarc.fr/NORDCAN/English/frame.asp).

Differences in prevalence rates may be related to the effectiveness of the health system, both in the ability to detect and diagnose cancer and in the supply of treatment. Detection and diagnosing may in turn be related to differences, for example, in the amount of 'wild' screening. For instance, PSA-testing for prostate cancer has contributed to an exceptionally high increase in the incidence of prostate cancer (Wilkins et al. 2009). Almost half of all men over 50 years of age probably have prostate cancer, but for most men the illness will never give any symptoms before they die of other causes (Cancerfonden 2006). The test is controversial due to the high risk of over-diagnosing and overtreatment and consequently lowering the quality of life for a 'false positive'. Kvåle et al. (2007) showed that after about 1990, the incidence of prostate cancer increased markedly in the Nordic countries, except Denmark, coinciding with the introduction of PSA-testing. Denmark, on the other hand, showed a downward trend in the period 1990-1995, where PSA-testing was limited until about 1995. This will contribute to the low prevalence rate observed for prostate cancer in Denmark.

4 Estimates of health care costs and public expenditures on ILCP related to cancer at the Nordic level

For policy and planning purposes it is of interest to know the magnitude and characteristics of cancer costs as well as the differences between the cancer sites. In this chapter estimates of cancer costs and its characteristics at the Nordic level are presented. The Nordic countries differ in terms of population size, and the relative influence on the Nordic estimate differs accordingly. Thus the data for Sweden will have a large effect on the estimated sum of cancer costs in the Nordic countries, while the data for Iceland and the Faroe Islands will have smaller effect. The costs are for the year 2007 and are measured in Euro.

4.1 Estimates for cancer in total (all sites)

4.1.1 Health care costs

Table 3 shows the estimates of cancer-related health care costs in the Nordic countries for 2007Table 3. These equate to a total sum of 3.3 billion Euro or 130 Euro per capita.

Table 3 Health care costs for cancer. Sum Nordic countries. EUR, 2007

	Treatment						Screening programs*	Sum Health care costs
	Hospital				Pre-scription drugs	Sum treat-ment		
	Inpatient (LOS>0)	Day patient (LOS=0)	Outpatient	Sum hospital				
Mill. Euro	1 681	148	817	2 646	394	3 041	221	3 262
Per capita	67	6	33	106	16	121	9	130
% Health care						93	7	100
% Treatment	55	5	27	87	13	100		

* Breast and cervical cancer.

How does this estimate correspond to previously published estimates? Our estimate is lower than (70 percent of) the cost of cancer estimated for the Nordic countries for 2007 in Wilking et al. (2009). However the estimates in Wilking et al. (2009) are very raw estimates based on different studies applying different methods.Except for Finland and Sweden, the estimates are based on the average share of total health care costs for cancer in a selection of European countries based on previous national estimates. Given the common methodological approach used across countries in our study, there is reason to believe that the present estimate is more accurate. On the other hand, this estimate probably underestimates total health care costs since it only captures hospital and medication costs.

Seven percent of the estimated health care costs are for screening programs for breast and cervical cancer.

Drug treatment is supplied both within a hospital setting and outside hospitals. In the first case the costs are included in hospital costs, while the latter are identified as prescription drugs. Of the 121 Euro per capita estimated treatment costs, 13 percent is for prescription drugs identified for cancer patients. The share for drugs in Jönsson and Wilking (2007) was 12 percent of cancer costs in Europe. Generally costs of cancer drugs are difficult to compare between different studies, since the definition of cancer drugs varies[11], price levels vary

[11] Which drugs (ATC-groups) are included, identification of drugs given to cancer patients or not.

between countries, the definition of costs varies[12] and since the costs of cancer drugs has increased rapidly during the last decade (Jönsson and Wilking 2007, Wilking et al. 2009). Even though cancer treatment more often takes place without the patient having to stay at the hospital (Wilking et al. 2009), inpatient hospital treatment still is the dominating cost type, amounting to 55 percent of treatment costs. This is lower than the share referred to from European studies in Jönsson and Wilking (2007). However these studies refer to data from 2002 or earlier and the trend has since been toward an increasing share of cancer treatment in outpatient settings. Hospital treatment in an outpatient setting and day patient setting represents 33 percent of the estimated treatment costs.

In Table 4 different measures of the health care cost of cancer in relation to total health care costs are shown. The data for total health care costs are from the OECD 2009 database for System of Health Accounts (SHA). The estimated cancer costs for the Nordic countries amount to 4.1 percent of total health care costs[13]. Since the cost of long term care[14], ambulances and patient transportation among other things, are not included in the estimated cancer costs, the actual share is higher. The share of hospital costs for cancer patients of costs for curative and rehabilitative care is 6.1 percent, while the estimated hospital costs for cancer patients accounts for 8.3 percent of the total hospital costs as measured by the SHA-data.

Table 4 Health care cost of cancer as percentage of total health care costs. With different definitions of cancer costs and health care costs. Sum Nordic countries. 2007

	A **Health care cost of cancer, % of total health care costs***	B **Hospital cost of cancer, % of curative and rehabilitative care****	C **Hospital cost of cancer, % of total hospital costs*****
Nordic countries	4.1 %	6.1 %	8.3 %

* Function HC1-Hc9 in System of Heath Accounts (SHA), OECD
** Function HC1-H2 in System of Heath Accounts (SHA), OECD
*** Provider HP1 in System of Heath Accounts (SHA), OECD

4.1.2 Public expenditures on income loss compensation payments (ILCP)

The estimated public expenditures on ILCP for cancer patients amount to about 0.8 billion Euro or 31 Euro per capita. 45 percent of the estimated public expenditure on ILCP is for disability pensions and 55 percent is for sickness benefits. The higher share for sickness benefits is to a large extent influenced by the Swedish data (see chapter5.3). Excluding Sweden gives a share of sickness benefits of 43 percent.

Table 5 Public expenditures on income loss compensation payments (sickness benefits and disability pensions) related to cancer. Sum Nordic countries. EUR, 2007.

	Public expenditures on ILCP		
	Sickness benefits	Disability pensions	Sum ILCP
Mill. Euro	428	345	773
Per capita	17	14	31
% ILCPcost	55	45	100

[12] Treatment setting (within or outside hospitals), wholesale price vs. pharmacy retail price, inclusion of value added tax (VAT) or not.

[13] Based on a comparison of data for 2007, the definition of total health care costs used in Wlking et al. (2009) is somewhat lower than the total cost from SHA-data. The share used for cancer in Wilking et al (2009) is 6.4 percent.

[14] In regards to Finnish data, some long term care might be included in the study from the health centres.

4.2 Estimates by cancer site

4.2.1 Health care costs and share of public expenditures on ILCP

Perhaps the most interesting results at the Nordic level relate to the estimates of specific diagnostic groups. In this section we focus on differences between cancer sites. First we present estimates of health care costs for the 11 cancer sites specifically identified (Figure 8).

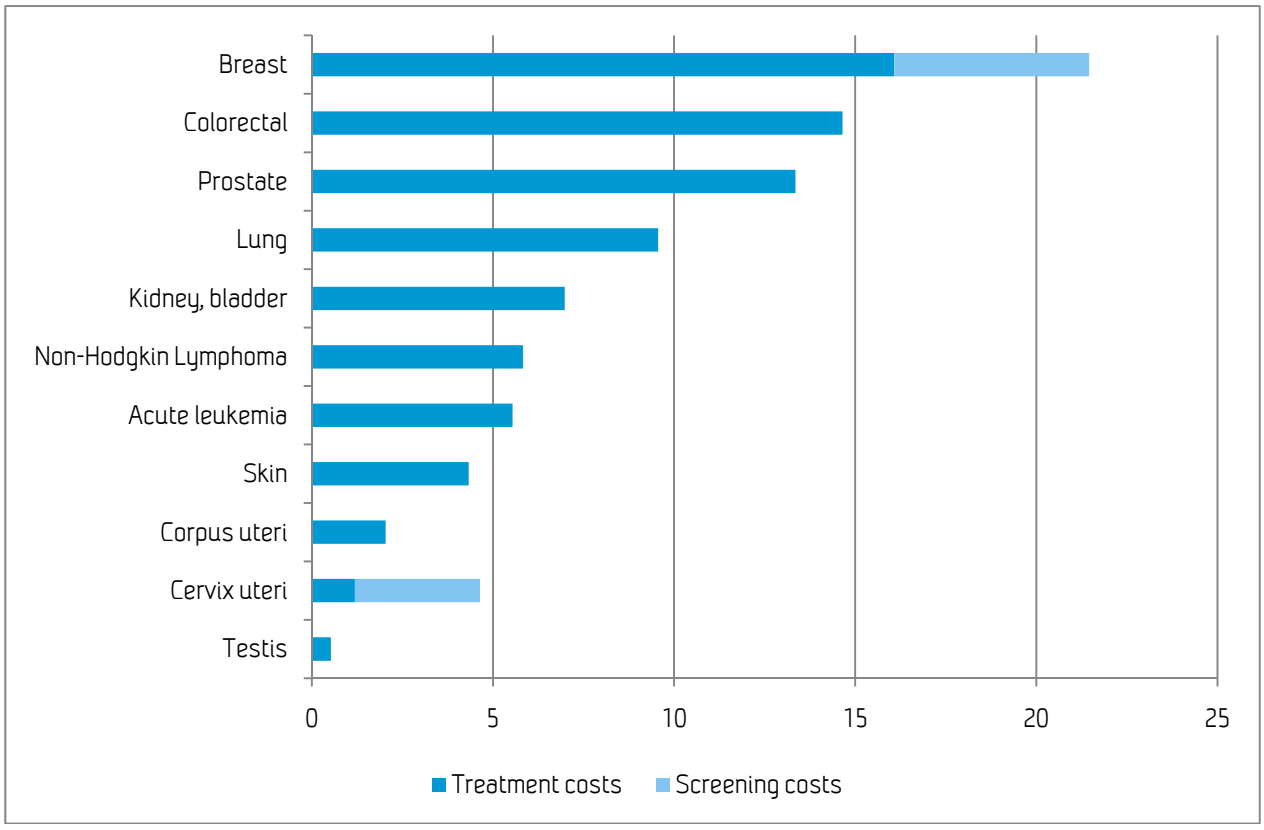

Figure 8 Health care costs by cancer site. Nordic countries. Ranked by treatment cost per capita. EUR per capita. 2007

Breast cancer is the site associated with the highest estimated health care costs in the Nordic countries in 2007. This is also the case if we exclude the estimated costs related to screening programs. The second largest site is colorectal cancer and the third largest is prostate cancer. Thus the three largest cancer sites in term of five-year prevalence numbers are also the largest sites in terms of estimated health care costs (although not in the same order). While skin cancer is the fourth larges site in terms of prevalence, lung cancer is the fourth largest site in terms of health care costs. The ranking of the largest cancer sites in the Nordic countries is comparable to US estimates of heath care costs (Mariotto et al. 2011). However the costs of lung cancer are found to be higher than the costs of prostate cancer in the US.

The estimated screening costs make up the largest part of the estimated health care costs of cervical cancer. Screening helps to detect cancers at an early stage when they are most treatable and pre cell cancerous cell change can be detected and treated before it develops into cancer. This makes cervical cancer one of few cancers that is preventable[15].

[15] http://www.cancerhelp.org.uk/type/cervical-cancer/about/cervical-cancer-screening

Differences in treatment length and costs, prognosis in term of recovery, disability and mortality, as well as age and sex distribution between diagnostic groups influence the amount of public expenditures spent on ILCP relative to health care costs for each cancer sites. Figure 9 shows the distribution of public expenditures on ILCP on cancer sites compared to the distribution of treatment costs[16]. Screening costs are excluded since screening program costs are only relevant for two of eleven cancer sites.

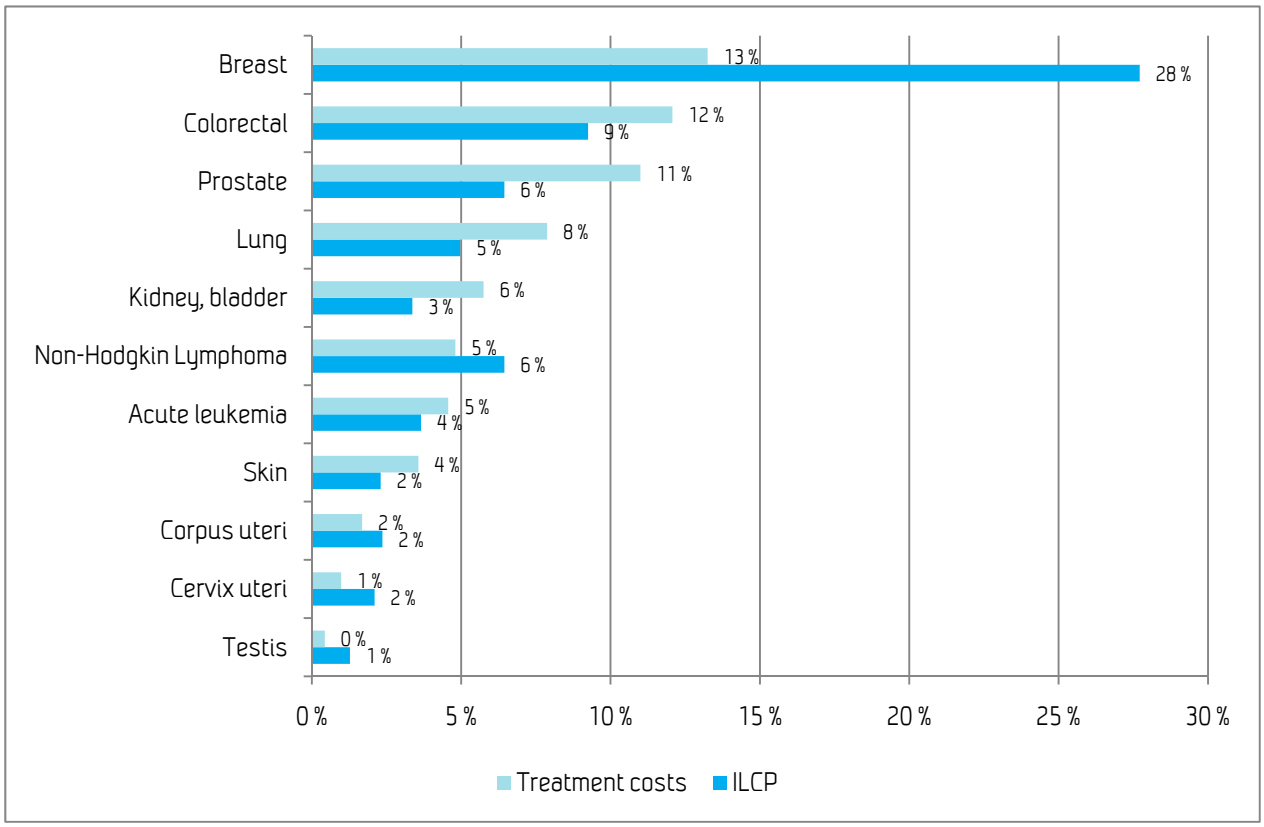

Figure 9 Distribution of treatment costs and public expenditures on ILCP (sickness benefits and disability pensions) on cancer sites. Nordic countries. Percentage 2007

Breast cancer alone makes up 28 percent of the estimated public expenditures on ILCP, compared to 13 % of the treatment costs. Testis, cervix uteri and Non-Hodgkin Lymphoma also have a higher share of ILCP than of cancer treatment costs. Prostate and Kidney, bladder have relatively low shares of ILCP compared to the shares of treatment costs. For the cancer sites mentioned the observed pattern are quite similar in the three larges countries for which we have data. As will be discussed in detail in chapter 5.3, expenditure levels and the rules and regulations for public ILCP, differ substantially between the six countries.

4.2.2 Decomposition I: Treatment costs per capita and per five-year prevalence

Differences in total and per capita treatment costs between cancer sites are to a large extent related to differences in prevalence. However differences in cost per prevalence may also contribute to differences in per capita costs. Table 6 shows the estimated treatment costs for the Nordic countries per capita by cancer site decomposed into costs per five-year prevalence and five year prevalence per (100 000) capita.

[16] The ranking of sites according to the relative distribution of ILCP are influenced by the estimation of expenditures for Denmark (see section 2.6). Figure 9 is based on data on ILCP for Finland, Norway and Sweden.

Table 6 Treatment costs of cancer per five-year prevalence and per capita, and five-year prevalence per 100 000 capita (prevalence rate). Sum Nordic countries. Ranked by cost per prevalence. EUR 2007

	Cost per capita	Cost per five-year prevalence	Prevalence rate
All sites	121	7 820	1 552
Skin	4	2 227	194
Testis	1	2 895	18
Corpus uteri	2	3 584	57
Prostate	13	3 787	352
Breast	16	5 353	300
Cervix uteri	1	5 942	20
Kidney, bladder	7	6 222	112
Colorectal	15	7 552	194
Non-Hodgkin Lymphoma	6	10 590	55
Lung	10	16 718	57
Acute leukemia	6	62 357	9
Median 11 sites	6	5 942	57

For cancer in total, the estimated treatment cost per five-year prevalence was about 7 820 Euro in 2007. The estimated cost per five-year prevalence varies from less than 3 000 Euro for testis and skin cancer to above 60 000 for acute leukemia.

The differences in treatment costs per prevalence and the ranking of diagnostic groups in terms of cost per prevalence vary somewhat between the countries. However for countries reporting complete data on cancer sites[17], the cancer sites can be divided into *three groups* based on the *ranking of treatment costs per prevalence*;

(i) The three sites with the highest cost per prevalence are acute leukemia, lung and Non-Hodgkin lymphoma – in that order. The Nordic average estimated cost per five-year prevalence is above 10 000 Euro for these sites.
(ii) The cancer sites with medium costs per prevalence are colorectal, kidney-bladder, cervix uteri and breast cancer. The Nordic average estimated cost per five-year prevalence is between about 5 000 and 8 000 Euro for these sites.
(iii) The four sites with lowest costs per prevalence are prostate[18], corpus uteri, testis and skin. The Nordic average is below 4 000 Euro per five-year prevalence for this group.

The separate contribution of variation in cost per prevalence and in the prevalence rate to variation in cost per capita is illustrated in Figure 10. In order to be able to portray all three indicators in the same figure, per capita costs, costs per five-year prevalence and the prevalence rate (five-year prevalence per capita) for each cancer site are shown relative to the *median* of the 11 sites. Acute leukemia is excluded in the figure due to a large diversion of costs per prevalence (Table 6).

[17] Finland, Norway, Sweden and Denmark (however prescription drugs for Norway on cancer sites is estimated).

[18] Denmark has higher cost per prevalence for prostate than for kidney-bladder.

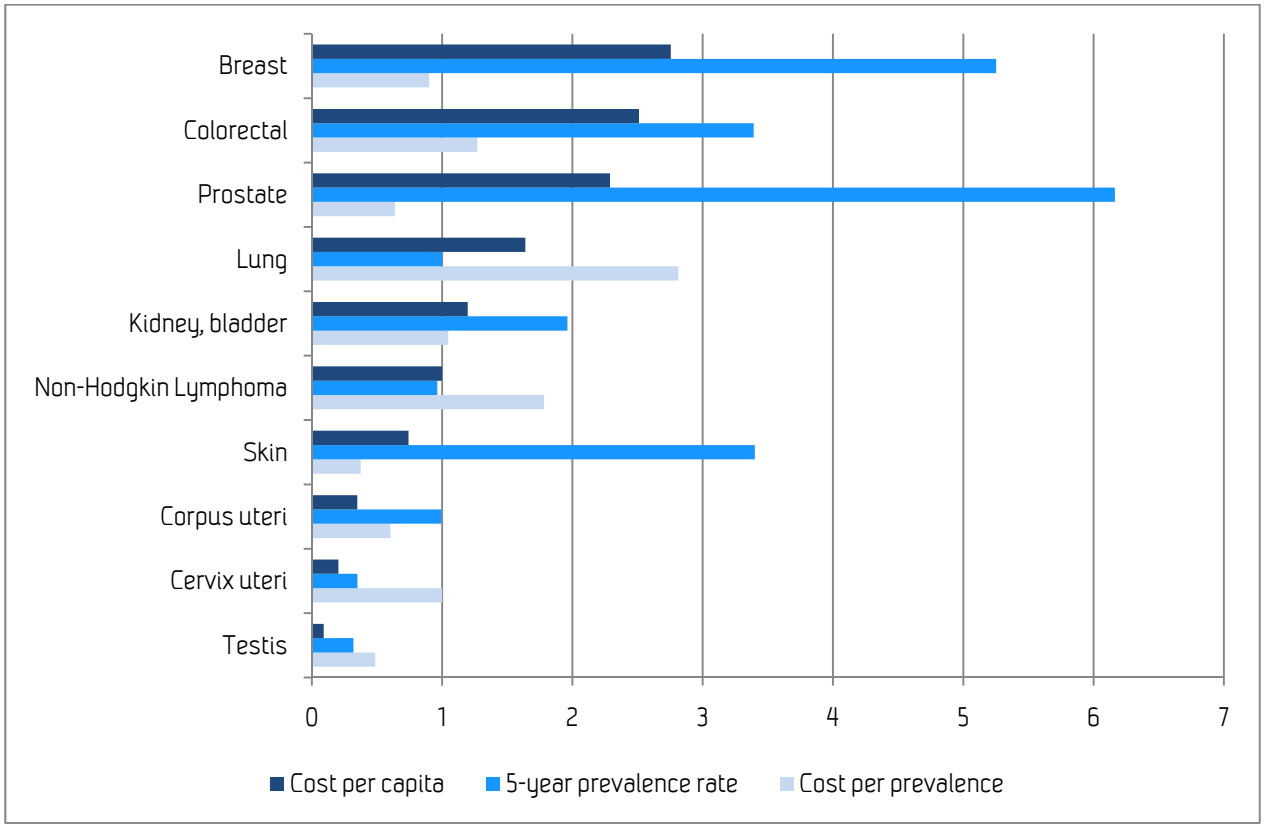

Figure 10 Treatment cost per capita, treatment cost per five-year prevalence and five-year prevalence rate by cancer site (excl. Acute leukemia). Relative to the median rate for the 11 sites (=1). Ranked by cost per capita. Nordic countries. 2007

The high per capita treatment cost of breast cancer is mostly related to a high prevalence rate. Breast cancer has near median cost per five-year prevalence. Also for colorectal cancer the high per capita cost is mostly related to the pervalence rate, but colorecetal cancer also has the fourth highest cost per prevalence. Prostate cancer has a relatively low cost per prevalence, but due to the high(est) prevalence rate the per capita cost is high. Even though skin cancer has a high prevalence rate, the low cost per prevalence contributes to low per capita costs. The opposite is the case for acute leukemia (Table 6, Figure 3). For testis low per capita costs can be attributed both to a low prevalence rate and to low cost per prevalence.

Lung cancer defines the median five-year prevalence rate of the 11 cancer sites shown. High cost per five-year prevalence contributes to high per capita costs. However as discussed in chapter 3 lung cancer has high mortality relative to the other cancer sites included, contributing to high cost per five-year prevalence. If we have chosen to use one-year prevalence rates as an indicator of the number of patients, the calculated relative cost per prevalence for lung cancer would be considarably lower, 50 percent above the median (for the cost per one-year prevalence) rather than almost 180 percent above the median (for the cost per five-year prevalence)[19].

Information of cost per prevalence and prevalence rates for cancer sites provides important background knowledge for assessing future treatment-related costs of cancer. What are the large sites in terms of prevalence rates? Which sites are expected to increase most? Are the fastest increasing sites low cost or high cost sites (in terms of cost per prevalence)?

[19] Since the yearly treatment costs are estimated independent of prevalence rates.

4.2.3 Treatment activity and organization by cancer site

To some extent the organization of cancer treatment differs in the Nordic countries. This will be described in more detail in chapter 5.1.3. In this chapter we look at differences between cancer sites for the Nordic countries as a whole, and the results are therefore dominated by the largest countries.

4.2.3.1 Prescription drugs

Compared to total treatment costs the share of the "outside hospital" medication costs (prescribed drugs) amounts to 15 percent or lower for all sites except prostate cancer. In the latter case 1/3 of the estimated treatment cost is for prescription drugs, see Figure 11. For most sites the share is between five and 15 percent. The lowest share is found for colorectal cancer.

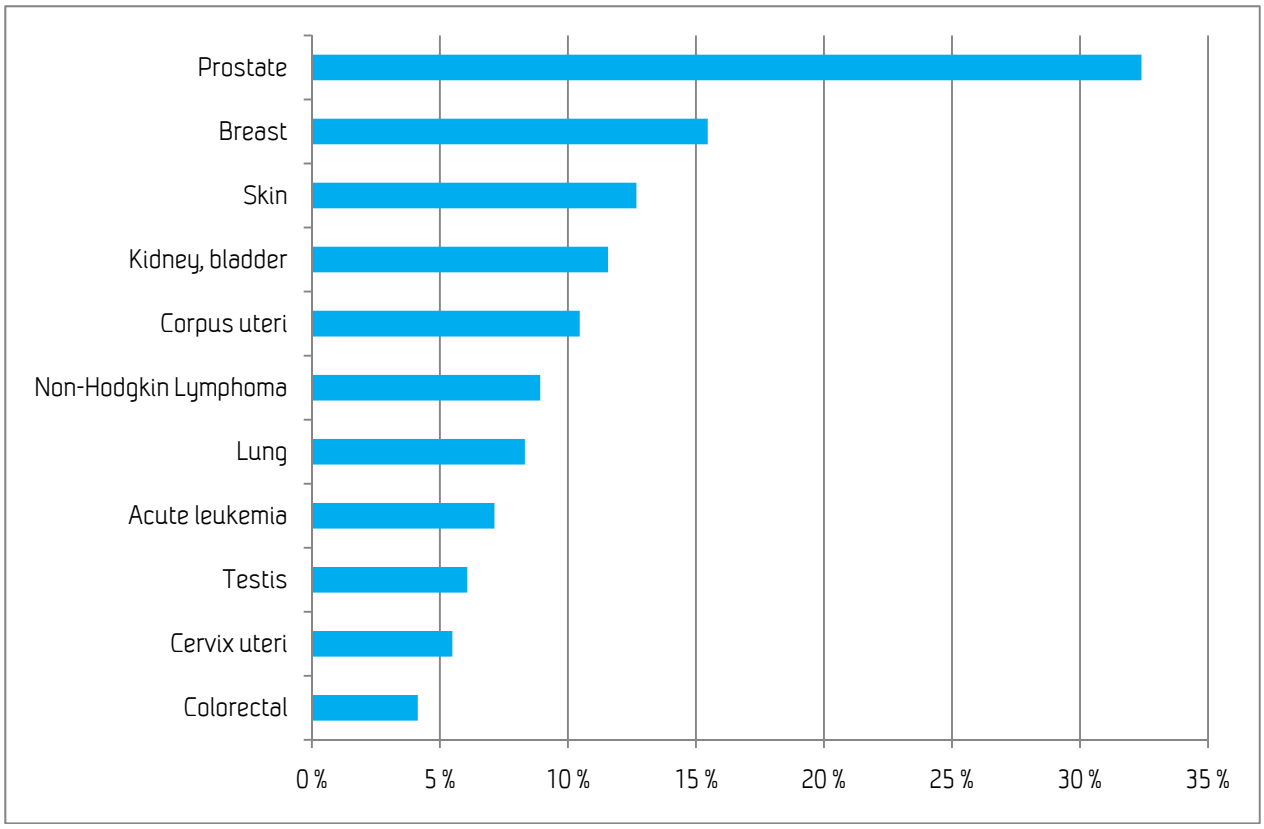

Figure 11 Share for prescription drugs of treatment costs. By cancer site. Nordic countries. 2007

4.2.3.2 Hospital activity and unit costs

Figure 12 shows the estimated activity level in hospitals by cancer site measured by inpatient and day patient bed-days and outpatient visits. The cost estimates for hospital treatment are based on activity data (discharges for inpatients and day patients and outpatient visits multiplied by respective unit costs) and the activity level for the different cancer sites shows the same pattern as the estimated cost. Breast, colorectal, prostate, and lung cancer are the sites with the highest activity levels for hospital treatment.

However the composition of hospital treatment differs between cancer sites. Colorectal and lung cancer have the highest estimated number of inpatient bed-days. These sites also have a high *share* of inpatient bed-days. Acute leukemia and kidney/bladder cancer have the highest share of inpatient bed-days. On the other hand breast cancer has both the highest number and share of outpatient visits. Skin, prostate and testis also have a high share of outpatient hospital treatment. The share of day patient activity is generally low (measured as share of

the sum of bed-days and visits); less than five percent for all cancer sites. However, the distinction between day patient activity and outpatient activity in the data differs between the countries.

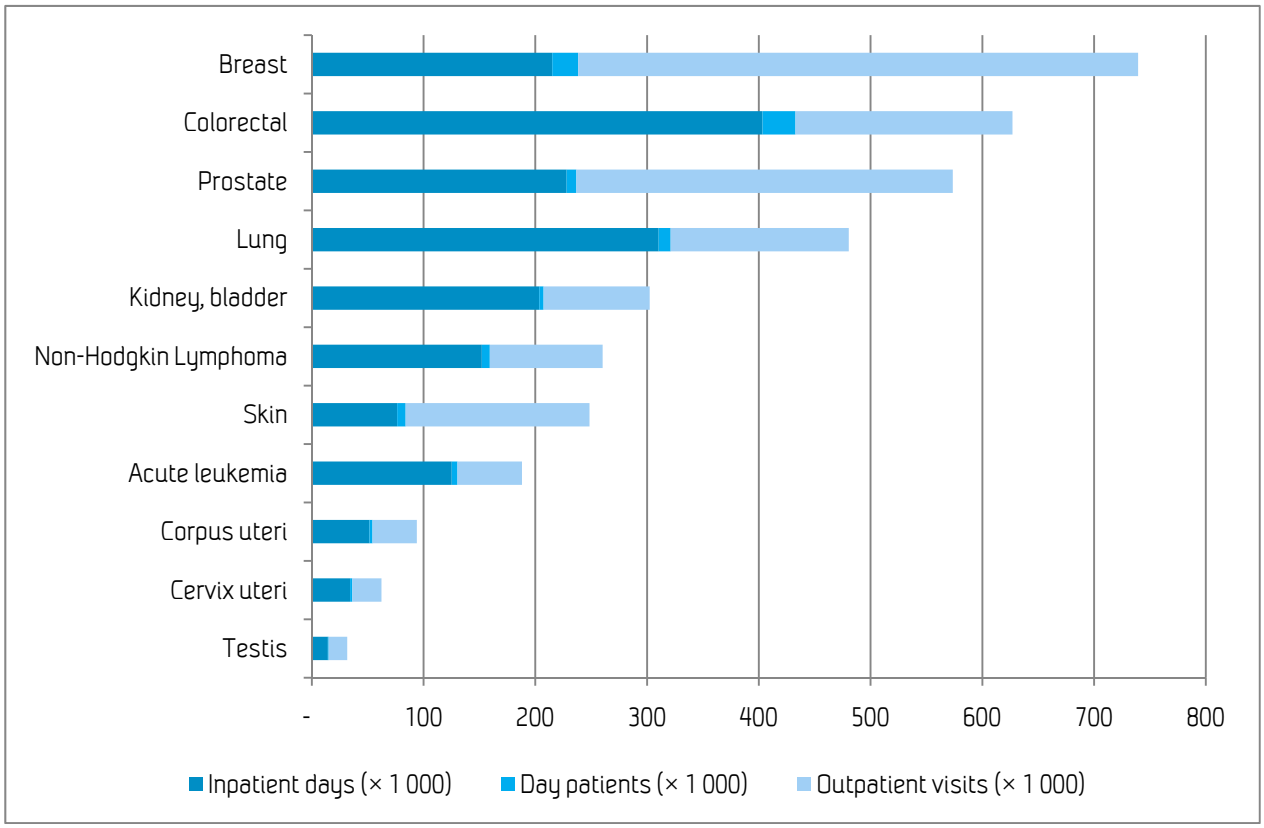

Figure 12 Hospital treatment - Days for inpatients, days for day patients and visits for outpatients. By cancer site. Nordic countries. 2007

The cancer sites also differ in the estimated average length of stay (ALOS) for hospital discharges, see Table 7. In total, the average length of stay for inpatients was 9.5 days (including the first day) for the Nordic countries in 2007. The average length of stay for all discharges, including day patients, was seven days. For most sites the average length of stay for inpatients was between seven and nine days. The highest average length of stay was found for lung, acute leukemia and colorectal cancer (11-12.2 days).

As will be discussed in more detail in chapter 5.1 a large share of inpatient bed-days in Finland is found within the health centers. These are generally long stays and affect the total ALOS for cancer at the Nordic level. To some degree these stays may be comparable with stays in long term care institutions in the other countries. If we exclude stays in health centers in Finland the ALOS for all cancer sites reduces to 8.8 days, or by seven percent[20].

[20] Excluding the health centers influences the number of bed-days and ALOS most for skin, breast and prostate cancer (13 percent reduction in ALOS), but does not affect ALOS for acute leukemia and testis.

Table 7 Average length of stay (hospital discharges) and unit costs (EUR) for hospital treatment. By cancer site. Sum Nordic countries. 2007

	ALOS, LOS>0	ALOS, incl. LOS=0	Cost per inpatient discharge*	Cost per inpatient bed-day*	Cost per day patient	Cost per sum bed-days**	Cost per visit***	Cost per visit****
All sites	9.5	7.0	5 341	560	1 121	584	357	529
Colorectal	11.7	6.8	7 192	614	842	629	409	487
Lung	11.0	8.2	5 204	475	1 008	493	385	511
Skin	7.6	4.7	3 816	503	1 502	594	273	356
Breast	6.8	4.4	3 638	532	979	575	406	530
Cervix uteri	7.4	5.4	3 643	491	786	508	375	438
Corpus uteri	7.4	5.6	4 624	623	789	632	289	424
Prostate	8.6	6.7	4 493	522	826	533	297	619
Testis	5.5	4.6	3 066	554	898	570	232	280
Kidney, bladder	8.1	7.1	4 579	568	1 303	581	360	573
Non-Hodg. Lymp.	9.0	6.6	5 343	595	1 472	634	318	447
Acute leukemia	12.2	8.5	10 251	837	1 732	873	265	437

* For patients with LOS>0

** Sum bed-days for inpatients (LOS>0) and day patients (LOS=0)

*** Different share of prescription drugs for the cancer sites may contribute to differences in estimated unit costs for hospital treatment, especially for outpatient visits.

**** Incl. cost of prescription drugs

4.2.4 Decomposition II: Cost per prevalence, activity per prevalence and cost per activity

Differences in estimated hospital costs per prevalence for the cancer sites is the product of differences in activity per prevalence and cost per unit of activity (unit costs). Figure 13 shows the decomposition of hospital costs per prevalence in (weighted) activity per prevalence and cost per (weighted) activity[21]. Acute leukemia is not included in the figure due to extremely high cost per prevalence, as shown in Table 6.

[21] See chapter 2.5.1 for a description of how the single (weighted) activity measure is calculated.

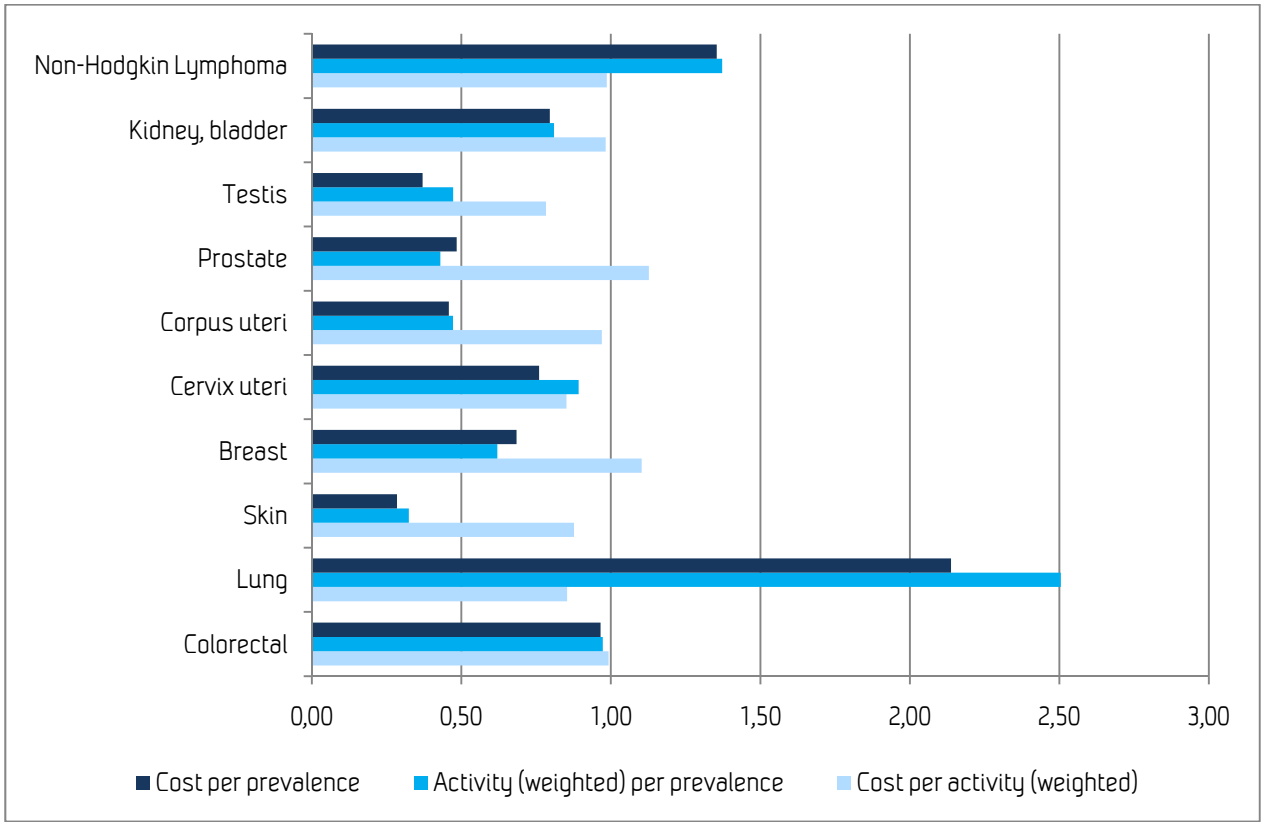

Figure 13 Treatment costs per five-year prevalence, hospital activity per prevalence and cost per unit of (weighted) activity. By cancer site (excl. acute leukemia). Relative to all cancer sites (=1). Nordic countries. 2007

As can be seen from Figure 13 differences in estimated treatment costs per prevalence between cancer sites are to a large extent related to differences in activity levels and to a minor extent to costs per unit of (weighted) activity.

5 Estimated health care costs and public expenditures on ILCP related to cancer by country

In the previous chapter we focused on characteristics of cancer site differences. In this chapter we focus on country specific differences between the Nordic countries. A comparative approach raises several difficulties which have to be taken into consideration. For instance, there are differences in cancer prevalence and composition, in the level and composition of treatment activities, and in compensation levels etc for the public expenditures on income loss compensation payments related to sickness absenteeism and early retirement.

First we present the comparative results for treatment costs (5.1) decomposing the per capita cost with a focus on country differences in costs and activity for cancer in total, i.e. sum over all cancer diagnoses. However we use information for different diagnostic groups to calculate the effect of country differences in prevalence composition (case-mix) and cost levels for the cancer sites on the estimated total treatment costs and activity levels. Next the results for estimated per capita cost and activity for screening for breast and cervical cancer is presented (5.2). Finally the comparative results of public expenditures on income loss compensation payments (ILCP), where the per capita expenditures on sickness benefits and disability pensions are decomposed to illustrate country differences in activity levels and payment levels, are presented in chapter 5.3.

We present the estimate measures relative to the population size or five year prevalence (treatment costs) of each country. The corresponding cost estimates are shown from Table 19 to Table 21 in the appendix.

5.1 Treatment costs

5.1.1 Per capita cancer costs and share of total health care costs

Figure 14 shows the estimated treatment cost per capita for the six Nordic countries in 2007. Norway has highest estimated costs per capita of 133 Euro. This is eight percent above Denmark (124 Euro per capita). The estimated costs for Iceland, Finland and Sweden (110-118 Euro per capita) are approximately 15-20 percent below Norway. The estimate for the Faroe Islands is somewhat lower than for the other countries, about 100 Euro per capita. However the costs are probably underestimated because of missing data for outpatient activity. If we assume the same per capita cost for outpatient activity as for Iceland the per capita costs for the Faroe Islands would be 110 Euro, i.e. the same as for Iceland. If we assume per capita outpatient costs equal to the average of the Nordic countries, except for Denmark that has a very high share of outpatient costs, the per capita costs for the Faroe Island would be 118 Euro. Thus differences in the estimated costs per capita for the Nordic countries are relatively modest[22].

Inpatient treatment at health centers is included in the Finnish data. The activities at the health centers are characterized by long average length of stay (section 5.1.3) and to some extent may capture activities that are found within long term care and are therefore not included in the other countries. Including health center activity may overestimate the costs for Finland *compared* to the other countries. But excluding health center on the other hand will probably underestimate the *relative* costs. This point is elaborated in section 5.1.3. The estimated costs

[22] We have used a deflator for hospital costs (Kittelsen et al. 2009) constructed to take into account differences in wage costs for hospital personnel in the Nordic countries (except for Iceland and the Faroe Islands). Thus the country differences in estimated hospital cost per capita should not be attributed to differences in wage levels, or social expenditures etc for hospital personnel. If we use the OECD GDP-PPP deflator also for hospital costs the cost estimate for Norway increases by about 11 percent. Also the cost estimate for Sweden increases by four percent. For the other countries the cost estimate is unchanged. The GDP-PPP deflator thus captures some but not all cost differences for hospitals. Country differences in estimated medication costs are discussed in greater detail in section 5.1.3.

for cancer treatment within the health centers constitute 11 percent of the estimated treatment cost of cancer for Finland. The estimated cost per capita is 104 Euro when health center costs are not counted.

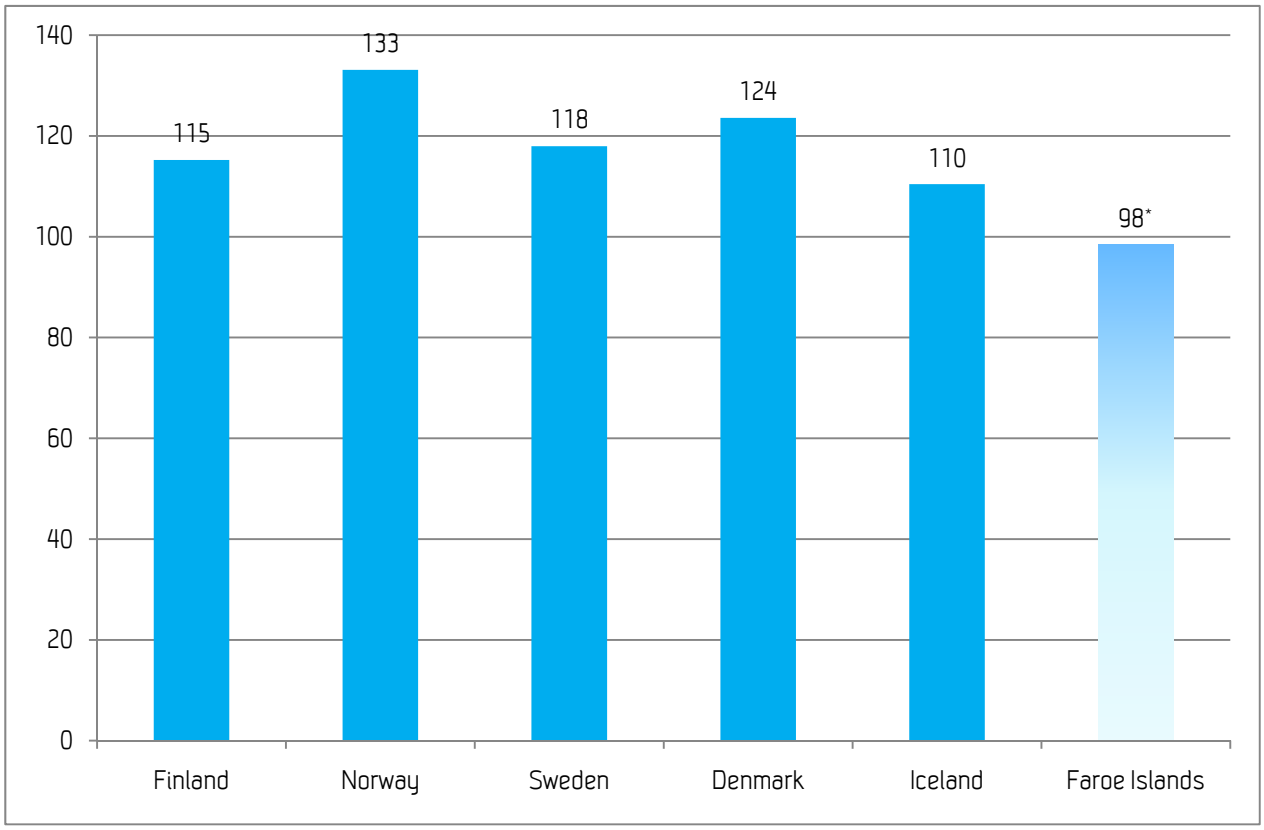

Figure 14 Treatment costs per capita by country. EUR 2007

* Missing outpatient hospital costs for patients treated in the Faroe Islands.

The estimated treatment costs per capita for the Nordic countries in 2007 are lower than the estimates in Wilking et al. (2009) for all countries except Finland[23]. This is also true if we add the estimated screening program costs. The estimates in Wilking et al. (2009) for 2007 are not based on actual studies of cancer costs in 2007, but rather on relatively crude assumptions about the share of total health care costs which is only partly based on previous national studies (Cancerfonden 2006, Mäklin and Rissanen 2006)[24]. The present estimates, based on comparable data for the Nordic countries, show much less variation between the countries. Given the common methodological approach used across countries in our study, it is reasonable to believe that the present estimate is more accurate than previously published estimates related to the differences between Nordic countries.

Kittelsen et al. (2009) estimated the differences in total hospital costs per capita between Norway on the one hand and Finland, Sweden and Denmark on the other. They estimated that the per capita cost of general (somatic) hospitals for Norway was more than 50 percent higher than for Finland, nine percent higher than for Denmark and six percent higher than for Sweden. Thus the previously published differences for somatic hospital care between Norway and Finland, Sweden and Denmark are respectively larger, somewhat lesser and about the same as the differences in costs of cancer estimated in this study.

[23] The Faroe Island is not included in Wilking et al. (2009).

[24] In Wilking et al. (2009) the cost estimates for cancer serve as an illustration of the burden of cancer in Europe and as the background to a discussion of patient access to cancer drugs.

The estimated *health care* costs (including screening programs) of cancer as share of total health care cost varies from 3.7-3.8 percent for Norway, Iceland and Denmark to 4.4-4.6 percent for Sweden and Finland based on data from System of Health Accounts (Table 8)[25]. The health care costs in the SHA-data are somewhat differently measured in the Nordic countries (Melberg 2009). This applies especially to the distinction between health care and social services within long term care. A more narrow definition may therefore give a better picture of country differences in cost shares. The estimated share of *hospital* costs of total cost to *curative and rehabilitative care* is 6.5-6.6 percent for Norway and Denmark, 6.1 percent for Finland, and 5.5 for Sweden and Iceland. Except for Finland, the share of cancer costs in hospitals of reported *total costs to hospitals* in the SHA-data shows the same pattern; the share is lower in Sweden and Iceland (7.6-7.8 percent) than in Denmark and Norway (8.2-8.7 percent). Finland has the highest estimated share of hospital costs (10.1 percent).

Table 8 Health care costs of cancer as percentage of total health care costs. With different definitions of cancer costs and total costs. Nordic countries, except the Faroe Islands. 2007

	A **Health care cost of cancer, % of total health cost***	B **Hospital cost of cancer, % of curative and rehabilitative care****	C **Cancer hospital expenditures, % of total hospital expenditures*****
Finland******	4.6 %	6.1 %	10.1 %
Norway*******	3.7 %	6.6 %	8.7 %
Sweden	4.4 %	5.5 %	7.6 %
Denmark	3.8 %	6.5 %	8.2 %
Iceland	3.8 %	5.5 %	7.8 %

* Function HC1-Hc9 in System of Heath Accounts (SHA), OECD

** Function HC1-H2 in System of Heath Accounts (SHA), OECD

*** Provider HP1 in System of Heath Accounts (SHA), OECD

**** Excluding health centers reduces the share for Finland to 3.9 %, 5.4 % and 8.9 % for column A, B and C respectively.

***** SHA-data for Norway is missing for 2007. We have used the 2006 data from SHA and added the percentage growth for hospitals from 2006 to 2007 (Midttun (red) 2008).

5.1.2 Decomposition I: cancer prevalence and cancer costs

Differences in cancer prevalence will contribute to different demand and cost of cancer treatment. In order to capture the effect of country differences in cancer prevalence we decompose the per capita treatment cost into cost per prevalence and prevalence per capita. However, cost per prevalence varies between cancer sites. Differences in cancer prevalence case-mix will therefore contribute to differences in estimated cost per prevalence between the countries. The total effect of differences in prevalence case-mix can be decomposted in a pure composition effect (case-mix index) and a cost effect (differences in actual and average cost per prevalence for the cancer sites)[26]. The raw five-year prevelence rate, the prevalence case-mix index and the prevalence rate corrected for differences in prevalence case-mix is shown in Table 9. Prevalence data are missing for the Faroe Island.

Table 9 Raw prevalence rate, prevalence case-mix index and standardized prevalence rate. Nordic average =1. Nordic countries, except the Faroe Islands. 2007

	Finland	Norway	Sweden	Denmark	Iceland
B. Prevalence rate*/ Nordic average	0.94	1.00	1.05	1.00	0.83
D. Prevalence case-mix-index	1.07	0.99	0.91	1.10	1.09
B2. Standardized prevalence rate/ Nordic average	1.01	0.99	0.95	1.10	0.90

* Five-year prevalence

[25] The Faroe Islands are not represented in the SHA-data.

[26] For details on the decomposition see 2.5.1.

Line D shows the cancer prevalence case-mix index. Denmark, Iceland and Finland have a more cost demanding prevalence case-mix than the Nordic average, i.e. a higher share of cancer sites with high cost per prevalence. The opposite is the case for Sweden. The case-mix-effect is relatively modest for Norway. Taking the prevalence case-mix into account the country differences in relative cancer prevalence alters. Denmark has the highest case-mix corrected prevalence rate. Finland and Norway are close to the Nordic average. While correcting for the prevalence case-mix increases the relative prevalence for Iceland (although still on the low side) the opposite is the case for Sweden. The raw total prevalence rate for Sweden is the highest among the Nordic countries; the corrected rate on the other hand is five percent below the Nordic average.

Taking into account the prevalence composition affects the estimated cost per prevalence significantly. In Figure 15 the per capita treatment costs are decomposed into standardized cost per prevalence and standardized five-year prevalence rate[27]. The three indicators are measured relative to the Nordic average.

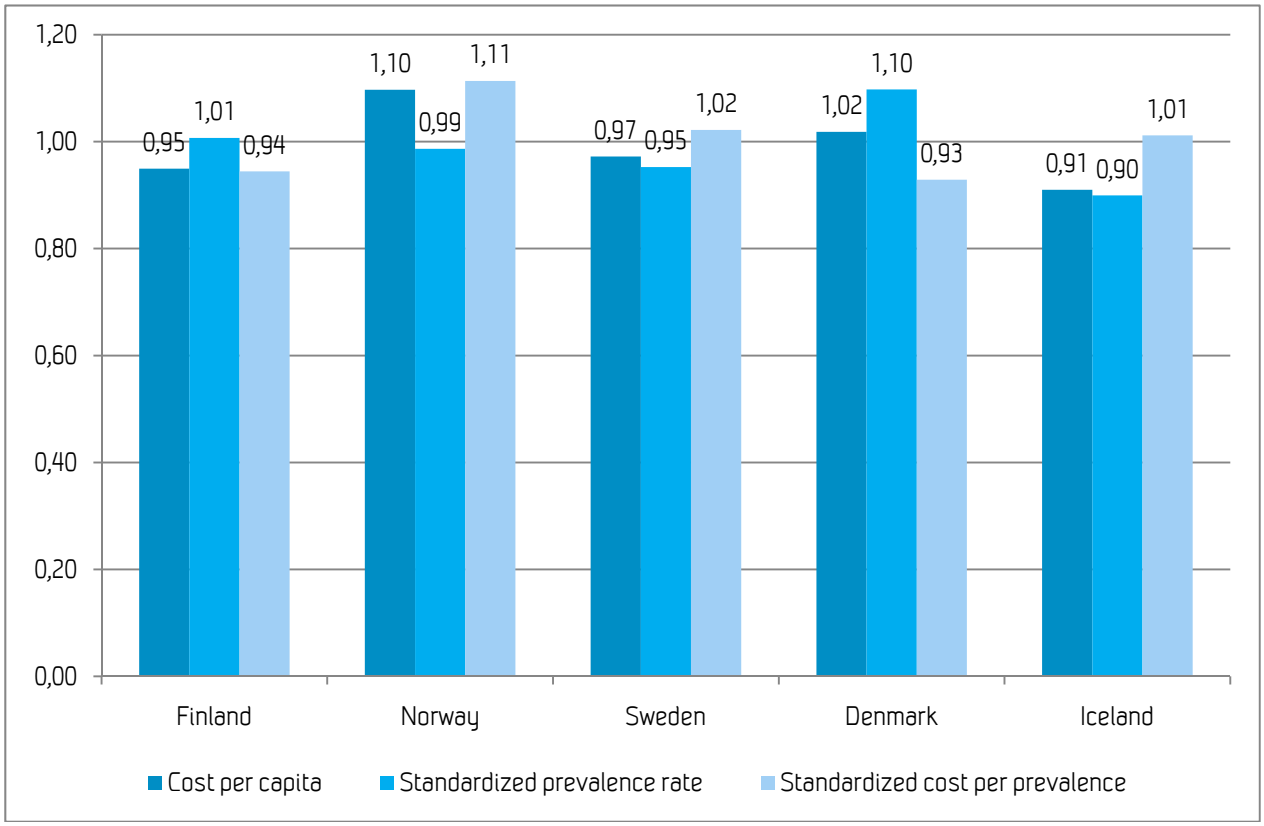

Figure 15 Treatment costs per capita and standardized cost per five-year prevalence, and the standardized five-year prevalence rate by country (excl. the Faroe Islands). Relative to Nordic average (=1). 2007

The relatively low per capita cost for Finland can be related to relatively low standardized costs per prevalence. For Norway on the other hand relatively high cost per capita is related to high standardized cost per prevalence. Sweden has the second highest standardized cost per prevalence and low standardized prevalence rate; contributing to near average costs per capita. Denmark has the lowest case-mix corrected cost per prevalence. However high standardized prevalence rate gives per capita costs close to the Nordic average. Iceland has standardized cost per prevalence close to the Nordic average. The low per capita costs thus reflect the low cancer prevalence rate compared to the other Nordic countries. It is important to bear in mind that Iceland (and

[27] The decomposition of per capita treatment cost (relative to the Nordic average) with and without standardization for differences in prevalence case-mix is presented in Table 11.

the Faroe Islands) are small nations relative to the other four Nordic countries, and are therefore relatively sensitive to incidental circumstances and measurement errors. They also face different conditions and challenges in the supply of medical services to cancer patients, e.g.. high preliminary expenses since it may be relatively more expensive to keep up service for few patients than a large group of patients.

5.1.3 Country differences in treatment activity and organization

In recent years a shift from inpatient treatment toward treatment in outpatient settings has been observed. In addition drug treatment has increased significantly (Wilking et al. 2009). Drug treatment can be given in different hospital settings, and also outside hospitals. In this section we describe country differences in hospital activity, both in level and composition and in the use of medication outside hospitals.

5.1.3.1 Prescription drugs

Figure 16 shows the composition of treatment costs on hospital costs and prescription drugs for cancer patients. In Denmark almost all cancer drugs are given within hospitals. Thus the level of hospital cost (per capita) is highest for Denmark. The estimated per capita costs for prescription drugs and the share of total treatment costs are highest in Finland, Sweden and Norway (about 20 Euro per capita, 18-15 percent of treatment costs), about the double the estimated level in Iceland and the Faroe Islands[28].

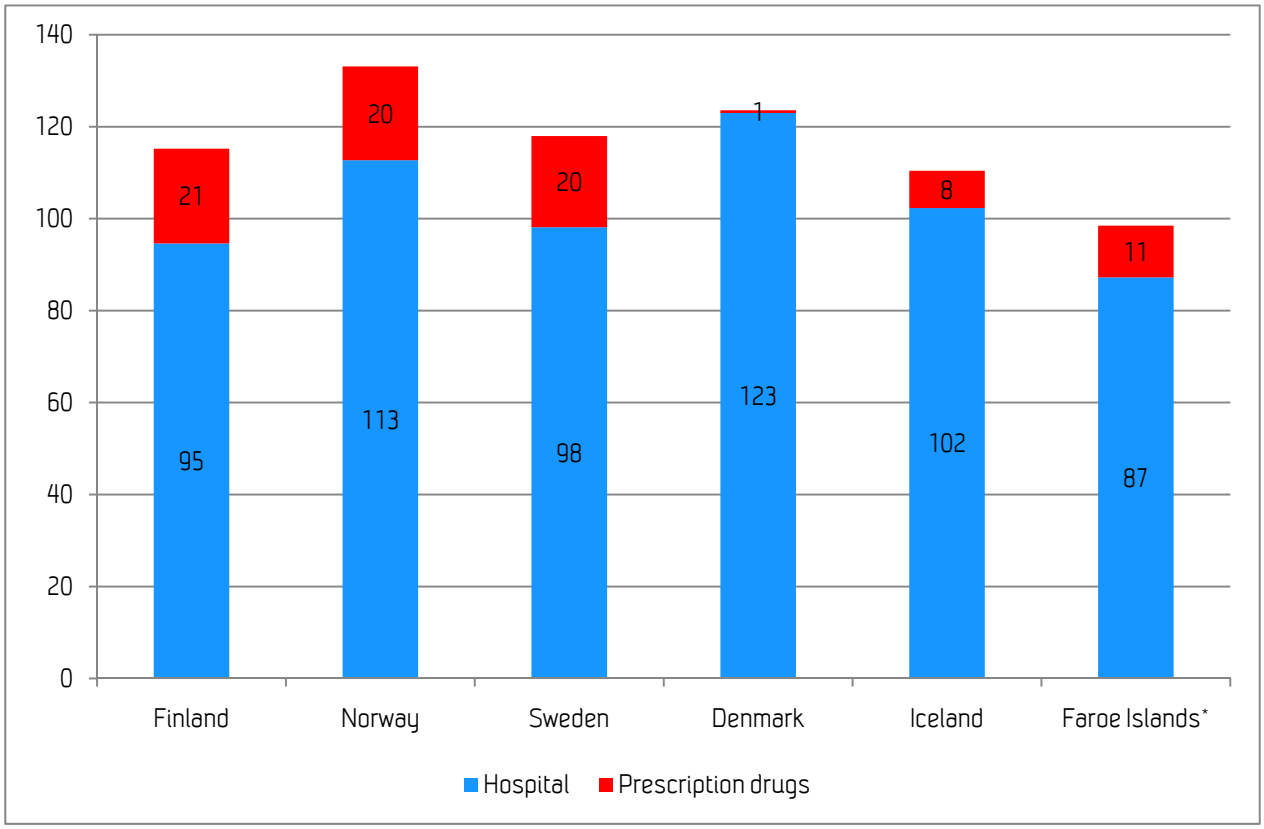

Figure 16 Expenditure on hospital treatment and prescription drugs per capita by country. EUR. 2007

* Missing outpatient hospital costs for patients treated in the Faroe Islands.

[28] The estimates for prescription drugs are affected by differences in how the data are collected, perhaps underestimating the costs for Denmark, Iceland and the Faroe Islands and overestimating the costs for Finland. Country differences in price levels may also influence the estimates of costs for prescription drugs, primarily underestimating the costs for Sweden. See A1.3 in the appendix for a detailed description of data and discussion of possible measurement errors.

In order to compare the use of cancer medicine between the countries we have gathered information on the *total sale* in 2007 of drugs in ATC-group L01 Antineoplastic agents (chemotherapy) and L02 endocrine therapy (where we find the major cancer drugs) based on national sales statistics. Compared to the estimated cancer-related treatment cost the size of total sales of cancer medicine is nearly 25 percent of the size of estimated treatment costs in Finland, Sweden and Denmark, somewhat lower (20 percent) in Norway[29]. Somewhat lower sales of cancer drugs in Norway than in Denmark, Finland, Sweden is in line with reported per capita sales in Wilking et al. (2009, figure 1-6). Differences in sales may reflect both price and/or quantity differences. Based on available sales data, 70-80 percent of chemotherapy drugs and only a minor part (less than five percent) of endocrine therapy are sales to hospitals in Finland and Norway.

The use of cancer drugs has increased rapidly in recent years and is making up an increasing share of cancer costs (Wilking et al. 2009). Wilking et al. (2010) show that the sale of cancer medicine (chemotherapy and endocrine therapy) in Sweden has increased five-fold in the ten-year period between 1998-2009. A report by Ministeriet for Sundhed og Forebyggelse (2009) shows that the hospital outlays related to cancer medicine in Denmark have experienced a tenfold increase from 2000 to 2008. The sale of cancer medicine in Finland increased by 50 percent from 2005 to 2008 (Kela 2008, 2009). In Norway sale statistics show an increase in sales of 70 percent in the years 2004-2009 (Apotekerforeningen 2005, 2010).

5.1.3.2 Inpatient, day patient and outpatient activity and corresponding unit costs

In order to illustrate country differences in activity levels and composition, days for inpatients, day patients and visits for outpatients (all measured per capita) is shown in Figure 17. Even though the different treatment settings contribute unequally in the caclulation of a single (weighted) activity measure, the sum of the three separate activity measures conveys a similar pattern of country differences as the composite activity measure[30].

[29] Drugs in ATC L01 and L02 are also given to other patient groups than cancer patients. In Norway and Finland cancer patients accounts for the major part (above 70 percent) of the costs in ATC—group L01 and L02 for prescription drugs. The cost of prescription drugs comprises more than cancer specific drugs in the ATC-groups L01 and L02 , see A1.3 in the appendix..

[30] See chapter 2.5.1 for a description of how the single (weighted) activity measure is calculated..

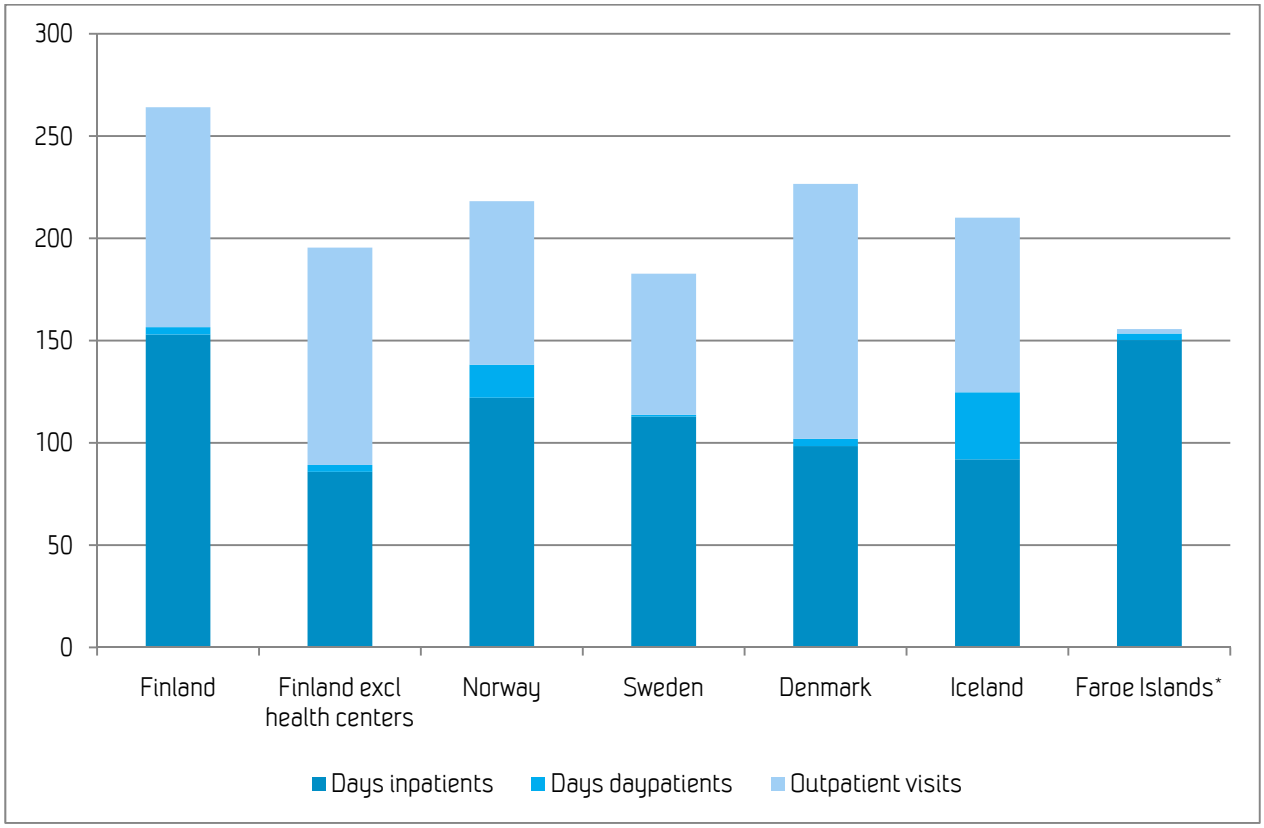

Figure 17 Hospital inpatient and day patient bed-days and outpatient visits per 1000 capita by country. 2007

* Missing outpatient visits for patients treated in the Faroe Islands

Finland clearly has the highest hospital use per capita, followed by Denmark, Norway and Iceland which have quite similar total per capita levels - about 15 percent higher than Sweden. The reported per capita activity level is too low for the Faroe Islands due to missing data on outpatient visits. Thus the activity level is probably in line with the other Nordic countires.

The type of hospital treatment given to cancer patients varies between the countries. Finland has high rates for both inpatient and outpatient activity. Finland also has relatively long average length of hospital stays (ALOS), see Table 10. High ALOS in Finland are related to the activity within health centers (ALOS are 23 days for the health centers). More than 40 percent of the inpatient bed-days for Finland are found within the health centers. Excluding activity in the health centers, the rate for inpatient bed-days per capita for Finland is lower than the other Nordic countries. The activity composition is therefore more in line with the profile we find for Denmark, i.e. a relatively high share of outpatient activity. The activity included for health centers in Finland is defined here as specialized health care. Whether the activity reported for the health centers is more comparable with activity that is found within long term care in the other Nordic countries is unknown since we havent been able to identify activity for cancer patients within long term care. However we can see from Table 10 that excluding health centers gives a considerably lower average length of stay for Finland than for the other countries. This may indicate that the division of labor between the hospitals and the health centers in Finland is different than between hospitals and long term care for the other countries, and that the acivity found in the health centers is (partly) found within hospitals in the other Nordic countries. Including half of the inpatient bed-days found within the health centers gives an activity level for Finland in line with Norway.

Denmark and Iceland have a relatively high share of outpatient activity compared to Norway and Sweden. Inpatient days per capita are higher for Norway and Sweden than for Denmark and Iceland. Sweden has a low level

and share of outpatient activity. Thus Sweden has a diverging level of outpatient activity for cancer patients[31]. The Faroe Islands has high rates for inpatient bed days. Cancer treatment for Faroese patients is to a high degree performed at Danish hospitals with long length of stays contributing to high rate of inpatient bed days.

Table 10 Average length of stay, share of day patient discharges and unit costs (EUR). By country. 2007

	ALOS, LOS>0	ALOS, incl LOS=0	Cost per inpatient discharge*	Cost per inpatient bed-day*	Cost per day patient	Cost per sum bed-day**	Cost per visit	Cost per visit***
Finland	10.7	8.7	4 738	444	624	448	228	419
Finland, excl. health centers	7.5	6.0	4 965	662	626	637	228	422
Norway	8.6	4.6	5 523	642	888	670	251	506
Sweden	9.6	9.0	5 977	623	1894	632	381	668
Denmark	9.0	7.1	4 645	517	2 499	585	508	513
Iceland	9.8	3.0	7 295	742	637	714	155	250
Faroe Islands****	13.8	10.9	7 123	516	2 685	561	510	
Average	9.5	7.0	5 341	560	1 121	584	357	529

* For patients with LOS>0

** Sum bed-days for inpatients (LOS>0) and day patients (LOS=0)

*** Incl. cost of prescription drugs

**** Unit costs for the Faroe Islands are based on estimated average cost per bed-day and visit by cancer site for Denmark.

Differences in the number of bed-days per capita may reflect both differences in the number treated and also different average lengths of stay (ALOS). Norway has the lowest ALOS, followed by Denmark[32]. The difference in the ALOS of Norway and Denmark is in line with the results reported for general (somatic) hospitals in Kittelsen et al. (2009). Compared to Norway and Denmark, the ALOS found for cancer patients in Sweden and Finland are respectively *relatively* lower and higher than the ALOS for all patients treated at somatic hospitals. It is reasonable to assume that the country differences in treatment of cancer patients are smaller than for hospital use in general, indicating again that the Finnish health centers to some extent contribute to complicate the comparison of Finland with the other countries. In addition to varying treatment intensity, differences in discharge levels and average length of stay may also reflect different organization and structures of hospital treatment, i.e. regarding the degree of specialization and division of labor between hospitals, and hospital transfers.

Table 10 shows the estimated relative unit costs for hospital treatment in the six countries. Broadly speaking, differences in unit costs for the different hospital activites are related both to differences in production costs in general and differences in organization[33]. Finland has low unit costs for all types of hospital activity. However the estimated cost per inpatient bed-day is relatively high when the health centers are excluded. This result must be interpreted in light of the low average length of stay found in Finnish hospitals. Norway has above average unit costs for inpatient activity and below average costs for day-patient and outpatient activity. Iceland has the same pattern of unit costs as Norway but with higher unit costs for inpatients and lower unit costs for day- and outpatients. Sweden has above average unit costs for all activities. Denmark has below average unit costs for inpatient treatment and high unit costs for day patient and outpatient treatment. The Danish unit costs per bed-day and per outpatient visit are used to estimate hospital costs for the Faroe Islands. However due to differences in average length of stay the cost per discharge for Faroe Islands differ from the Danish cost per disharge.

[31] The highest share of daypatients is found in Iceland, followed by Norway. However the definition of daypatients versus outpatients varies between the countries due to different financing systems and patient classification systems. Thus to a large extent the varying share of daypatients is likely to reflect different definitions of daypatients. While radiation therapy is mostly included in the outpatient activity for all countries, chemotherapy is mainly counted as day patients in Norway and Iceland, and as outpatient visits in the other countries.

[32] The Faroe Islands pateints have long stays at danish hospitals.

[33] In addition, there is also the possible element of measurement errors in the unit costs (per discharge and per visit) applied in the study.

So far we have only considered hospital costs. A varying degree of medical cancer treatment outside hospitals may also give rise to differences in unit costs. This is illustrated by adding the cost of prescription drugs to outpatient costs, which contributes to reduce the country differences in estimated cost per outpatient visit[34].

5.1.4 Decomposition II: Costs, prevalence, activity level and unit costs

The contribution of differences in activity and unit cost to country differences in treatment *costs per prevalence* is illustrated in Figure 18. In order to be able to decompose cost per prevalence in an activity component and a price component, we have constructed a weighted activity measure for hospital treatment and calculated unit costs as country spesific estimated treatment costs divided by estimated (weighted) activity[35]. We show the results *after correction for prevalence case mix*[36]. The indicators are shown relative to the Nordic average..

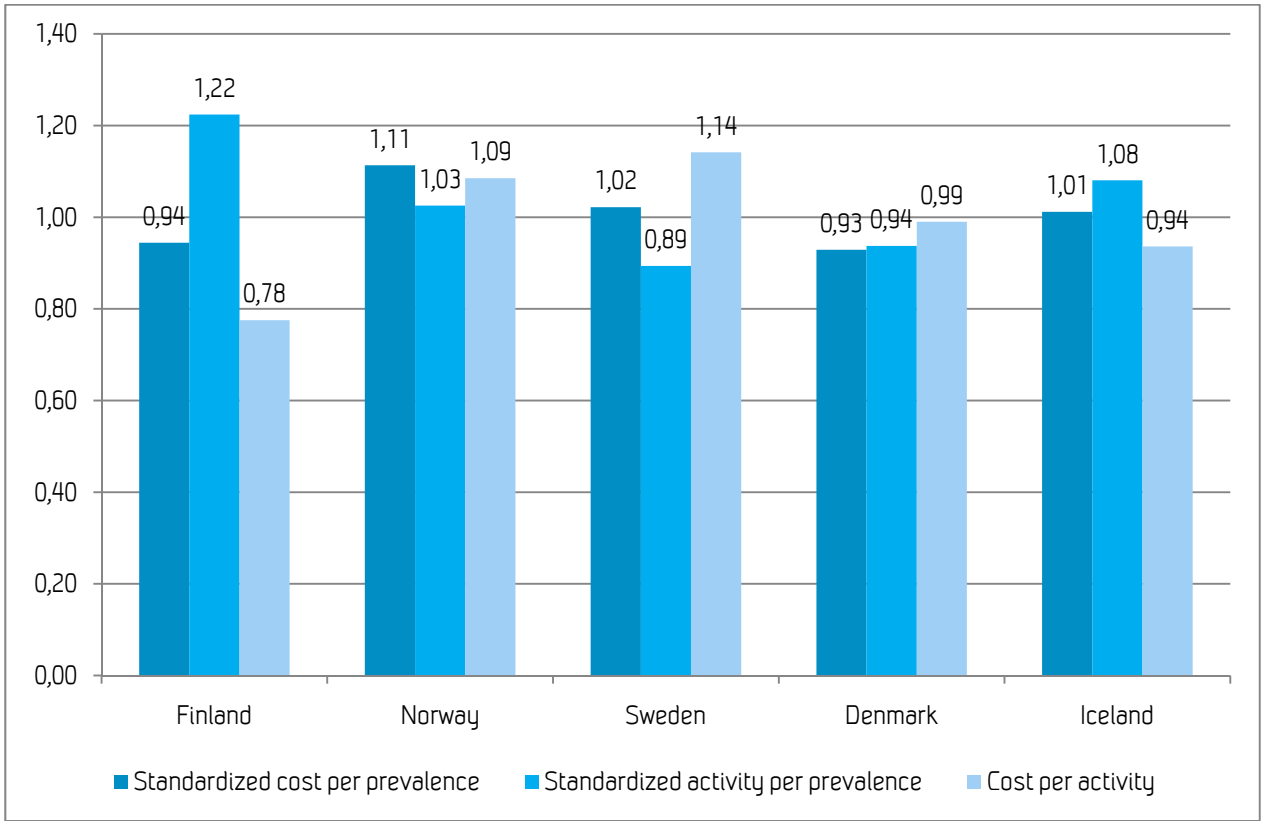

Figure 18 Standardized treatment cost per five-year prevalence, standardized (weighted) activity per prevalence and cost per (weighted) activity by country. Relative to Nordic average (=1). Excluding the Faroe Islands. 2007

Finland has about 20 percent higher activity level than what would result with average activity per prevalence for the cancer sites. However very low cost per activity contributes to relatively low treatment costs per prevalence. The inclusion of inpatient activity found within health centers may contribute to overestimating the actvitiy and cost per prevalence, and underestimating cost per activity.

[34] Due to missing data on outpatient visits, the calculated unit cost including prescription drugs is not shown for the Faroe Islands.

[35] See section 2.5.1 for details.

[36] The decomposition of treatment cost per prevalence (relative to the Nordic average) with and without standardization for differences in prevalence case-mix is presented in Table 11.

Norway has close to average avtivity per (standardized) prevalence. Thus high costs per prevalence can be explained by high cost per activity. Sweden also has high cost per activity, but the low(est) actvity per (standardized) prevalence gives average standardized treatment cost per five-year prevalence. Denmark has close to average cost per standardized (weighted) activity, and the below average standardized cost per prevalence is related to below average activity per prevalence taking the cancer prevalence case-mix into account. Iceland has high activity per prevalence and low cost per activity, which in sum gives average cost per prevalence. Thus, even though Iceland has high unit costs for inpatient activity, the high share (and low unit costs) of outpatient activity contributes to relatively low cost per weighted activity.

5.1.5 Summary: Decomposition of per capita treatment costs

The results presented in this chater are summarized in Table 11: decomposition of estimated treatment costs per capita in different components capturing diffent prevalence rate; different diagnostic composition (prevalence case-mix); different activity levels; and different cost per prevalence and per (weighted) activity[37]. The decomposition of costs both with and without correction for cancer prevalence case-mix is shown.

Table 11 Decomposition of (relative to Nordic average) treatment cost per capita[38]. Nordic countries. 2007

		Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
A=B*C =B*C2*D=B2*C2	Cost per capita	0.95	1.10	0.97	1.02	0.91	0.81**
Not standardized:							
B	Prevalence rate*	0.94	1.00	1.05	1.00	0.83	
C=Ca*Cb	Cost per prevalence	1.01	1.10	0.93	1.02	1.10	
Ca	(Weighted) activity per prevalence	1.31	1.02	0.81	1.04	1.17	
Cb	Cost per (weighted) activity	0.78	1.08	1.15	0.98	0.94	
Standardized:							
D	Cancer prevalence case-mix index	1.07	0.99	0.91	1.10	1.09	
B2=B×D	Standardized prevalence rate	1.01	0.99	0.95	1.10	0.90	
C2=C2a*C2b	Standardized cost per prevalence	0.94	1.11	1.02	0.93	1.01	
C2a	Standardized (weighted) activity per prevalence	1.22	1.03	0.89	0.94	1.08	
C2b=Cb	Cost per (weighted) activity	0.78	1.08	1.15	0.98	0.94	

* Five-year prevalence

** Missing costs for outpatient activity for patients treated in The Faroe Islands.

Norway has the highest cost per capita. The five-year prevalence rate and composition on cancer sites, as well as the activity per prevalence are close to the Nordic average. High treatment cost per capita compared to the other Nordic countries can be attributed to relatively high treatment cost per (weighted) activity.

Denmark has the next highest estimated treatment cost per capita, close to the Nordic average. The raw prevalence rate for Denmark is, like Norway, equal to the Nordic average. Denmark has a cost demanding prevalence composition, i.e. relatively high prevalence rates for cancer sites with high cost per prevalence. The

[37] See section 2.5.1 for details.

[38] See section 2.5.1 for details..

standardized cost per prevalence is low. Low standardized cost per prevalence is related to a relatively low standardized activity level. The cost per activity is close to the Nordic average.

Sweden has just below average estimated treatment cost per capita. Sweden has a high(est) raw prevalence rate. However corrected for the prevalence case-mix, the standardized prevalence rate is low. Sweden has relatively high cost per activity. Standardized cost per prevalence near the Nordic avarage is related to low activity level also when taking the cancer prevalence composition into account..

Iceland has low estimated treatment costs per capita. Iceland also has a low prevalence rate, even after correction, for a relativey cost-demanding prevalence case-mix. The standardized cost per prevalence is close to the estimate for Sweden. Iceland has a high activity level and low estimated cost per activity.

Finland has estimated treatment cost per capita five percent below the Nordic average. Low cost per prevalence, taking the prevalence composition in to account, contributes to low cost per capita. Finland has a low raw prevalence rate but a relatively cost demanding prevalence composition. Low standardized cost per prevalence is related to low(est) costs per activity. The estimated activity level is high. The activity in health centers contributes to high estimated activity level for inpatients in Finland. To what extent this is activity found within long term care, which is not included in the study, for the other countries is unknown. If we assume that results based on inclusion of some, but not all, of the activity in the health centers is more accurate, one such estimate could be based 50 percent on results including health centers and 50 percent on results excluding health centers. The results of such a model is shown in Table 22 in the appendix. The cost per capita for Finland would be lower, just below the Icelandic level. The standardized cost per prevalence would also be lowest among the Nordic countries. The standardized activity per prevalence would be considaribly lower, below the Icelandic level and approaching the Norwegian level. Unit costs for Finland on the other hand would be higher, but still considaribly lower than the estimates for the other Nordic countries. This model contributes to a small increase the variation in estiamted costs per capita and per prevalence among the Nordic countries, but reduces the variation in estimated activity levels and unit costs.

The *Faroe Islands* has low estimated costs per capita. This can probably be explaind by missing data on outpatient activity. Prevalence data is not available for the Faroe Islands. However the cancer incidence per capita is low

5.2 Screening programs

All of the Nordic countries have screening programs. Finland has three nationwide screening programs. The earliest of these, the cervical cancer screening program, started in 1963 and covers the age group 30 (or 25) up to 60 years. This group is screened every five years. The biannual breast cancer screening targets the age-group between 50 to 59, but plans exist to extend the targeted group up to 69 years of age within a ten year period from 2007. The last of the Finnish programs is colorectal cancer screening. This program has been ongoing since 2004 and targets men and women aged 60-69 years. In 2007 35 percent of the targeted population was covered, and within a few years this figure is expected to reach 50 percent.

In Sweden screening programs are established for cervical cancer and breast cancer. These programs are under the administration of each county council. The nationwide screening program for cervical cancer was introduced in 1967 (Day 1984). The screening program for breast cancer was introduced between 1986 and 1996. It is estimated that by 1992 at least 90 percent of the women in the age-group 50-69 had been invited for screening at least once (Zahl et al. 2004).

Norway also has two national cancer screening programs - one for cervical cancer and one for breast cancer. Despite promising trials initiated as early as 1959 in Østfold county, no nation-wide screening program was established for cervical cancer before 1991 (Bjørge et al. 1995). Today all women in the age-group 25 to 69 are offered screening every three years. Screening for breast cancer was introduced in 1996 and expanded

geographically over the following 9 years until full geographical coverage was reached in 2005 (Kalager et al. 2010). Biannual screening is currently offered to all women between 50 and 69 years of age.

Denmark has three cancer screening programs. The first population-based cervical cancer screening program was introduced in 1967-8 in three counties (Bigaard et al. 2000). Since then, the program has spread geographically until all counties offered screening in 1996. The offer extends to all women between 23 and 49 years of age every third year, and every woman in the age-group 50-64 every fifth year. Although some counties introduced breast screening in the early 90s, a program with full national coverage wasn't initiated before 2007(European Cancer Observatory 2007). It is expected that all women between 50 and 69 years of age should have been given a screening offer by the end of 2009. The colorectal screening program is Denmark's most recent program. After a pilot project in 2005-6 it was decided in 2010 that screening should become a service extended to all Danes between 50 and 74 years of age.

In Iceland two screening programs are established. A cervical screening program was initiated in 1964 and currently offers screening to all women between the ages of 20 and 39 every second year, and to all women aged 40-69 every second-fourth year. Prior to 2009 the frequency was every two years for women aged 20-69 (Sigurdsson 2010). In 1987 a national program for breast cancer screening was initiated, which today offers screening to all women aged 40 to 69 years every second year (Hjörleifsdóttir and Whyte 1999).

A national screening program for cervical cancer was adopted by the Faroe Islands in 1995. An offer for screening goes out every third year to all women aged 25 to 59 years

In the following two sections statistics on costs of screening per capita and screenings per capita among the Nordic countries are presented. Except for the Faroe Islands all the Nordic countries screen for both breast cancer and cervical cancer at the present (2010). We therefore present estimates of these two most common types of screening. Denmark, not having official screening statistics readily available, unfortunately drops out of this comparison.

5.2.1 Expenditures per capita

Figure 19 displays the per capita costs associated with screening for breast cancer and cervical cancer in the Nordic countries.

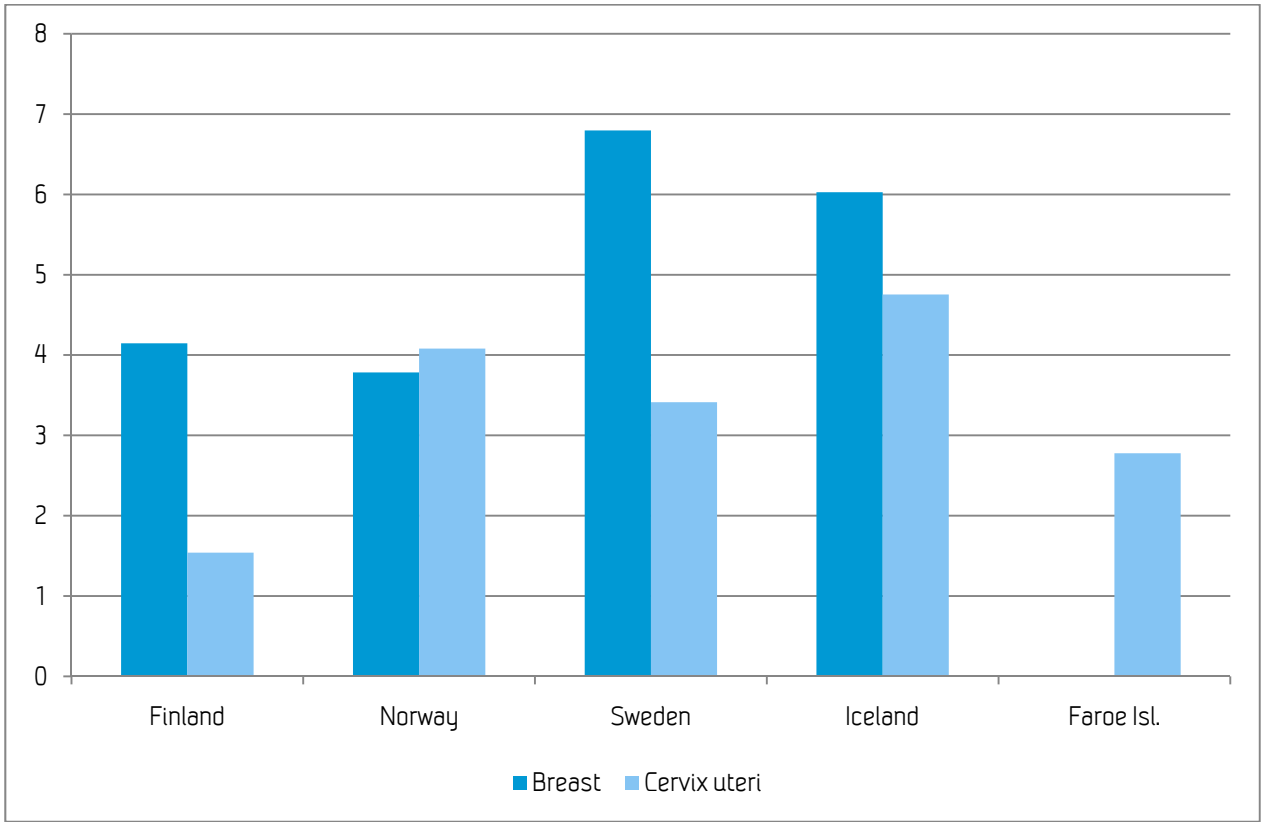

Figure 19 Screening programs – Estimated costs per capita. EUR, 2007

For breast cancer it is Sweden followed by Iceland which has the highest screening costs. For cervical cancer it is Iceland followed by Norway which has the highest costs. If we compare the national estimates of cost of the two screening programs, we see that for Finland and Sweden the estimated cost for breast screenings are twice the cost, or more, of screening for cervical cancer. The difference in cost between the two programs is less for Iceland, and for Norway the costs are about the same. These national differences in costs are, however, merely a function of the estimated number of screenings per capita since the same cost per screening, capturing the direct health care cost of performing tests (94 Euro for breast and 45 Euro for cervical), is set for all countries[39].

5.2.2 Screenings per capita

As seen in Figure 20 there is some variation across the Nordic countries in the extensiveness of the national screening programs. Mirroring the findings on costs, Sweden and Iceland have significantly higher screening rates for breast cancer than Finland and Norway. These differences are connected to differences in the countries' screening policies, namely the frequency of screening and differences in which age-groups are covered. As can be seen in Table 12 Finland, Norway and Iceland have biannual screenings for breast cancer, while Sweden offers screening every 18 months for the youngest age cohort and every second year for the oldest age cohort. This elevates the screening rate in Sweden compared to the other countries. The other factor that leads to differences in screening rates is differences in the age cohorts offered screening. In Iceland and Sweden women are invited to participate in the breast screening program when they reach 40 years of age, while the screening programs in the other Nordic countries only extends this offer to women when they reach 50 years of age. There are also national differences in how long screenings are offered. Except for Sweden, all Nordic countries offer women screening for breast cancer up until they have reached 69 years of age. Sweden, on the other hand, extends this offer to women until they have reached 74 years of age.

[39] See section A.1.4 in the appendix for details.

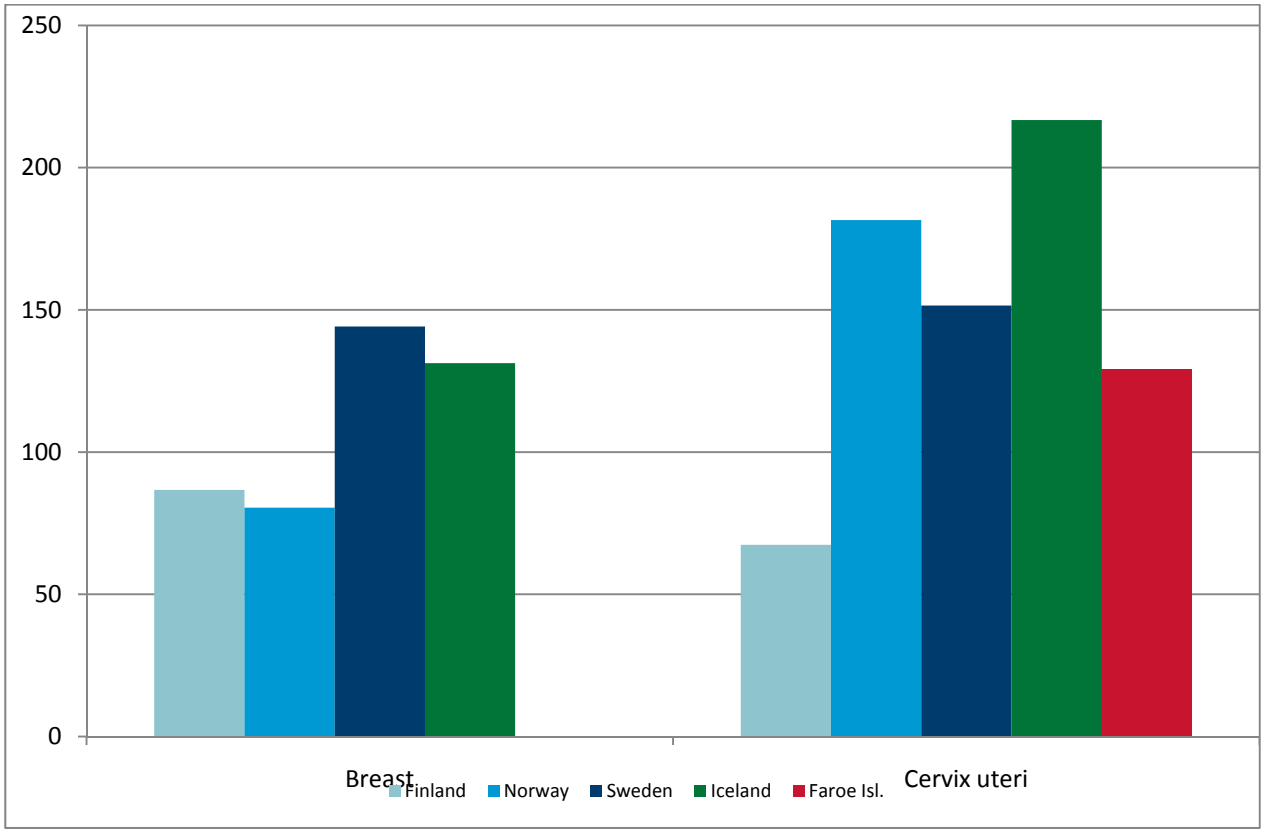

Figure 20 Screening - Number of cases per 1000 capita (women). 2007

Table 12 Screening policy by country.

Breast	
Finland	Woman aged 50-69 (starting to expand to 60-69 from 2004) every second year
Norway	Woman aged 50-69 every second year
Sweden	Women aged 40-74, 18 months interval below age of 55, 2 years interval between age 55 and 74.
Denmark	Women aged 50-69 every second year)
Iceland	Woman aged 40-69 (every second year)
Faroe Islands	None
Cervix uteri	
Finland	Woman aged 30-60 every fifth year
Norway	Woman aged 25-69 every third year
Sweden	Women aged 23-50 (3 year interval), age 51-60 (5 year interval)
Denmark	Women aged 23-50 (3 year interval), age 51-65 (5 year interval)
Iceland	Women aged 20-39 (2 year interval), age 40-69 (2-4 year interval). Prior to 2009: Women aged 20-69 every second year
Faroe Islands	Woman aged 25-59 every third year

Similar discrepancies in the Nordic screening programs for cervical cancer can also explain much of the differences in these screening rates. A brief glance at Table 12 reveals that Iceland begins screening of women at an earlier age than the other countries, they also screen women more frequently and until they reach an older age than most other countries. Hence, it is no surprise that Iceland, as seen in Figure 20, has a markedly higher screening rate per capita than the other Nordic countries. At the other end of the scale is Finland with distinctly

lower screening rates than the other Nordic countries. This can also easily be explained by differences in screening policies. For cervical cancer Finland start screening women at an older age than the other countries, they end screening at a lower age than most of the other countries, and they screen more infrequently than the other countries.

5.3 Public expenditures on income loss compensation payments related to cancer: Sickness benefits and disability pensions

All Nordic countries have public schemes for income loss compensation in case of illness. There are two basic types of compensation. The first type of compensation is sickness benefits in the form of either wages (in a statutory employer period) or daily cash benefits paid by public institutions. The second type of compensation, disability pension, applies if the incapacity to work is deemed more permanent, and is typically not granted before the period of sickness-leave extends beyond one year[40]. This chapter deals with these two types of income-compensation. The current chapter is, in other words, concerned with *public expenditures* on income loss compensation payments (ILCP). Forgone resources (in terms of productive capacity/lives) fall outside the scope of the present study.

In the first section we first address the distribution of the public expenditures. Following this, we further explore the reasons for differences between Nordic countries by decomposing the public expenditures on sickness benefits and disability pension separately, capturing country differences in compensation levels. Unfortunately, the estimates of public expenditures on ILCP do not include Denmark as the available data relating to public expenditures on sickness benefits and disability pensions from Denmark could not be broken down according to cancer diagnoses.

5.3.1 Expenditures

As alluded to above, the present section addresses the distribution of public expenditures on ILCP in the Nordic countries. The results are presented in two figures. In addtion to displaying public expenditures per capita, the first figure displays how total expenditures are split between sickness benefits and disability pension. In the second figure the public expenditures on ILCP are seen as a share of combined costs of cancer treatment and public expenditures on ILCP.

As seen in Figure 21 there are large variations in the level of cancer-related public expenditures on ILCP per capita. Norway clearly has the highest total expenditure level per capita, while Iceland has the lowest expenditure level. Iceland's diminutive public expenditure compared to the other countries is a result of Iceland's mandatory insurance scheme, which covers all employees, both public and private. Rather than being organized by the public authorities, the insurance scheme is administered by the labor unions (NOSOSCO 2009: 104) and thus these expenses are not included in official statistics. While this scheme is primarily oriented towards sickness benefits, it also covers parts of the expenses on disability pension. The level of disability pension for Iceland would therefore be approximately 30 percent higher if these expenses were included.

Finland and the Faroe Islands seem to have fairly equal levels of cancer-related public expenditures on ILCP per capita and allocation between sickness benefits and disability pensions. While the Faroe Islands, Iceland and Finland on the one hand have less per capita expenditures tied to sickness benefits than disability pensions, Sweden has, on the other hand, most of its' indirect expenditures (70 percent) in sickness benefits. Norway has a nearly equal share of expenditure on sickness benefits and disability pensions.

[40] Sweden changed the system of pensions in 2003, replacing the disability pension with sickness and activity allowance. We use the term disability pensioners also for Sweden.

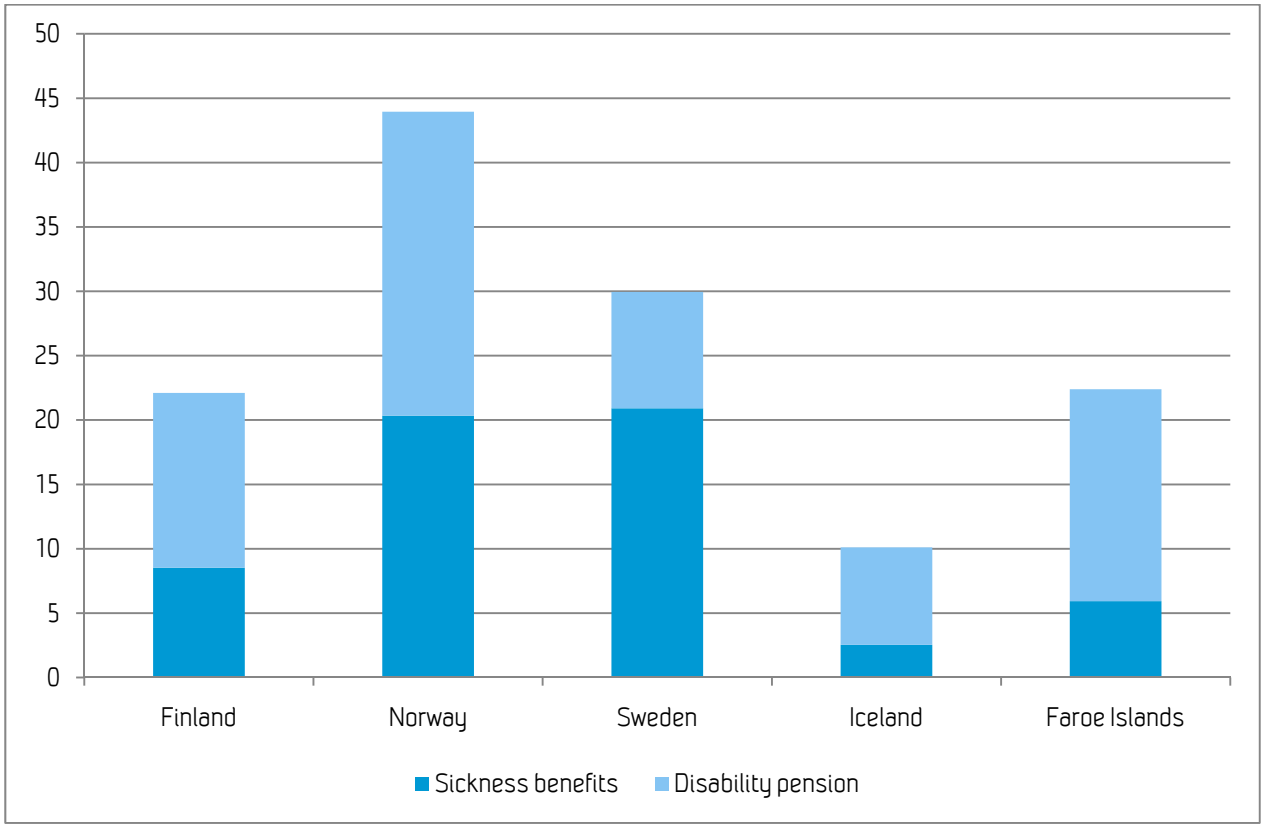

Figure 21 Public expenditures on ILCP per capita. EUR, 2007

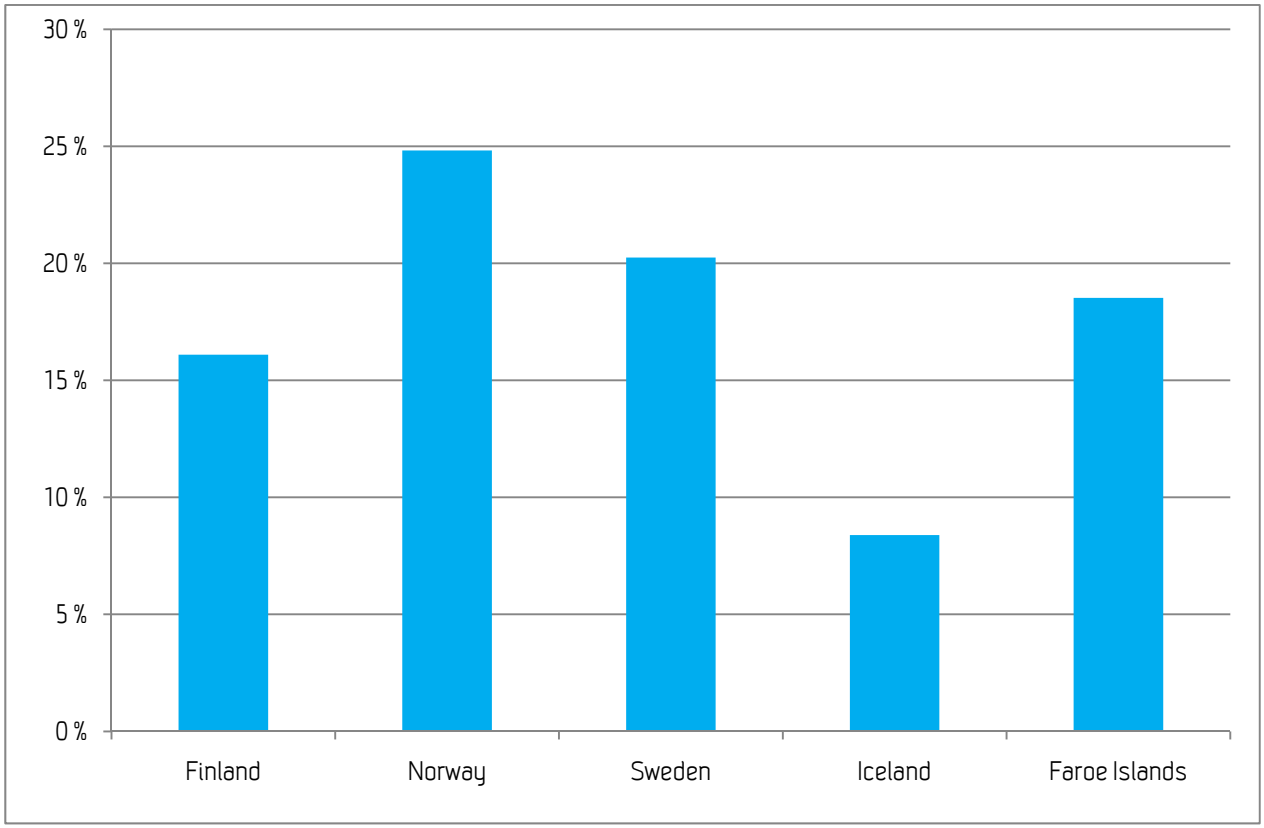

Figure 22 Public expenditures on ILCP as share of sum treatment and public expenditures on ILCP. 2007

The same general Nordic expenditure-pattern seen for per capita expenditures is also evident when the public expenditures on ILCP are seen as a share of the *sum* of treatment costs and public expenditures on ILCP (Figure 22). Although the general pattern is similar there is now less distance between the countries. Norway has the highest share of public expenditures on ILCP followed by Sweden. The Faroe Islands have somewhat higher expenditure levels for ILCP compared to treatment costs than Finland[41].

Summing up so far, the results demonstrate that there are consistent patterns of public expenditures on ILCP across the Nordic countries over different measures. It can be stated with relative certainty that Norway has the highest level of total public expenditure on ILCP among the Nordic countries. Across all estimates, Iceland has shown the lowest level of cancer-related *public* expenditure on ILCP.

In addition to a per capita measure of public expenditures on ILCP, the first figure of this section (Figure 21) also contained information on the split of these expenditures between expenditures on sickness benefits and disability pension. The figure reveals rather large Nordic differences. In the following section we therefore take a closer look at sickness benefits and disability pension by decomposing expenditures.

5.3.2 Decomposing expenditures on sickness benefits and disability pension

As public expenditures on ILCP are the sum of outlays on public sickness benefits and disability pension it is relevant to decompose these costs separately to gain some insight into what may create the Nordic differences we have seen regarding total public expenditures. Looking first at sickness benefits, Figure 23 reveals that Norway and Sweden have about the same costs per capita, followed by Finland and the Faroe Islands and, finally, Iceland with the least costs.

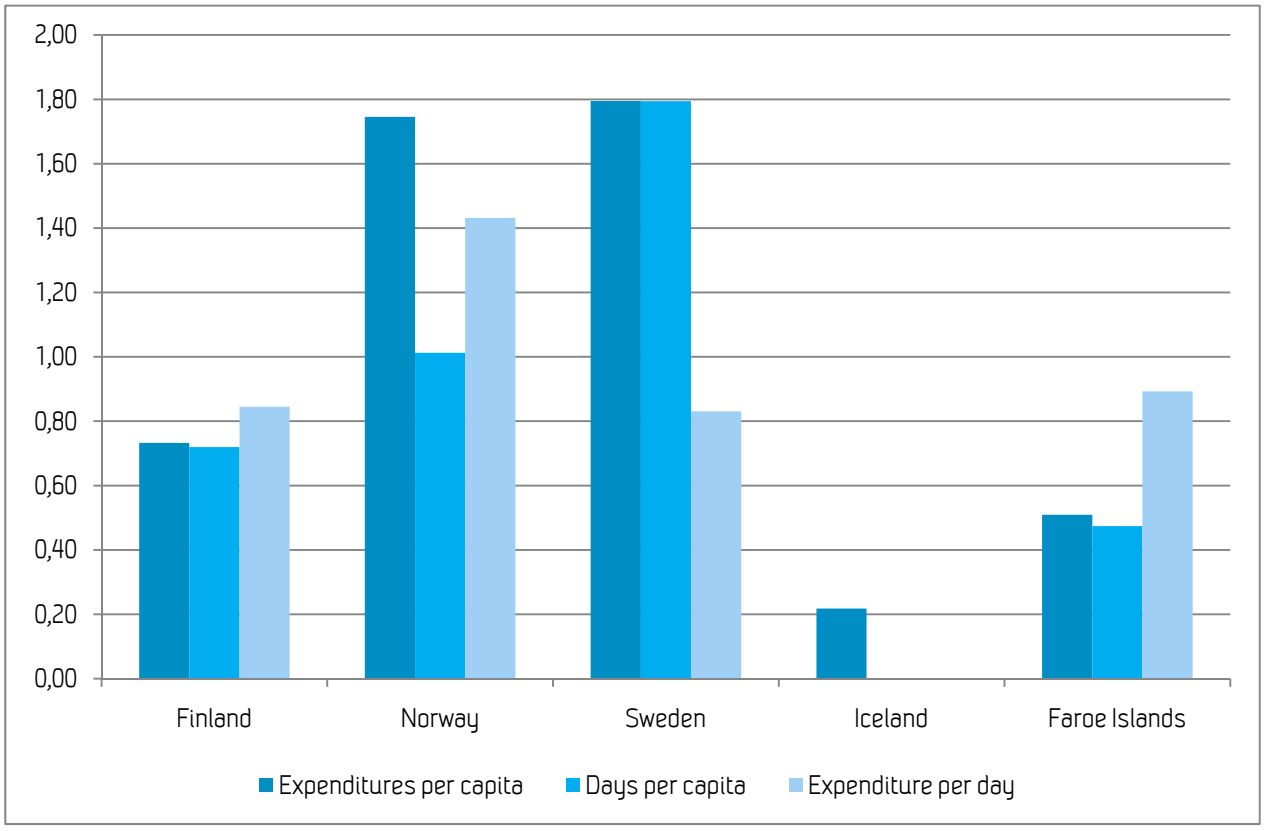

Figure 23 Decomposition of sickness benefits; expenditures per capita, days per capita and expenditures per day. Relative to average (un-weighted) for Finland, Norway, Sweden and the Faroe Islands (=1). 2007

[41] Excluding (some of) the costs related to health centers in Finland would decrease the difference between Finland and the Faroe Island.

As previously mentioned, Iceland has a scheme administrated by the labor organizations that covers most of the costs associated with sickness benefits. This is also the reason why there is a lack of official data on the days of sickness leave associated with cancer diagnoses.

For Norway and Sweden, the two countries with the highest public expenditures per capita for sickness benefits, we see two different explanations for expenditure levels when this measure is decomposed into days per capita and expenditure per day. Comparing Norway to Sweden in Figure 23, it is obvious that Norway has fewer days per capita, but higher expenditure per day than its neighbor. For Sweden, the relationship is the opposite, having lower expenditure per day, but more days per capita compared to Norway. Compared to Norway, Finland and the Faroe Islands have both lower expenditure per day and days per capita. Sweden, Finland and the Faroe Islands have similar expenditure per day.

Some of the observed differences in public expenditures on sickness benefits relate to different rules (e.g. qualifying time, duration of employer period, maximal time for receiving sickness benefits), and compensation levels (e.g. maximal amounts per week). For a description of the policy of sickness benefits in the Nordic countries see chapter 5 in NOSOSCO (2009). In line with what we observe for estimated expenditure per day for cancer patients, Figure 5.1 in the NOSOCO report (p 109) shows considarably higher compensation levels for Norway than in Finland, Sweden and the Faroe Islands. Sweden's remarkably longer period during which cancer patients receive sickness benefits, has in all likelihood a simple explanation. In Sweden there are no time limitations on how long people with serious illnesses can receive sickness benefits (NOSOSCO 2009: 114). Hence, large groups of cancer patients will receive sickness benefits for periods longer than the maximum period allowed for people suffering from less serious ailments.

The low level of sickness days paid for in the Faroe Islands is in accordance with the general low number of sickness beneficiaries in general (NOSOSCO 2009: 113). Cancer incidence also seems to be low in the Faroe Islands. In general Finland also has a relatively low number of sickness beneficiaries, while Norway clearly has the highest level (ibid).

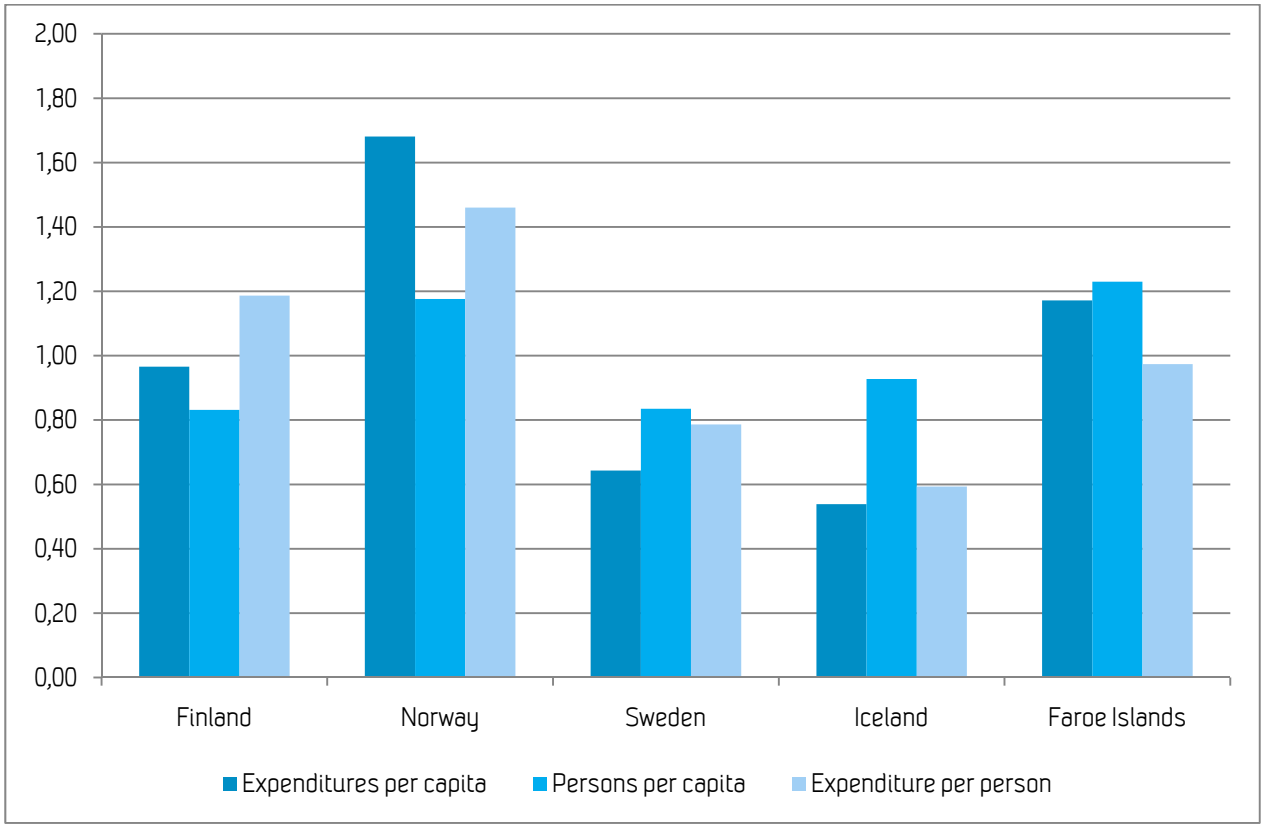

Figure 24 Decomposition of disability pension; expenditures per five-year prevalence, persons per prevalence and expenditure per person. Relative to average (un-weighted) for all countries except Denmark (=1). 2007

The distribution of disability pensions for the Nordic countries is displayed in Figure 24. As for sickness benefits, Norway has the highest expenditure per person and also a high level of disability pensioners related to cancer, which is in line with what is observed for Norway in general (NOSOSCO 2009: 171). The high expenditures of disability pensions per capita in the Faroe Islands are caused by a relatively high number of recipients per capita (persons per capita). Nevertheless, statistics on the general level of recipients of disability pension compared to the population size is very low (ibid); the Faroe Islands has, in fact, the lowest percentage of disability pensioners among the Nordic countries. With this in mind, it looks as if granting cancer patients disability pension rather than sickness benefits reflects a local practice on the Faroe Islands[42].

Finland is in a middle position regarding the level of public expenditures on disability pensions and pensioners. It is worth noticing that Iceland has an average rate of utilization of disability pensions (persons per capita), but still has low public expenditures per capita due to low expenditure per person on disability pensions (see Figure 40). The explanation for this must again be seen in connection with the unique private insurance scheme in Iceland which also covers a substantial amount of the outlays on disability pensions.

The low level of per capita expenditures on disability pensions in Sweden is mostly a result of low levels of people with cancer being classified as disability pensioners (persons per capita) but also below average compensation level. The lower number of persons receiving disability pension in Sweden, despite a high prevalence of cancer, could be explained by the rules for sickness benefits, allowing for longer sickness periods than one year. The rules for the compensation systems are likely to substitute each other and in this case ease the pressure on the

[42] The method for identifying cancer patients among recipients of disability pension for the Faroe Islands may contribute to overestimating disability pensioners due to cancer. However the same procedure for identifying cancer patients is also applied for sickness benefits for the Faroe Islands.

disability pension system. In general (for the whole population), Sweden does not have a low level of disability pensioners (NOSOSCO 2009: 171). However, the figures for disability pensions should be interpreted with some caution since there is uncertainty about the diagnostic setting and retrieval of diagnostic codes from the register for disability pensions.

Different policy regimes will also contribute to the observed country differences in public expenditures on disability pensions due to cancer (see chapter 6 in NOSOSCO 2009). Compared to the average monthly amount of statutory disability pension shown in table 6.3.7 in NOSOSCO (2009: 170), the observed differences in estimated expenditure per person is not as easily explained by differences in average compensation levels as for sickness benefits[43]. This may of course have to do with differences between the composition of cancer patients and the general population (for example differences in age composition).

[43] The average monthly amount is highest in Norway followed by the Faroe Islands, and Sweden and Finland. The latter two having similar levels.

6 Projections of treatment-related cost of cancer: 2007-2025

For national governments, and for stakeholders responsible for the supply of cancer treatment specifically, information about future costs and the underlying characteristics of these costs, are of great interest. For instance, is it primarily high cost or low cost cancer sites that are likely to increase? Is it cancer sites dominated by inpatient or outpatient treatment that are likely to increase? Is this increase likely to necessitate a proportionately larger outlay on drug expenditure or is there reason to believe that major investment in human capital should be undertaken? Analysis of future costs can help to shed light on these and related questions.

In this chapter we present estimates of future cancer costs in the Nordic countries. We project present treatment costs by utilizing estimated cost per five-year prevalence in 2007 and predicted cancer prevalence in 2025. Changes in the age composition and life expectancy of the population, as well as population size, will influence the changes in cancer prevalence. We focus on changes in treatment costs due to changes in cancer prevalence, taking the distribution on cancer sites into account. To some extent this is a simple approach because future cancer costs depend on several additional factors like:

- changes in technology
- changes in cancer drug treatment
- available resources
- willingness to pay and ranking of priorities

Innovations in medicine and technologies influence investments in equipment, diagnostic and surgical procedures, and the organization of cancer treatment - all which affects treatment costs. There has been a sharp increase in the cost of cancer drugs in the last decade, both related to new indication for the use of existing drugs and the introduction of new expensive cancer drugs (Wilking et al. 2009). In the period 1995-2008 32 new products (on average 2.5 per year) were approved for marketing in the European Union (Ministeriet for Sundhed og Forebyggelse 2009). However, the new targeted therapies seldom replace existing cancer drugs, instead acting as supplements (ibid). Nevertheless, the growth rate for the costs of cancer drugs is expected to slow down (Jönson and Wilking 2010). In Sweden the growth rate observed after 2007 is considerably lower than in the years 2000-2007. Based on a forecast model for cancer drugs, the growth in the period 2007-2022 is predicted to be about four percent per year[44] (ibid), compared to 15-20 percent in the previous years. An important contribution to the slow-down in the growth in costs of cancer drugs is that prices of existing drugs are not expected to increase; rather a reduction is expected due to expiration of patents and subsequent replacement by cheaper generics. While new high-cost equipment and procedures and new cancer drugs may contribute to increase costs, shorter hospital stays and increasing treatment in outpatient settings (also within primary care) following these innovations may pull costs in the other direction. Growth in gross domestic product (GDP) and the development of need in health care in general and within other areas of society will influence priority-setting in the use of scarce recourses and thus the future cancer-related costs. Environmental and behavioral factors, including policies directed toward prevention, will also affect future cancer incidence and prevalence.

The above mentioned factors are all associated with uncertainty. We focus on *changes in treatment costs due to changes in cancer prevalence,* taking the *distribution on cancer* sites into account. The prediction of future prevalence is performed by the Cancer Registry of Norway as a separate input to the cost of cancer project. The results, methods and material are documented in Rahimi et al. (2010). The predictions of future prevalence are performed for all Nordic countries except the Faroe Islands.

[44] An increase from 2.5 billion SEK in 2007 to 4.8 billion in 2022.

6.1 Growth in prevalence and costs at the Nordic level

Based on the predictions of future prevalence, in 2025 about 470 000 living persons will have received a cancer diagnosis within the last five years. Compared to the five-year prevalence in 2007 this is an increase of 32 percent (Figure 25)[45]. The increase in cancer may be the result of several factors such as changes in life expectancy and age composition. In all Nordic countries the share of elderly is expected to increase significantly. Population size is also expected to increase during the same time period by about seven percent for the sum of the Nordic countries[46]. The predicted per capita growth in five-year prevalence of cancer is 23 percent (compared to the 32 percent growth in absolute numbers) from 2007 to 2025. Assuming unchanged cost per prevalence on cancer sites, the predicted increase in cancer-related treatment cost is 28 percent (20 percent per capita). Thus on average the prevalence is expected to increase most for sites with relatively low costs per capita.

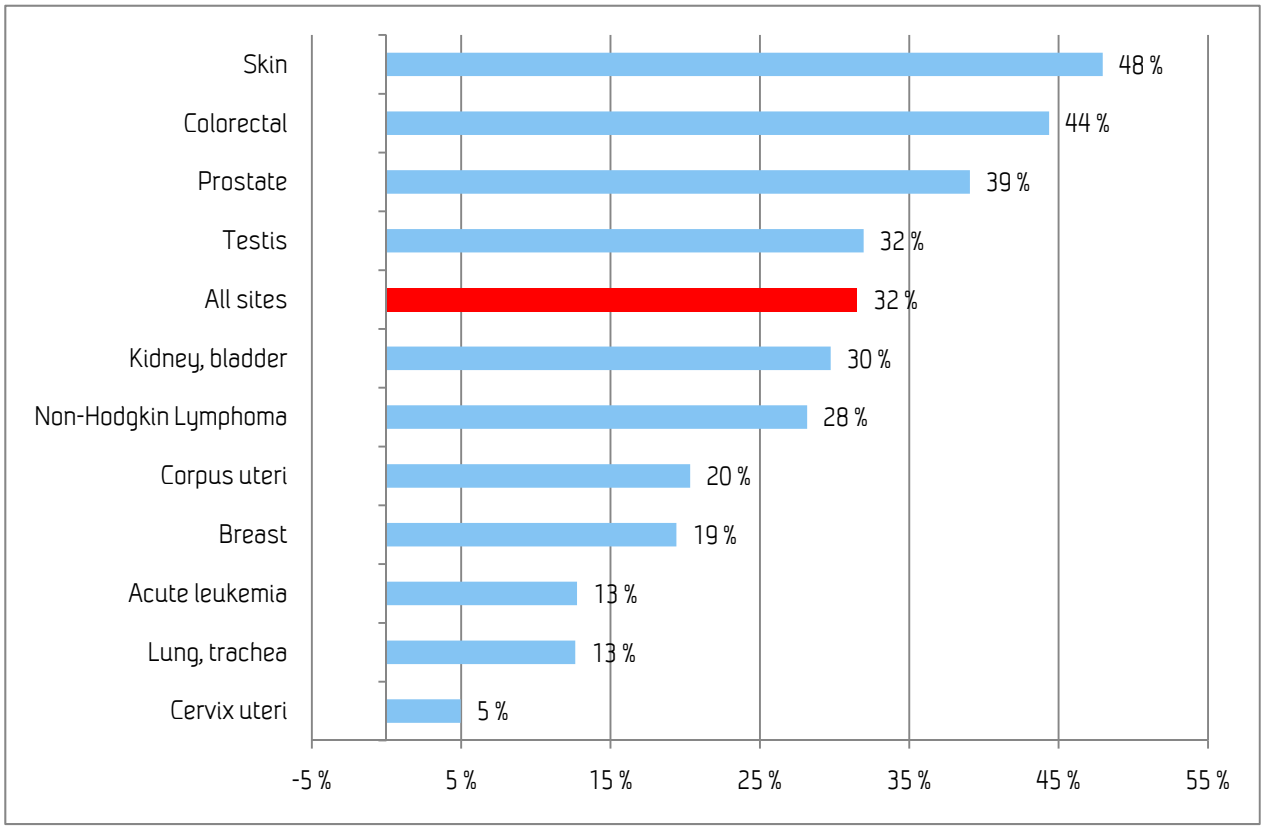

Figure 25 Percentage change in predicted five-year prevalence 2007-2025 by cancer site. Sum Nordic countries.

Of the cancer sites identified in this project the predicted increase in prevalence is highest for skin (excl. non-melanoma), colorectal and prostate cancer. These are all large sites in terms of cancer prevalence in 2007. They differ in other respects. Based on the results for 2007 presented in chapter 4, skin cancer is characterized by low treatment cost per prevalence and a high share of outpatient activity. Prostate is also characterized by relatively low cost per prevalence and a high share of outpatient visits. Prostate cancer also has a considerably higher share of medication outside hospitals (prescribed drugs) than the other cancer sites we have identified. Colorectal cancer on the other hand is characterized by higher costs per prevalence, high share of inpatient activity, long length of stays, and a low share of costs related to medication outside hospitals. Thus with

[45] The predicted prevalence of skin cancer in 2025 does not include non-melanoma. In order to have comparable cost estimates in 2025 and 2007 we have assumed an equal growth in non-melanoma as for melanoma of skin, and added this to the predicted prevalence for melanoma and for cancer in total.

[46] Based on data received from the Cancer Registry of Norway.

unchanged cost per prevalence, colorectal cancer increases most in terms of the share of estimated future costs, followed by prostate cancer (Figure 26).

The three sites with the lowest predicted change in five-year prevalence are cervix uteri, acute leukemia and lung cancer. The latter two both have a predicted increase of 13 percent. The predicted growth for cervix uteri is five percent. While acute leukemia and lung cancer are characterized by long length of stay, high share of inpatient activity, and high treatment costs per prevalence, cervical cancer occupies a middle position of the identified cancer sites in terms of treatment pattern and treatment costs. Of the three sites, it is lung cancer that is the largest in terms of estimated costs in 2007, followed by acute leukemia. Thus measured as the share of costs for all sites, it is lung cancer that decreases most. Breast cancer is the largest site in terms of costs in 2007. Since the prevalence of breast cancer is expected to increase less in relative terms than the overall cancer prevalence, the predicted cost share also decreases. With unchanged cost per prevalence, the prevalence predictions indicate that colorectal cancer will take over the position as the largest cancer site in terms of treatment costs in 2025.

Thus the characteristics both of the cancer sites expected to increase the most until 2025 and the sites with the the lowest predicted growth, differ in terms of treatment patterns and per prevalence costs.

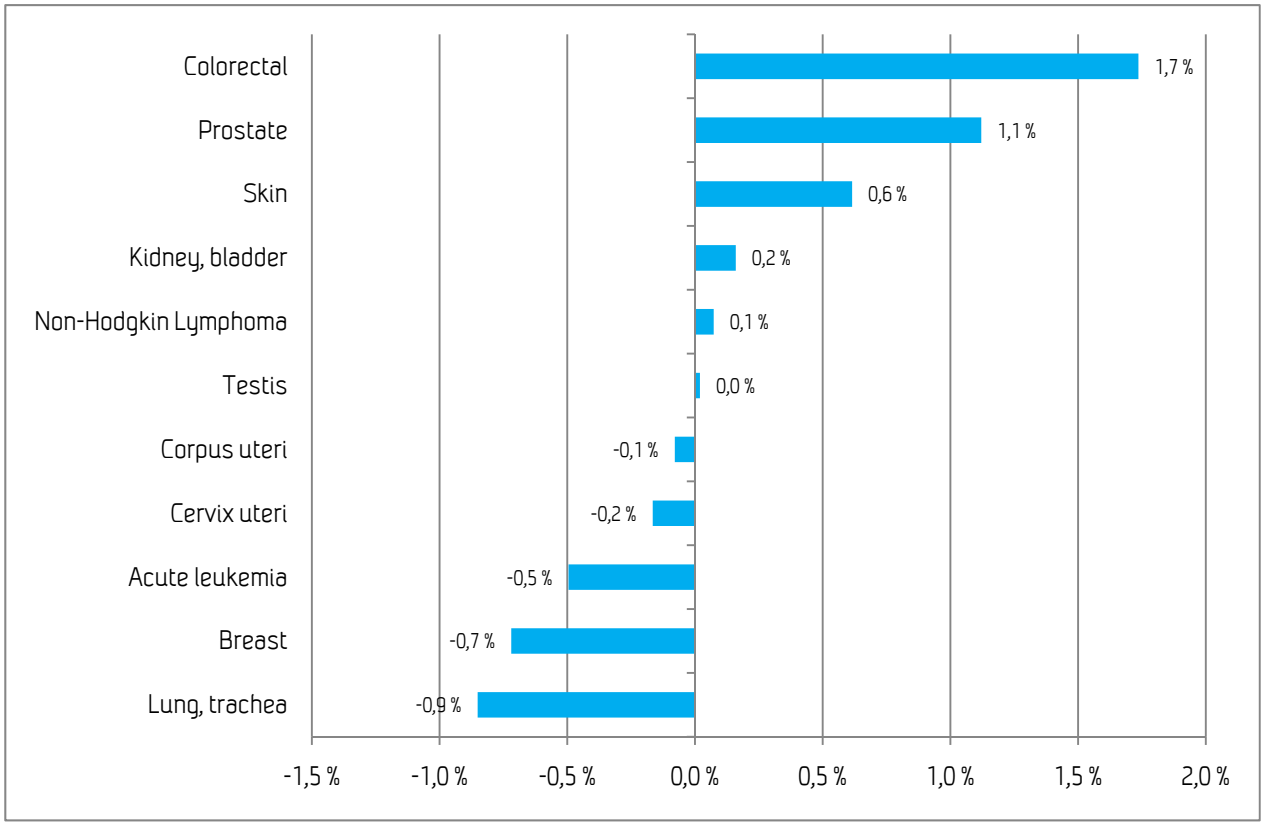

Figure 26 Change in predicted costs shares 2007-2025 by cancer site. Percentage points. Sum Nordic countries.

The predicted change in prevalence for cancer sites at the Nordic level does not reflect the predicted developments for each country.

6.2 Growth in prevalence and costs by country

Figure 27 shows the predicted percentage change in the five-year prevalence of cancer from 2007 til 2025 for each country. Iceland is predicted to face the highest percentage change in cancer prevalence (60 percent), followed by Norway with an increase of about 40 percent. The predicted increase for Finland, Sweden and Denmark is just below 30 percent. The five countries face a different growth in population size, with the highest growth expected to occur in Iceland and Norway. Thus the predicted increase in five-year prevalence per capita is smaller for all countries, from just below 20 percent in Sweden, to about 25 percent in Finland, Norway and Denmark and somewhat above 30 percent in Iceland.

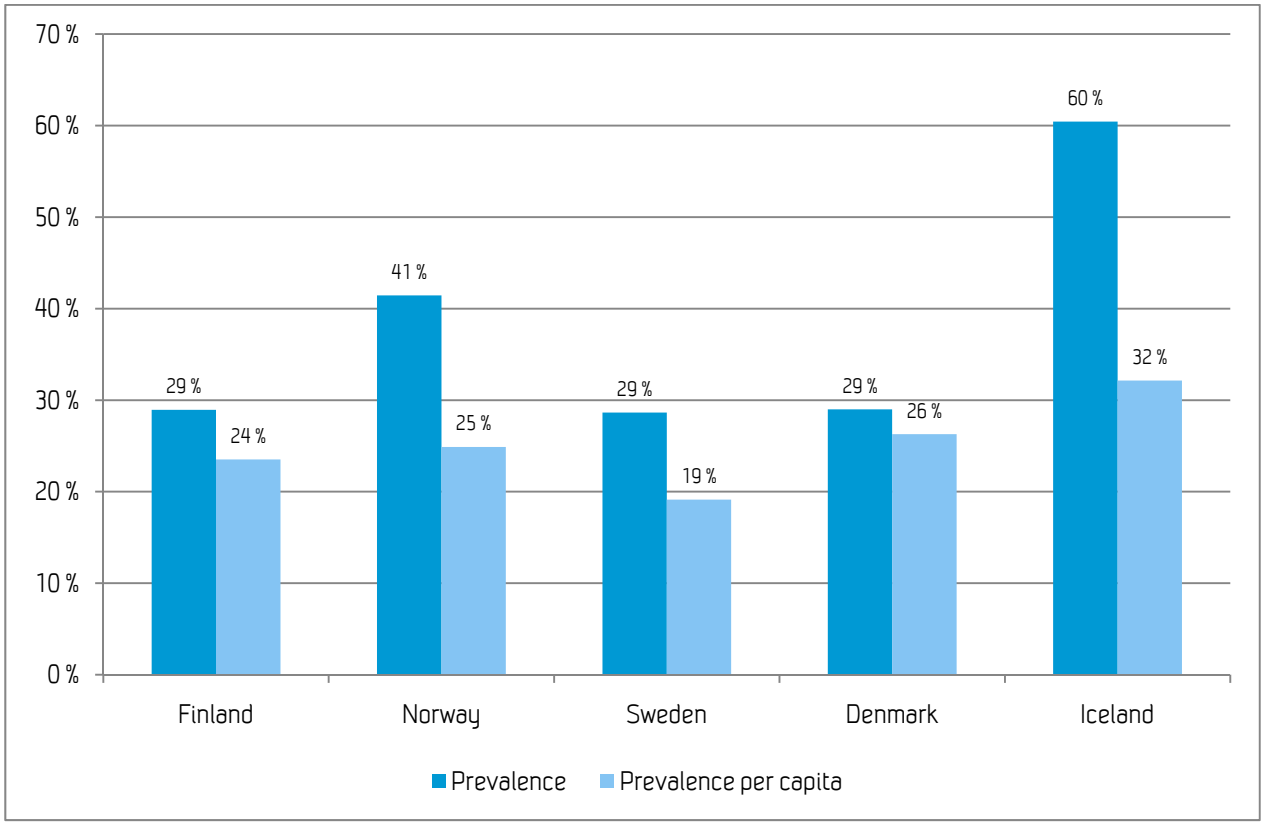

Figure 27 Percentage change in predicted five-year prevalence of cancer 2007-2025 by country. Absolute change and change in prevalence per capita.

Table 13 shows the estimates of treatment costs in 2025. The prediciton exploits the information on predicted five-year prevalence for the cancer sites in 2025 and the estimated site specific costs per five-year prevalence in 2007. Thus the estimates take into account different rates of growth in prevalence and different estimated cost per prevalence in 2007 for different diagnostic groups[47]. If the composition of prevalence on cancer sites is the same in 2025 as in 2007, the estimated growth in costs would mirror the growth in total prevalence. Thus the difference between the predicted growth in total prevalence and estimated growth in costs on cancer sites illustrates the effect of taking the change in prevalence distribution on cancer sites into account. Table 14 mirrors Table 13, however it also shows the *per capita* present and future costs.

[47] The 11 selected cancer sites do not cover all cancer diagnoses. A residual diagnostic group is constructed as the difference between prevalence for cancer in total and the sum of the 11 cancer sites.

Table 13 Estimated treatment costs 2007 and 2025[48]. Measured in million 2007-EUR. Nordic countries excl. Faroe Islands.

	Sum Nordic countries	Finland	Norway	Sweden	Denmark	Iceland
Estimated cost 2007	3 031	611	631	1 083	677	35
Estimated cost 2025, sum cancer sites*	3 892	743	866	1 395	835	53
Total growth prevalence	31.5 %	28.9 %	41.4 %	28.6 %	29.0 %	60.4 %
Total growth cost	28.2 %	21.6 %	37.4 %	28.8 %	23.4 %	52.9 %**
Yearly growth prevalence	1.5 %	1.4 %	1.9 %	1.4 %	1.4 %	2.7 %
Yearly growth cost	1.3 %	1.1 %	1.8 %	1.4 %	1.2 %	2.4 %**

* Sum five-year prevalence multiplied by cost per five-year prevalence 2007 over cancer sites
** Estimated, based on growth in costs with average Nordic costs on cancer sites both in 2007 and 2025, due to missing information on cost distribution on cancer sites in 2007

Table 14 Estimated treatment costs per capita 2007 and 2025[49]. Measured in 2007-EUR. Nordic countries excl. Faroe Islands.

	Sum Nordic countries	Finland	Norway	Sweden	Denmark	Iceland***
Estimated cost 2007	121	115	133	118	124	110
Estimated cost 2025, sum cancer sites*	145	134	161	141	149	139
Total growth prevalence	23.1 %	23.5 %	24.9 %	19.1 %	26.3 %	32.1 %
Total growth cost	19.7 %	16.5 %	21.3 %	19.3 %	20.8 %	25.9 %**
Yearly growth prevalence	1.2 %	1.2 %	1.2 %	1.0 %	1.3 %	1.6 %
Yearly growth cost	0.9 %	0.9 %	1.1 %	1.0 %	1.1 %	1.3 %**

* Sum five-year prevalence multiplied by cost per five-year prevalence 2007 over cancer sites
** Estimated, based on growth in costs with average Nordic costs on cancer sites both in 2007 and 2025, due to missing information on cost distribution on cancer sites in 2007

The estimated cost in 2025 at the Nordic level, based on information for each cancer site, is about 3.9 billion Euro (145 per capita), an 860 million Euro increase from 2007 in real terms.

Comparing the predicted growth in total cancer prevalence with estimated costs, indicates that Finland, Norway and Denmark will experience a less cost demanding cancer prevalence composition in 2025 than in 2007 (most so for Finland), whereas Sweden will not[50]. Correcting for cancer prevalence composition reduces the estimated growth in treatment cost from 29 (growth in total prevalence) to 22 percent for Finland. Using the estimated cost per prevalence for each of the diagnostic groups identified in the study, the estimated growth for Denmark and Norway is reduced from 29 to 23 percent and from 41 to 37 percent respectively, while for Sweden the estimated growth both in total prevalence and costs is 29 percent.

[48] The predicted prevalence of skin cancer in 2025 does not include non-melanoma. In order to have comparable cost estimates in 2025 and 2007 we have assumed an equal growth in non-melanoma as for melanoma of skin, and added this to the predicted prevalence for melanoma and for cancer in total. This causes a slightly different growth for cancer in total.

[49] The predicted prevalence of skin cancer in 2025 does not include non-melanoma. In order to have comparable cost estimates in 2025 and 2007 we have assumed an equal growth in non-melanoma as for melanoma of skin, and added this to the predicted prevalence for melanoma and for cancer in total. This causes a slightly different growth for cancer in total.

[50] The necessary estimates for cost per prevalence for cancer cites is not calculated for Iceland due to missing and incomplete data for cost distribution between cancer sites. However based on average costs for the Nordic countries also Iceland has a less cost demanding composition in 2025 than in 2007.

The estimated yearly growth rate for cancer costs varies from 1.1 percent for Finland to 1.8 in Norway (using Nordic average cost per prevalence, the yearly growth rate for Iceland would be 2.4). The etimated yearly growth rate in per capita costs varies from 0.9 percent for Finland to 1.1 for Norway and Denmark (using Nordic average costs per prevalece the yearly growth rate for per capita costs in Iceland would be 2.3).

How does our extrapolation of cancer-related costs compare to other projections? Based on a regression-model approach, Mäklin and Rissanen (2006) estimated an increase in health care costs related to cancer of nearly 40 percent for Finland between 2004 and 2015[51]. If we calculate the predicted yearly growth rate for the period 2004-2015 based on the cost projections suggested by Mäklin and Rissanen (ibid), we find that it is higher than our estimate (about three percent). The estimated growth in Mäklin and Rissanen (ibid) is also based on growth in five-year prevalence, which is assumed to increase by 35 percent. Thus differences in the predictions of growth in cancer prevalence explain much of the difference in prediction of growth rates for cancer related health care costs. Mäklin and Rissanen (2006) also present predictions based on expert evaluations. This gives a considarably higher estimate for growth in cancer-related health care costs, almost a doubling of real costs between 2004 and 2015, since a three percent annual increase in costs due to more expencive cancer treatments is added. In Hermanson et al. (2010) the results of the expert evaluation in Mäklin and Rissanen (2006) are projected onto 2020, which gives an eatimate of real costs of nearly 2.5 times the cost in 2004[52]. Engblom and Engblom (2003) estimate the cancer-related costs in Sweden for the year 2020. Hospital costs are assumed to double from 2002 to 2020, which gives an yearly growth of 3.9 percent. The projection is based on an asummption of a growth in real GDP of 40 percent in the period and an additional growth in health care cost (above the growth in GDP) of 40 percent[53]. Costs of cancer drugs are assumed to increase at three times the rate of hospital costs. Thus compared to previous estimates for Finland and Sweden our projection for treatment costs of cancer is on the low-side. This partly relates to lower estimates of growth in cancer prevalence, but also reflects the fact that we do not incorporate assumpitions of increases in treatement costs per prevalence.

It is difficult to anticipate future developments of cancer treatment and thus the related costs. Projections of the treatment cost of cancer based on predictions of future prevalence still provide a useful point of departure. Similar approaches are used for projection of future cancer-related health care costs in the US (Mariotto et al .2011) and England (Featherstone and Whitham 2010, Department of Health 2007). The predicted increase in the health care costs of cancer due to increasing cancer prevalence is 1.5 percent per year for England. This equals the predicted annual increase in five-year prevalence for the Nordic countries. The predicted yearly growth rate is about two percent for the US.

[51] We extract the costs of sickness benefits and disability pensions in Mäklin and Rissanen (2006).

[52] We have calculated estimates of growth in real costs based on a comparison of real and nominal cost estimates for 2015 in Mäklin and Rissanen (2006).

[53] The prevalence is assumed to increase by 50 percent in the period.

7 Discussion

7.1 Summary and discussion of results

Cancer imposes major burdens on patients and their families. It also incurs high costs on the societies at large. In 2007 more than 900 000 persons living in the Nordic countries had cancer or had previously been diagnosed with cancer. Of these, almost 390 000 persons had been diagnosed with cancer within the last five years. This number amounts to 1.5 percent of the total population of 25 million in the Nordic countries.

The Nordic countries share major similarities concerning the political system, the welfare system and the health care system. There is also a close collaboration between the Nordic countries both at the political level and also regarding the advances of cancer preventions and treatment through the Nordic Cancer Union (NCU), - a collaborative body for cancer societies in the Nordic countries. The collaboration of cancer registries through the Association of Nordic Cancer Registries (ANCR) has contributed to joint standardization of registration and classification and since 2000 the NORDCAN-project and -database has provided high-quality comparable data on cancer incidence, mortality and prevalence for the Nordic countries.

Information on cancer-related costs, both at large and by its components, will provide additional information for policy and planning purposes. This study aims at providing a systematic collection and comparison of costs for all the Nordic countries. This has not been an easy, straightforward task. Even though the Nordic countries share many similarities, there are also country differences in systems, data registration and data availabilities that pose major challenges and obstacles in preparing data for cross-country comparison. In our work we have put weight on the comparable aspect and strived to apply similar definitions and boundaries for the different types of data for all countries. As far as has been possible, costs related to cancer have been identified using information on primary diagnoses. This is in line with the methodology of general cost-of-illness (COI) studies (Heijink et al. 2006), applying a top-down method to prevent double counting of costs for different diseases due to co-morbidity. Data availability has also restricted the types of costs to include in the study. The main focus in the study is on health care costs. The study covers treatment costs, in terms of hospital treatment and costs of prescription drugs, and costs of screening programs for breast and cervical cancer. These are the health care costs included. Cancer also imposes economic burden in terms of sickness absenteeism and early retirements. In order to shed light on country differences in the public income loss compensation payments related to cancer, we have collected data on public expenditures on sickness benefits and disability pensions.

Even though the study can be placed in the area of cost description and as such is in the tradition of COI-studies (ibid), the study does not represent a traditional COI-study (Cooper and Rice 1976, Hodgson and Meiners 1982) in that we do not attempt to calculate indirect societal costs in terms of production loss due to morbidity and mortality associated with cancer. There is controversy regarding both the usefulness and appropriateness of COI-studies, especially as a tool for evaluation and priority-setting of government investments in preventive interventions (e.g. Shiell at al. 1987). Knowledge about cost-differences both between cancer sites and between countries might still be valuable and provide useful information for policy makers and other stakeholders, both when it comes to promoting interest and awareness about the economic burden imposed by cancer and by pointing to specific areas of attention (Corso et al 2004). This is especially the case when the observed cost differences are decomposed into different potential causal factors. The comparative approach is particularly useful in this account. Combined with predictions of future cancer prevalence, estimates of present treatment costs provide a good starting point for making predictions of future costs of cancer.

Results at the Nordic levels

The yearly treatment costs associated with cancer in the Nordic countries, including hospitals costs and costs of prescription drugs, is estimated to be 121 Euro per capita or 7 820 per five-year prevalence in 2007. Screening

programs for breast and cervical cancer add another nine Euro per capita to health care costs. The estimated cancer-related hospital costs amount to 8.3 percent of total hospital costs in the Nordic countries in 2007, as measured by the System of Health Accounts.

Prostate cancer is the most frequent type of cancer in the Nordic countries measured by five-year prevalence, constituting almost ¼ of the total number. This is followed by breast cancer (19 percent), and colorectal and skin cancer (both 12 percent). Treatment costs per prevalence differ between cancer sites. In terms of costs, breast cancer is the largest group followed by colorectal, prostate and lung cancer. Differences in costs per prevalence between cancer sites mainly reflect differences in the levels of treatment activity. The study reveals major site specific differences in terms of characteristics of hospital treatment (inpatient and outpatient activity) and the amount of medicine costs found outside hospitals in the form of drugs prescribed to cancer patients.

All Nordic countries have public schemes for income loss compensation payments in case of illness (ILCP). The size of public expenditures on sickness benefits and disability pensions amounted to 31 Euro per capita in the Nordic countries in 2007. The highest spending is found for breast cancer and colorectal cancer. However relative to the size of treatment costs, testis, cervix uteri and breast cancer are associated with the highest share of public spending on ILCP.

Country comparisons

Turning to the country comparisons, the results not only disclose differences in cost levels (per capita costs) but also indicate interesting underlying differences in prevalence, activity levels, treatment patterns and unit costs, as well as differences in screening policy and characteristics of national policy regarding income loss compensation payments.

The estimated per capita treatment costs is found to be highest in Norway, followed by Denmark, Sweden and Finland, and finally Iceland and the Faroe Islands with the lowest estimated treatment-related costs. If all other things were equal, except five-year prevalence rates on cancer sites (i.e. equal cost per prevalence), Denmark would have the highest per capita costs and Sweden and Iceland the lowest per capita costs[54],. Sweden has the highest raw five-year prevalence rate, but has a relatively high share for cancer sites with low estimated costs per prevalence.

Differences in activity levels and unit costs contribute to differences in costs per (standardized) prevalence, ie. correcting for the diagnostic prevalence-mix. Even though the per capita (weighted) hospital activity is relatively high in Denmark, the prevalence composition contributes to low standardized activity per prevalence. Sweden has the lowest measured activity per prevalence, even when the prevalence composition is taken into account. Finland has the highest activity level both measured per capita and per five-year prevalence. In Finland inpatient activity is found within hospitals and local health centers, both run by the municipalities. Inpatient activity in the health centers contributes to the high activity levels observed for Finland. To some extent the activity within health centers may be equivalent to activities found within nursing homes in the other Nordic countries, which is not included in the study. On the other hand it seems that the health centers to some degree also substitute for inpatient care in hospitals, and thus should be included in the cross-country comparison. Including half of the inpatient bed-days found within the health centers gives an activity level for Finland in line with Norway.

The higher per capita cost in Norway is mainly related to relatively high estimated unit costs (cost per (weighted) activity). High estimated unit costs are also found for Sweden. In addition Sweden has relatively long average length of hospital stays. Several factors may cause country differences in unit costs. For instance, a higher proportion of outpatient activity may be associated with lower costs. There has been a shift in hospital treatment from inpatient towards outpatient settings in recent years. The results of this study represent a snapshot of the situation in a single year and may reflect that the countries were in different stages in the process of substituting

[54] Prevalence rates are missing for the Faroe Island. Based on incidence rates, prevalence rates probably are low also in the Faroe Islands.

outpatient for inpatient care. Sweden and Norway are found to have a lower share of outpatient activity than for example Denmark. Different geography may restrict on the organization of hospital treatment. The use of patient hotels reduces the need for hospital beds, but geography may nevertheless inflict additional costs for countries with low population density and a scattered settlement pattern. We find however the lowest unit costs for Finland. Low health care costs and highly cost-effective hospital activities in Finland are also found in other Nordic studies on hospital costs in general. In Norway the results in Kittelsen et al. (2009) were met with great interest and have initiated an on-going follow-up study focusing on differences in hospital strucure and organisation among the four largest Nordic countries.

Drug treatment may be supplied both within a hospital setting and outside hospitals. In the first case the costs are included in hospital costs, while the latter are identified as prescription drugs. Even though differences in costs of cancer drugs are difficult to compare, since the available data gives unequal opportunities to identify cancer patients and since the price levels vary between countries[55], the results point to interesting differences among the Nordic countries related to the organization and financing of drug treatment. Denmark differs from the other Nordic countries in that the cost of cancer drug treatment is included in hospital costs, whereas in Norway, Sweden and Finland 15-18 percent of the estimated treatment costs are for prescription drug[56]. The use of cancer drugs has increased rapidly in recent years and is making up an increasing share of cancer costs (Wilking et al 2009). Organization of and payment systems for drug treatment and price-setting regimes are therefore important factors in determining both the level and growth of the treatment costs of cancer. Separate financing of drugs outside hospital budgets may induce cost shifting and fewer incentives for cost containment in prescribing cancer drugs. On the other hand tight hospital budgets and fixed reimbursement rates for hospital treatment may represent a barrier to the introduction of new expensive cancer drugs and limit patient access. Separate payment systems for cancer drugs can improve access to new cancer therapy (ibid). However it may have the opposite effect if approval schemes for new drugs are stricter for prescription drugs than for use in hospitals. In addition, centralized purchase organizations and maximal price-regimes for medicine may contribute to lower drug costs (Ministeriet for Sundhed of Forebyggelse 2009b).

The data collected for screening programs for breast and cervical cancer also reveal significant country differences in screening activities and costs reflecting differences in screening policies. Unfortunately data for Denmark was not readily available. Sweden and Iceland have the highest screening levels for breast cancer, 80-50 percent above Finland and Norway. The Faroe Islands does not have a screening program for breast cancer. The country differences in screening rates are considerably larger for cervical cancer. Iceland has highest rates, while Finland has very low rates. Finland and Sweden have much higher estimated costs of screening for breast cancer than for cervical cancer. Norway, on the other hand has similar estimated costs for the two screening programs.

There are also considerable country differences in the estimated public expenditures on ILCP related to cancer. Norway has the highest public expenditures on sickness benefits and disability pensions, which can be related both to high number of refunded sickness days and disability pensions and also to high compensation levels. Iceland on the other hand has low public expenditure levels, reflecting a reliance on the mandatory insurance scheme administered by the labor unions[57]. In Sweden most of the income compensation payments are on sickness benefits, whereas payments for disability pensions constitute a smaller share. This reflects the unrestricted time-period for being in sick-leave that was in place until year 2007. From 2008 a one-year time-limit was introduced, however still with possibilities for extensions. Hence, for patient-groups where the prognosis is uncertain, patients had the possibility to continue claim sickness benefits over several years. Unfortunately public expenditures on ILCP by diagnosis are not available for Denmark.

[55] A detailed description on data for prescription drugs is given in the appendix I.A.1.a)(1)A.1.3 .

[56] Including other medicines than cancer drugs.

[57] The expenditures of the insurance schemes are not included in the study.

Future prevalence and cost

Cancer incidence and prevalence are expected to rise in the years to come. Based on predictions performed by the Cancer Registry of Norway (Rahimi et al. 2010), the five-year prevalence is expected to increase to 470 000, amounting to 1.9 percent of the population, in the year 2025, compared to 1.5 percent in 2007. This equals a yearly growth rate of 1.5 percent. Assuming constant treatment costs per prevalence for each cancer site, the treatment costs of cancer in 2025 will be 28 percent higher in real terms than in 2007 due to the increase in cancer prevalence (yearly rate of 1.3 percent).

The expected trend is for cancer sites with relatively low costs per prevalence to increase the most, and thus the growth in treatment-related costs of cancer will increase less than the predicted growth in the raw prevalence rate (given unchanged cost per prevalence for each cancer site). Of the 11 cancer sites we have identified in the study, the five-year prevalence at the Nordic level is predicted to increase most for skin, colorectal and prostate cancer. Skin and prostate cancer are characterized by low treatment costs per prevalence and a high share of outpatient activity. Cervix uteri, acute leukemia and lung cancer are predicted to increase the least. Acute leukemia and lung cancer are characterized by long lengths of stay, high shares of inpatient activity and high treatment costs per prevalence. Unequal growth of cancer sites implies that the distribution of total costs for sites will alter. With unchanged cost patterns, colorectal cancer is predicted to increase its share of total treatment costs the most. Lung and breast cancer on the other hand are predicted to take up a smaller share of the total treatment costs of cancer. Applying these assumptions, colorectal cancer will pass breast cancer as the largest site in terms of treatment costs at the Nordic level.

Except for Norway and Iceland, the predicted growth in five-year prevalence of cancer for sites is close to 30 percent[58]. Higher growth in Norway and Iceland is (partly) related to higher population growth. The predicted per capita growth in cancer prevalence is lowest for Sweden, relatively similar for Finland, Norway and Denmark and highest for Iceland. Comparing the predicted growth in five-year prevalence over all cancer diagnoses to the estimated growth in the sum of treatment costs for cancer sites, indicates that for all countries, except Sweden, the predicted prevalence growth is on average highest for sites with relatively low cost per prevalence in 2007.

The country-specific estimated yearly growth rate for treatment costs of cancer is in the range of 1.1-2.4 percent. The prevalence-related cancer cost is predicted to grow at a higher rate than the population size.The range of annual growth in per capita costs is 0.9-1.3 percent. The estimates of yearly growth per capita indicate the necessary yearly growth in per capita gross domestic product in order to finance the projected increase in cancer-related costs *due to increasing cancer prevalence* in the Nordic countries.

To maintain specific cancer site per prevalence costs, the average yearly growth in cancer-related costs of 1.3 percent until 2025 for the Nordic countries is below the average growth in real-GDP of 3.4 percent experienced in the ten-year period before 2007. It is also below average annual growth rates during the years 2001-2010 (1.7 percent), which includes the economic resession from 2008[59]. The estimated yearly growth rate of cancer-related costs due to increasing prevalence is also below a OECD estimate for the yearly growth of GDP until 2025 (1.6-1.8 percent) for the Euro-area (Hervé et al. 2008). The projected yearly GDP growth rate is higher in the first ten years of this period (1.9-2.1 percent until 2015 and 1.4-1.6 percent in the years 2016-2025). Statistics Norway has projected the need for personnel in somatic specialized health care (hospitals) in 2025 to be about 1.3 times the number employed in 2007 (assuming the reference scenario whereby the number of treatments per person in age cohorts and the personnel needed per treatment is held unchanged) (Holmøy and Nielsen 2008). The estimated need for real cancer-related costs applying similar assumptions is projected to be 1.37 times higher in 2025. Thus our estimate for Norway is in line with other projections for general hospital growth in the same period.

[58] Excluding the Faroe Islands.

[59] Source: OECD Economic Outlook No. 88 Annex Tables - Table of Contents. http://www.oecd.org/document/61/0,3343,en_2649_34573_2483901_1_1_1_1,00.html

The predictions of future costs are solely based on predictions of future prevalence, and do not take into account innovations in medicine, technologies and cancer drugs which may influence investments in equipment, diagnostic tools, surgical procedures, treatment approaches and the organization of cancer treatment - all which can affect treatment costs. Some of the innovations may contribute to reduce costs due to more efficient treatment approaches with shorter stays and the substitution of outpatient and primary care activity for traditional hospitalization. On the other hand, new and more advanced treatment may come at a cost of more expensive equipment and medicines. However the sharp increase in costs of cancer drugs experienced during the last decade has already slowed down, at least in Sweden, and the yearly growth rate is expected to be much lower in the future (Jönson and Wilking 2010). New innovations may also contribute to increasing costs if they lead to new indications and lowering of thresholds for treatment, or if they increase the length and intensity of treatment along the patient pathway.

Our projections give lower future annual growth rates for cancer-related costs than previous Nordic studies (Finland: Mäklin and Rissanen (2006), Hermanson et al. (2010), Sweden: Engblom and Englom (2003), Cancerfonden (2006)). This is partly because our study is based on a lower predicted increase in cancer prevalence than the previous studies. However some of the differences are related to assumptions of rising costs of cancer treatments in the future. For instance, the prognosis based on expert opinions in Finland added three percent to the annual growth rate due to more expencive cancer treatments (Mäklin and Rissanen, 2006).

The effect of increases in cost per prevalence can be illustrated by applying different assumptions on price-additions to the yearly per capita growth rate. If we add a 0.5 percent annual increase in costs per capita the annual growth rate would still be equal to or lower the OECD-estimate of GDP-growth for the Euro-area (Hervé et al. 2008). This would give an *additional* nine percent increase in the treatment-related per capita costs of cancer in the period 2007-2025. The increase in cancer costs at the Nordic level would amount to 40 percent compared to 28 percent when only the increase in prevalence is taken into account. An even higher yearly increase in cost per capita would imply that the treatment costs would make up a steadily increasing share of GDP. An additional 1.5 percent yearly increase in per capita costs would give an *additional* 30 percent increase in per capita costs for the period, or a 70 percent increase in cancer costs at the Nordic level. Adding a three percent annual price increase would give an *additional* 70 percent increase in costs per capita. The projected treatment-related cost of cancer would then more than double from 2007 to 2025.

It is difficult to anticipate future developments of cancer treatment and related costs. Projections of treatment costs of cancer based on predictions of future prevalence still provide a useful point of departure. The rising costs of cancer treatment raise important questions concerning how to address future challenges; including the question of sustainable growth, efficient use of available resources, advances in cancer prevention and treatment, and the impact of financial mechanisms. The cross-country comparisons among Nordic countries point to some interesting differences and areas where potential gains can be made.

7.2 Limitations

This study of cancer-related costs covers costs of hospital treatment, prescription drugs, screening programs for breast and cervical cancer, and public expenditures related to sickness absenteeism and early retirement. The estimates are likely to be on the low side since the study has not been able to include additional health care costs in terms of long term care and primary care expenditures. The study has not aimed at estimating the indirect costs of productivity loss due to illness and mortality, only the public expenditures on income loss compensation payment.

In the calculation of estimates at the Nordic level, missing data on screening programs and public expenditures on sickness benefits and disability pensions for Denmark made it necessary to estimate these costs and expenditures based on the assumption that Denmark has the same average cost and expenditure-level per five-year prevalence as the other Nordic countries. Denmark represents 20 percent of the total five-year prevalence in

the Nordic countries. Hence, even in the case that the Danish estimates deviated by a large amount from the true costs/expenditures this would only give minor errors in the total estimate for the Nordic countries[60].

In estimating hospital costs, primary diagnoses are used to identify cancer related activity and costs. Cancer-related costs may also be found for discharges and visits with primary diagnoses other than cancer, where cancer is secondary diagnosis[61]. A recent calculation of hospital costs for cancer patients including costs related to secondary diagnoses in Denmark, gives an estimate of cost that suggest that cancer *patients* account for ¼ of total production value in general hospitals (Indenrigs- og Sundhedsministeriet 2010). Including cancer as secondary diagnosis is problematic both because of the possibility of difference practices involved in setting secondary diagnoses, but also since we would probably significantly over-estimate costs because of double-counting associated with co-morbidity, especially among older patients. Ignoring co-morbidity may lead to under-estimation of costs.

In the analysis of expenditure differences we have used five-year prevalence to approximate the number of cancer patients. The choice of five year-prevalence instead of, for instance, one-year prevalence has consequences for the estimated relative treatment costs per prevalence for the Nordic countries, since the ranking of countries in terms of prevalence rates differs for the two measures[62]. The choice of prevalence rate especially affects the relative results for Denmark, which has an *average* (Nordic) five-year prevalence rate, but clearly the *highest* (nine percent above the total Nordic rate) one-year prevalence rate. Another example is Sweden which has the highest five-year prevalence rate (five percent above the total Nordic rate), but close to an average one-year prevalence rate. The high (raw) five-year prevalence rate for Sweden is related to the age-composition of the population, with a high share of elderly. The prevalence measure that comes close to the actual time pattern for cancer treatment may differ between cancer diagnoses and between countries, depending on the progress of the illness, the treatment regime and the efficiency of the health care system in early detection and cancer treatment. A recent study (Coleman et al. 2010) shows persistent differences in cancer survival rates between Sweden, Norway and Denmark in the period 1994-2007. Survival rates were highest in Sweden, somewhat lower in Norway, and lowest in Denmark. Since the diagnostic case-mix also differs between the one-year and five-year prevalence, the choice of prevalence measure has less consequences for the estimated country differences in cost per prevalence when the estimates are corrected for the composition of prevalence on cancer sites.

The national, relative treatment costs found in this study are in line with corresponding estimates in a previous study by Kittelsen et al. (2009), with the exception that the estimated total per capita costs for Finland were considerably lower than the other countries in their study. The estimated cancer costs for Finland compared to the other countries may be too high. First, our method of estimating costs tied to prescription drugs may include drugs for cancer patients not related to the cancer illness. Secondly, the inpatient activity found within health centers, which is included in the data for Finland, may to some extent represent a grey zone towards long term care. Long term care is not included in this study because of data limitations in identifying cancer patients. The amount of costs for long term care is therefore unknown, which also implies that we cannot assess how an inclusion of long term care costs would affect the estimates of costs per capita.

The results tell us that there is a relatively high share of inpatient treatment activity in Norway, and a relatively high share of outpatient treatment activity for Denmark. This is also in line with what has been observed for hospital treatment in general in Kittelsen et al. (2009). The activity numbers and composition in Sweden display yet another pattern, having a relatively low share of day and outpatient activity for cancer patients. This was not the case for general hospital activity in Sweden (ibid), where there was a very high rate for day patient and outpatient activity compared to Norway. Whether this reflects measurement errors or the fact that cancer treatments differ a lot from the total hospital activity pattern is difficult to assess.

[60] E.g. a 20 percent deviation would give a four percent measurement error for the actual cost type.

[61] z- procedure code (Z510 Radiotherapy session, Z511 Chemotherapy session for neoplasm, Z515 Palliative care) as the main diagnosis where there is a cancer diagnosis as a secondary diagnosis is however included.

[62] Costs are estimated independent of data on cancer prevalence.

Inspection of the data for the four largest cancer sites (in term of estimated costs, i.e. breast, colorectal, prostate and lung), shows a consistent *ranking* of the sites in the four largest countries in relation to costs and activity per five-year prevalence; treatment pattern (share of outpatient visits); share of prescription drugs of total treatment costs; and the level of public expenditures on sickness benefits and disability pensions compared to treatment costs (although the levels may vary to some degree). Thus, even though some results probably partly reflect country differences in data accessibility and available estimates of unit costs, the overall impression is that the data gives a relatively consistent pattern for cancer sites.

Meta-studies of cancer costs which compare the findings of different national case-studies are in general problematic since the results inevitably will reflect differences in estimation approaches, methods, and data applied in the studies. This is a critique that often faces cost of illness studies in general. The results in the present study will therefore deviate from previously published estimates for the Nordic countries and with estimates for other countries (e.g. Cancerfonden 2006, Mäklin and Rissanen 2006, Wilking et al. 2009). The major advantage of our study in comparing cancer costs between the Nordic countries is that a common methodological approach is applied for all six countries. Differences between countries in data accessibility and in the possibility of identifying cancer patients in some of the data sources represent a limitation in the cross-country comparisons of cost levels. Nonetheless, we still believe that these results present a good picture of the cost levels across the Nordic countries and that the decomposition provides further insights into the causes of the observed differences.

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A Appendix

A.1 Cost and activity data

A.1.1 Inpatients and day patients

Organisation					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Hospitals, responsibility of the municipalities/regional health authorities	Hospitals, responsibility of the state regional health authorities	Hospitals, responsibility of the county councils.	Hospitals, responsibility of the 5 regions	Landspitali University Hospital (LUH) and Region Hospital of Akureyri (RHA), responsibility of the state health authorities	Hospitals. Large part of cancer treatment of Faroese patients is made in Danish hospitals. Faroese patients treated in places other than Denmark are not included in the data.
Activity data					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Source: Finnish Hospital Discharge Register **DRG-grouper**: Common Nordic DRG 2009 (Full). **Identification of cancer patients:** ICD-10 codes	**Source**: Norwegian Patient Register **DRG-groper**: Norwegian, yearly **Identification of cancer patients:** ICD-10 codes	**Source**: National Patient Register, The National Board of Health and Welfare **DRG-groper**: Swedish grouper for 2006 Full **Identification of cancer patients:** ICD-10 codes	**Source**: National Patient Register **DRG-groper**: Danish, yearly **Identification of cancer patients**: ICD-10 codes	**Source**: Patient Registers from LUH and RHA **DRG-grouper**: NorDRG-Ice **Identification of cancer patients:** Inpatients: ICD-10 codes in all inpatient units. Day care patients: Special day care unit for strictly cancer patients. ICD-10 classification/ coding is not reliable in the day unit. Missing patients treated abroad.	**Source**: Faroese Patient Register and Danish Patient Register **Identification of cancer patients**: ICD-10 Codes.
Costs					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Costs are calculated using the DRG cost-weights and unit price based on calculations of CHESS on hospital discharges. Includes outlier and capital costs but excludes user charges. User charges (4 %) added, and capital costs (5 %) subtracted.	Costs are calculated using the DRG cost-weights. Unit price is calculated on the basis of total cost per DRG-point (excl. capital costs) for Norwegian hospitals, corrected for cost of research (SAMDATA-database).	Costs are calculated using the DRG cost-weight. Unit price is calculated based on real data from the Cost Per Patient database ex. outlier costs and patient fees. Outlier costs (20.7 %) and patient fees (80 SEK per hospital day) are added. Capital costs (1 %) are subtracted.	Costs are calculated using the DRG cost-weights and unit price Cost-weights are based on costs in most of the Danish public hospitals – in 2007 27-43 hospitals. Unit costs are based on trimmed data (both very high and very low costs excluded). Capital costs not included. Outlier costs (long stays) added based on the price paid and number of days per cancer group.	**Cost:** LUH: Cost based on national DRG weights and local cost per unit. RHA: Cost based on national DRG weights and local cost per unit, does not include cost of cancer drugs. Costs include outlier cost, and exclude capital costs. Includes cancer drugs at day care unit financed by the Social Security. Cost of patients treated abroad is added (6 % of inpatient costs).	Cost estimated based on average Danish cost per bed-day.
Comments					
Generally: Rehabilitation outside hospitals that is not DRG-grouped is not included. A common definition of unit costs is applied, including outlier costs. Costs to education and research are excluded if identified. For some countries estimates of outlier costs and capital costs are added to previous estimates of unit costs. Differences in calculation methods may contribute to differences in estimated unit costs. The registration of patients as day patient or outpatient varies between the countries. This has to do with differences in organization, financing and data systems (groupers).					

A.1.2 Outpatients

Organisation					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Hospitals, responsibility of the municipalities/regional health authorities	Hospitals, responsibility of the state regional health authorities	Hospitals, responsibility of the county councils.	Hospitals, responsibility of the 5 regions	Landspitali University Hospital(LUH)	Large part of cancer treatment of Faroese patient is made in Danish hospitals.
Activity data					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Source: Finnish Hospital Bench-marking Project **DRG-grouper**: Finnish NordDRG 2009 Full **Identification of cancer patients**: ICD-10 codes	**Source**: Norwegian Patient Register **DRG-groper**: No **Identification of cancer patients**: ICD-10 codes	**Source**: National Patient Register, The National Board of Health and Welfare. **DRG-groper**: Swedish grouper for 2006 Full **Identification of cancer patients**: ICD-10 codes. The amount of missing data was 22% in 2007. Visits for all cancer sites are increased by 22 %.	**Source**: National Patient Register **DRG-groper**: Danish, yearly **Identification of cancer patients**: ICD-10 codes	**Source**: Patient Registers from LUH and RHA **DRG-grouper**: NorDRG-Ice **Identification of cancer patients**: Special outpatient unit for cancer patients (dedicated to cancer treatment). ICD-10 classification/coding is not reliable in the unit. Other outpatient units and home care visits at LUH and RHA: ICD-10 codes. Some underestimation for other outpatients units as ICD-10 coding is not sufficient.	Includes only outpatient activity at Danish hospitals. Data for outpatient treatment in the Faroe Islands is missing.
Costs					
Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Costs are calculated using the DRG cost-weights and unit price for the national weights of 2008 Full Finnish DRG. Weights calculated by Finnish Consulting Group (FCG). Discharges. Capital costs (5 %) are subtracted. User charges (4 %) and outlier costs (18.9 %) added.	Costs are calculated using the outpatient reimbursement (based on codes in the patient data file), including patients co-payment. 50% cost-coverage is assumed, i.e. to calculate cost the reimbursement is multiplied by 2.. Radiotherapy is estimated based on activity for 2008 is added.	Costs are calculated using the DRG cost-weights. Unit price is calculated based on real data from the Cost Per Patient database ex. outlier costs and patient fees. Outlier costs (20.7 %) and patient fees (300 SEK per visit) are added. Capital costs (1 %) are suntracted. Costs for all cancer sites are increased by 22 % due to missing activity data.	Costs are calculated using the DRG cost-weights and unit price Cost-weights are based on costs, exclusive capital costs, in most of the Danish public hospitals – in 2007 27-43 hospitals.	Cost: LUH: Cost from Case Costing System for all visits. Does not include cost of cancer drugs. RHA: Cost based on national DRG weights and local unit price, does not include cost of cancer drugs. Data on treatments and cost in radiotherapy was not registered in 2007 so data from 2006 was used for 2007 (corr for inflation). Data only from LUH.	Costs estimated based on average Danish cost per visit.
Comments					
Generally: A common definition of unit costs is applied, including outlier costs. Costs to education and research are excluded if identified. For some countries estimates of outlier costs and capital costs are added to previous estimates of unit costs. Differences in calculation methods may contribute to differences in estimated unit costs. The registration of patients as day patient or outpatient varies to some extent between the six countries. This has to do with differences in organization, financing and data systems (groupers).					

A.1.3 Prescription drugs – medication outside hospitals

Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
Source: Finnish National Insurance Institution **Identification of cancer patients:** ICD-10, cancer patients identified via medication reimbursement decisions. Patients having cancer in active stage is defined by restricting patients to those who received their reimbursement decision within five years prior to the year of interest.	**Source**: Norwegian prescription database. **Identification of cancer patients:** Reference point 9= cancer/malignant tumors, i.e. lacking information for specific diagnosis groups. Estimates for specific cancer sites based on cost share for the first half of 2009 (when data on ICD-10 codes exists).	**Source**: Swedish prescription database. **Identification of cancer patients:** Cancer patients have been identified from the Cancer register, and then matched with data of prescribed medication. Just the prescribed medicines that where prescribed up to 3 months after each cancer diagnosed visit as an in-/outpatient is included.	**Source**: Register of Medicinal Product Statistics. **Identification of cancer patients**: no diagnosis, only overall numbers by each ATC. ATC-group L01-03 used to estimate costs for cancer patients. Most cancer medicines given in hospitals.	**Source:** LUH pharmacy database **Identification of cancer patients:** ATC-group L01-03 drugs prescribed by doctors with the oncology speciality. Most cancer medicines are given in hospitals.	**Source**: Faroese Pharmacy Database. **Identification of cancer patients**: no diagnosis, only overall numbers by each ATC. ATC-group L01-03 used to estimate costs for cancer patients.
Costs					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Expenditures based on Pharmacy retail price.	Expenditures based on Pharmacy retail price	Expenditures based on Pharmacy retail price	Expenditures based on Pharmacy retail price for ATC-group L01-03	Expenditures based on Pharmacy retail price for ATC-group L01-03	Expenditures based on Pharmacy retail price for ATC-group L01-03
Comments					

Generally:

The methods of identifying costs for cancer patients varies and may overestimate costs for some countries (especially Finland) and underestimate costs for others. For the Faroe Islands (and Denmark) prescription drugs for cancer patients are equated with the total prescription sales of ATC-group L01 (Antineoplastic agents- cancer chemotherapy drugs, cytotoxic drugs), L02 (Endocrine therapy-hormone therapy) and 20 percent of L03 (Immonustimulants). This may exclude other medicine given to cancer patients, but may also cover medicine given to patients without cancer. For Finland medicine costs of cancer patients are estimated by first identifying patients with cancer[63] and then identifying prescription drug costs for these individuals. This procedure may imply also including medicine given to patients diagnosed with cancer but that is not taken because of the cancer diagnosis. The same type of procedure is applied for Sweden, however retraining the data to those receiving prescription drugs up to 3 months after each cancer diagnosed visit as an in-/outpatient. The Swedish expenditures still amount to more than the cost of only the L-group. For Norway medicine costs for cancer patients are identified by a specific code for cancer in the prescription drug register. The data for Sweden and Finland cover a lower share for the L-group of the cost estimate for medication costs for cancer patients (55-60 percent) than the Norwegian data (near 90 percent). Based on statistics on total sales for L-group 01 and 02 for Finland and Norway, the share for prescription drugs of total sales (including sales to hospitals) are relatively similar for Finland and Norway (about 20-30 % for L01 and almost100 % for L02).

Country differences in the share of prescription drugs may also be related to differences in the relative cost/price levels for prescription drugs and hospital treatment. Our cost estimates are based on pharmacy retail prices. Differences in retail prices may reflect differences in wholesale price, discounts, pharmacy gross margins and taxes (VAT). Price indices for list prices for medicine in general (Legemiddelforeningen 2007) show higher prices for Denmark (16 percent) and Sweden (7 percent) than for Norway and Finland (1 percent above Norway). However low discounts in Sweden contribute to eliminate the price differences in negotiated prices between Sweden and Denmark (Ministeriet for Sundhed of Forebyggelse 2009b). Low prices for Norway may be attributed a centralized purchase organization and the regime of maximal prices on medicine (ibid). Analyses of differences in sales prices excluding VAT show that the price level for medicines is about 10 percent higher in Sweden and Denmark and more than 20 percent higher in Finland compared to Norway (Apotekerforeningen 2009, Brekke et al. 2008). The higher prices in Finland are related to higher profit margins (Apotekerforeningen 2009). However the lower VAT on medicines in Finland (8 percent) compared to Norway and Denmark (both 25 percent) eliminates most of the price differences. The study of list prices of selected medicine in Ministeriet for Sundhed of Forebyggelse (2009b) indicates minor price differences between Norway and Denmark for selected medicine in the L01 group. Taken together the information indicates that there are probably minor errors due to price differences in the comparison between Denmark, Norway and Finland. However the costs for Sweden are probably underestimated because there is no VAT on prescription drugs in Sweden. Different VAT will also affect non-labor costs for hospitals. Since we do not have information of price differences on cancer medicine, only medicine in total, we have chosen not to correct the data for prescription drugs for possible price differences.

[63] Persons having a reimbursement decision related to cancer within the last five years (Finland).

A.1.4 Screening for breast cancer and cervical cancer

Organisation					
Finland	**Norway**	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Breast cancer: Women aged 50-59 (from 2004 onwards the age groups has been started to be expanded to 60-69 year olds) are invited to the screening every second year. **Cervical cancer**: Women aged 30-60 are invited to the screening every fifth year.	**Breast cancer**: Women aged 50-69 years is invited to participate every second year. **Cervical cancer**: Main target group is women aged 25-69 years, every third year.	**Breast cancer:** Women age 40-74, 18 months interval below age of 55, 2 years interval between age 55 and 74. **Cervical cancer**: Women, age 23-50 (3 year interval), age 51-60 (5 year interval)	**Breast cancer:** Women age 50-69, every second year. **Cervical cancer**: Women, age 23-49 (3 year interval), age 50-65 (5 year interval)	**Breast cancer**: Women at age 40 to 69 are invited to such screening every second year. **Cervical cancer**: Women age 20 to 69 are invited every second year prior to 2009. From 2009: Women age 20 to 39 are invited every second year, women age 40-69 every second – fourth year	**Breast cancer**: No screening program for breast cancer. **Cervical cancer**: Main target group is women aged 25-60 years, every third year.
Activity data					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Source: Finnish Cancer Register **Breast cancer**: Number of women screened during the year of interest. **Cervical cancer**: Number of women screened during the year of interest.	**Source**: Cancer Registry of Norway. **Breast cancer**: Estimate based on the number of invitations per year and turnout (Hofvind m fl 2008). **Cervical cancer**: Number of tests performed each year (Johansen m fl 2009)	**Source**: **Breast cancer**: Based on estimates for 2002 in Lidgren et al (2007) **Cervical cancer**: Based on estimates for 2006 in Bistoletti & Sennfält (2008)	Data missing	**Source**: Icelandic cancer registry **Breast cancer**: Number of women screened each year. **Cervical cancer**: Number of examination performed each year.	
Costs (se comments)					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Unit cost is based on the price information of laboratory and radiology units who produce laboratory and radiology services to the university hospitals. **Breast cancer**: The unit cost represents an average price which includes costs related to the personnel, equipments etc. **Cervical cancer**: The unit cost includes only the laboratory cost, not the cost related to the moment when the sample is taken.	**Breast cancer**: Unit costs based on estimates of direct costs in Zaman (2010). **Cervical cancer:** Unit cost **b**ased on estimates of direct costs in a report on economical evaluation of HPV-vaccination (Neilson and Freiesleben de Blasio, 2007).	**Breast cancer**: Based on estimates for 2002 in Lidgren et al (2007) **Cervical cancer**: Based on estimates for 2006 in Bistoletti & Sennfält (2008)	Data missing	Total operational cost for the screening unit of the Icelandic cancer society.	Unit cost of **cervical cancer** is based on estimated direct cost per GP-consultation
Comments					
Generally: Due to different methods of calculating unit costs, average unit costs based on national estimates (Norway (96) and Iceland (75) for breast cancer (the national estimates for Finland (127) and Sweden (34) was very deviant), and Finland (43), Norway (48), Sweden (43) and Iceland (48) for cervical cancer) are used to calculate screening costs for all countries. The estimate captures direct health care costs of performing the screenings. The average unit costs (breast cancer=94 and cervical cancer=45) is close to the national estimates for Norway which includes: **Breast cancer** (based on estimates of direct costs in a Master thesis)= Cost of mammography (=(Out of pocket payment+fixed unit price*standard weight for mammography)*100/40 (assuming 40% cost coverage) + Cost of recall examination (added for 3.4 percent of the screenings) (=(Cost of mammography+cost of ultrasound+cost of biopsy) **Cervical cancer**: (Based on estimates of direct costs in a report on economical evaluation of HPV-vaccination)= Cost of cytology-test (=GP visit + Pap-smear testing procedure + consumable items + path/lab processing) +Cost of HPV-test (added for 1.6 percent of the tests) (=(Outpatient Tariff plus patient co-payment per visit)					

A.1.5 Sickness absenteeism

Organisation					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Rules: All people aged 16-67 are eligible to receive a sickness benefit if they have been working, studying etc. 3 months prior to the disability to work. National Insurance Institution starts paying sickness benefit after 10 days of absence (1 day if the same disease renews within 30 days). Maximal time for payment is 300 working days (working day=Monday-Saturday).	**Rules**: Self certified absence is 3 days (8 days if the firm is a so-called IA-firm, i.e. firm signed the agreement on inclusive working life). The employers pay for the first 16 days. The national insurance covers max 52 weeks total. The basis for sickness allowance is max 6G, i.e. 6 times the base amount of the national security system (1G=66812 NOK in 2007). The employer may cover the wage gap.	**Rules**: All citizens are entitled to receive a sickness benefit from the Social Insurance system for maximum of 364 days during a 15-month period. There also exists some minor add-on insurance paid by employers as specific agreements. The period can be extended in certain cases. The employer pay the first 14 days and there is "a waiting period" (*karensdag*) of one day. Except for your first day away from work, sick leave pay in Sweden typically amounts to 80 percent of your salary. For longer sickness periods (>14 days) there is a requirement to obtain a certificate from a doctor.	Not included. Cannot identify cancer patients in the national data.	**Rules:** Number of days self certified absence is 0. Number of days employer payment is variable; in the general labour marked up to 3 months, for civil servants up to one year. Maximal time for payment is one year. The sickness benefit from the social insurance is a fixed amount (plus some supplementary benefits - such as children allowance). From the labour organizations sickness and pension funds the amount is dependent on your previous salary and how long you have been working and payments being made to the fund.	**Rules**: All people aged 16-66 are eligible to receive sickness benefits if they have been working for a total of at least 20 hours in a period of 5 weeks. The public authorities pay sickness benefits from the first day of illness, after which employers reimburse the two first days of illness. The amount of sickness benefit is 100% of previous income from work with at maximum of 3956 DKK per week (2010). Maximal payment is 40 weeks within a year. There are also various rules for employers payment according to various agreements on the private labor marked.
Activity data					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Source: Finnish National Insurance Institution **Identification of cancer patients:** ICD-10	**Source**: The Norwegian Labour and Walfare Administration **Identification of cancer patients:** ICPC-2	**Source**: The Swedish Social Insurance Agency **Identification of cancer patients:** ICD-10		**Source**: Icelandic National Sickness Insurance Institution **Identification of cancer patients:** ICD-10	**Source**: Social security register **Identification of cancer patients**: Data are mapped with data from the patient register based on personal ID. Based on ICD-10
Costs					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Reimbursed sickness benefits.	Reimbursed sickness benefits.	Reimbursed sickness benefits.		Reimbursed sickness benefits.	Reimbursed sickness benefits.
Comments					
Generally: Only publicly refunded sickness benefits to the employers are covered. Different compensation levels and rules contribute to differences in estimated costs. The publicly paid sickness benefits plays a limited role in Iceland, which relies heavily on the labor organization sickness and pension funds.. The number of days counted differs. To get comparable estimates the number of days for Finland is reduced by the factor 5/6 and the number of days for Sweden is reduced by the factor 5/7.					

A.1.6 Disability pensions

Organisation					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Rules: National Insurance Institution pays disability pension to people aged 16-64 whose working ability has been permanently reduced. Disability pension can start a the earliest one year after the work disability has started and continues until the age of 63 (when the normal pension related to earnings start) or 65 (for low income people who receive state pension). The amount of disability pension is dependent on earnings five years prior to the start of the pension. If the person does not have earnings at all (or low earnings), the disability pension consists completely (or partly) of state pension.	**Rules:** Earning ability must be permanently reduced by at least 50 %. Also home-workers and persons outside of working life may receive disability pensions. Disability pension consists of basic (state) pension (full pension equals (40 years of social security rights) =1G for singles and 0.85*G for spouses and cohabitants) plus an additional pension. The size of the additional pension depends on the number of years one has earned "pensions points" and income. Low income earners with little or no additional pension get a special allowance. Persons providing for children or spouse can get a dependants allowance. The compensation degree falls with (previous) income. For a person receiving average salary the compensation is -/+ 60 percent-depending whether one is married or single.	**Rules:** All citizens are entitled to the system for early retirement as a part of the Social Insurance system. To receive sickness compensation, the work capacity must be permanently reduced for a foreseeable future. In order to receive the benefit a doctor examination and approval by the Social Insurance Agency is necessary. Both benefits are income-related up to a maximum level. The need for rehabilitation service is decided in collaboration between the Social insurance agencies and different rehabilitation providers, mainly run by the county councils. Disability pension is decided by the Social insurance agency and require a doctors certificate.	Not included. Cannot identify cancer patients in the national data.	**Rules:** A fixed amount from the social insurance is paid (plus some supplementary benefits - such as children allowance and a supplement due to high medical costs). From the labour organizations sickness and pension funds the amount is dependent on your previous salary and how long you have been working and payments being made to the fund.	**Rules:** The Social Security Institution pays disability pension to people aged 18-66 whose working ability has been permanently reduced. The amount of the disability pension is dependent on the degree in the reduction of the working ability. People whose working capacities have been reduced by at least 50 % may be granted the lowest disability pension. People whose working capacities have been reduced by at least 2/3 may be granted intermediate pension, while those with no working ability may be granted maximum pension. The pension is independent of previous income. Also persons outside the working life may receive disability pensions. There can be paid some supplementary benefits such as children allowance and relieve and nursing supplement.
Activity data					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Source: Finnish National Insurance Institution **Identification of cancer patients:** ICD-10	**Source**: Aggregated register data – from NAV, number of persons **Identification of cancer patients:** ICD-10 (and ICD-9)	**Source**: The Swedish Social Insurance Agency **Identification of cancer patients:** ICD-10		**Source**: Icelandic National Pension Insurance Institution and the Pension funds **Identification of cancer patients:** ICD-10	**Source**: Social security register **Identification of cancer patients**: Data are mapped with data from the patient register based on personal ID.Based on ICD-10
Expenditures					
Finland	Norway	**Sweden**	**Denmark**	**Iceland**	**Faroe Islands**
Publicly paid disability pensions.	Publicly paid disability pensions.	Publicly paid disability pensions.		Publicly paid disability pensions.	Publicly paid disability pensions.
Comments					
Generally: Only publicly paid disability pensions are covered. Different compensation levels and rules contribute to differences in estimated costs. . The pensions paid by the Icelandic National Pension Insurance Institution plays a limited role in Iceland, which relies heavily on the labor organization pension funds which are regarded as part of the public social insurance.					

A.1.7 Important caveats regarding cost estimates

Direct costs/expenditures:	
Hospital treatment	- For the Faroe Islands outpatient activity only includes activity performed at Danish hospitals and costs estimates are based on Danish estimates for average cost per bed-day/visit. - The data for day patients and outpatients for Iceland is based on information regarding activity and costs at special day care/outpatient wards for cancer patients, and cannot be separated between different cancer sites. Activity and cost may be underestimated since any cancer patients treated at other day patient/outpatient wards are not included. - In the collected data for outpatient visits for Sweden about 20 percent of the total number of visits are missing. The number of visits and the cost estimates for outpatients are increased by the same percent, both total and for each cancer site. - DRG-groupers and unit costs for hospital treatment vary between countries. Estimates of the national unit costs are based on available, previous estimates. We have tried to correct for differences in the basis for national cost calculations. Based on rough estimates the unit costs are standardized to cover outlier costs, capital costs and user charges. - The registration of patients as day patient or outpatient varies to some extent between the six countries. This has to do with differences in organization, financing and data systems (DRG-groupers). - Differences in organization of treatment and care regarding the amount of workload outside hospitals/specialized care may vary between the countries, as well as the definition of or boundary between hospital/specialized treatment and long term/primary care.
Prescription drugs	- For Iceland most cancer medicine is included in the costs for hospitals, including medicine given in hospitals reimbursed by the Social Security. - For Denmark and the Faroe Islands we do not have information for cancer patients, only the total costs by ATC-codes. Costs for ATC-codes L01 and L02 which mainly cover cancer drugs are included and 20 % of L03 (roughly based on share of costs for cancer patients of total costs for prescription drugs in the L03-group in Norway and Finland). This may include some medication costs for patients with a diagnosis other than cancer, and underestimate medication costs for cancer patients included in other ATC-codes. However most medication costs are paid for by the hospitals in Denmark. - Data provides information on cost of prescription drugs by cancer site only for Finland and Sweden. For Norway data on the distribution of costs on cancer sites from the first half of 2009 is used to distribute the total medication costs for cancer in 2007. - Country differences in price policies etc. may contribute to different cost estimates for prescription drugs. The amount of medication costs covered by hospitals varies between the countries. In Denmark and Iceland almost all cancer drugs are covered by hospitals.
Screening	- Cost is roughly estimated based on available, previous national estimates. Due to differences in definition and availability of estimates of national unit costs, a common average of country specific unit cost is used for all countries. Cost variation for screening is thus only related to differences in estimated activity.
Indirect costs/expenditures:	
Sickness absenteeism	- The costs do not cover sick pay from the employer or from collective funds or private insurance. - The number of days refunded is not comparable between the countries because the number of days counted in a week (5, 6 or 7) differs. For countries that count 6 or 7 days per week, the total number of days is corrected by 5/6 and 5/7 respectively. - The data for Denmark does not allow identification of cancer patients and is thus missing.
Disability pensions	- The costs do not cover payments from collective funds or private insurance. - The data for Denmark does not allow identification of cancer patients and is thus missing.

Other:	
Deflators	We use different deflators for the different costs types. However except for hospital cost, we do not have deflators developed specially for each cost type. The GDP-PPP deflator is a commonly used deflator for international comparisons. However based on information on price differences for medicines between Nordic countries, the GDP-PPP does not seem appropriate to use for medicine, hence only different exchange rates are taken into account.
General:	
Estimate of total Nordic costs	- Data on cancer sites for day patient and outpatient in Iceland is estimated assuming the same distribution on cancer sites as for inpatients activity and costs respectively. - Missing data on screening, sickness benefits and disability pensions for Denmark are estimated based on average cost per five-year prevalence for the other Nordic countries.

A.2 Cost deflators

Costs are measured in 2007 EURO at Finnish cost/price levels. Three different deflators are used. For hospital costs the deflator developed by Kittelsen et al. (2009) is used. For prescription drugs only differences in exchange rates (2007 from OECD) are taken into account. For the other cost types a cost deflator based Purchasing Power Parities (PPP) index for Gross Domestic Product (GDP) from OECD converted to EURO using exchange rates for 2007, also from OECD, is used[64]. For the Faroe Islands the deflators for Denmark is used. For Iceland GDP-PPP is also used for hospital costs. The deflators are displayed in Table 15.

Table 15 Deflators

	Kittelsen et al (2009) Hospital costs	Exchange rate Prescription drugs	GDP-PPP Other costs
	2007	2007	2007
Finland	1.00	1.00	1.00
Norway	10.60	8.02	9.36
Sweden	9.94	9.25	9.47
Denmark	8.86	7.45	8.87
Iceland	119.71	87.67	119.71
Faroe Islands	8.86	7.45	8.87

A.3 Population

Table 16 shows the population numbers that is used in the report. For all the countries this data shows the population at the end of the year (or 1 st. January the next year).

[64] http://stats.oecd.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=SNA_TABLE4&ShowOnWeb=true&Lang=en

Table 16 Population. 2007

	2007
Finland	5 300 484
Norway	4 737 171
Sweden	9 182 927
Denmark	5 474 527
Iceland	315 459
Faroe Islands	48 383
Nordic countries	25 060 958

A.4 Data on prevalence

Data on prevalence of cancer are provided by the NORDCAN data base (http://www-dep.iarc.fr/NORDCAN/english/frame.asp) owned by the Association of Nordic Cancer Registries (ANCR), see Engholm et al (2010a, 2010b).

Five-year prevalence is used as the primary approximation of the number of cancer patients. Table 17 shows the five year prevalence for the Nordic countries in 2007.

Table 17 Five-year prevalence for cancer, in total and by cancer site. Nordic countries. 2007

	Finland	Sweden	Denmark	Norway	Iceland	Faroe Isl.	Nordic countries
All sites	77 157	148 927	84 898	73 393	4 054	-	388 865
Colorectal	7 806	17 845	11 801	10 711	442	-	48 605
Lung, trachea	2 088	4 336	4 656	3 054	196	-	14 330
Skin	7 098	19 958	11 319	9 908	444	-	48 727
Breast	17 158	28 139	17 074	12 121	775	-	75 267
Cervix uteri	541	1 714	1 521	1 181	57	-	5 014
Corpus uteri	3 254	5 596	2 640	2 661	111	-	14 262
Prostate	20 071	40 137	11 715	15 545	861	-	88 329
Testis	551	1 327	1 417	1 235	47	-	4 577
Kidney, bladder	2 984	11 055	7 550	6 135	384	-	28 108
Non-Hodgkin Lymphoma	3 282	4 703	3 048	2 620	152	-	13 805
Acute leukemia	474	786	550	387	30	-	2 227

Source: NORDCAN (ANCR).

A.5 Expenditure estimates

Table 18 Health care costs and public expenditures on income loss compensation payments (ILCP) related to cancer. Sum Nordic countries. Mill. EUR. 2007

	Sum	Health care costs							Public expenditures on ILCP		
		Treatment costs									
		In-patients	Day-patients	Out-patients	Pre-scrip-tion drugs	Sum treat-ment	Screen-ing	Sum Health care	Sick-ness bene-fits	Disability pensions	Sum ILCP
All sites	4 036	1 681	148	817	394	3 041	221	3 262	428	345	773
Colorectal	441	248	25	79	15	367	-	367	45	28	74
Lung, trachea	284	147	11	61	20	240	-	240	21	24	45
Skin	127	38	11	45	14	109	-	109	9	9	18
Breast	754	114	23	203	62	403	135	538	135	82	216
Cervix uteri	135	17	2	10	2	30	87	116	8	10	18
Corpus uteri	69	32	2	11	5	51	-	51	12	6	17
Prostate	379	119	7	100	108	335	-	335	29	16	45
Testis	24	8	1	4	1	13	-	13	6	5	11
Kideny, bladder	203	116	5	34	20	175	-	175	13	15	28
Non-Hodg.Lymp	196	90	11	32	13	146	-	146	21	29	50
Accute leukemia	168	105	9	15	10	139	-	139	14	16	29

Table 19 Treatment costs related to cancer. Nordic countries. Mill. EUR. 2007

	Sum treatment costs	Inpatients (LOS>0)	Day patients (LOS=0)	Outpatients	Prescription drugs
Finland	610.8	359.8	11.9	129.9	109.2
Norway	630.6	371.0	68.0	95.0	96.7
Sweden	1083.3	645.9	13.8	241.3	182.3
Denmark	676.5	278.7	47.8	346.8	3.2
Iceland	34.8	21.5	6.6	4.2	2.6
Faroe Islands	4.8	3.7	0.4	0.1	0.5

Table 20 Screening programs – estimated cases (1 000) and costs (Mill. EUR). Nordic countries. 2007

	Cases (1 000)		Costs (mill Euro)	
	Breast	Cervix uteri	Breast*	Cervix uteri**
Finland	234	182	22	8
Norway	191	432	18	19
Sweden	666	700	62	31
Denmark				
Iceland	20	33	2	2
Faroe Islands	0	3	0	0.1

* Estimated unit cost 94 Euro. ** Estimated unit cost 45 Euro.

Table 21 Public expenditures on income loss compensation payments related to cancer: Sickness benefits and disability pensions. Mill. EUR. 2007

	Total	Sickness benefits	Disability pension
Finland	117	45	72
Norway	208	96	112
Sweden	275	192	83
Denmark			
Iceland	3	1	2
Faroe Islands	1.1	0.3	0.8

A.6 Sensitivity analysis: health centers in Finland

Table 22 Decomposition of (relative to Nordic average) treatment cost per capita assuming 50 % weight on the results including health center activity and 50% weight on results excluding health center activity in Finland. Nordic countries. 2007

		Finland	Norway	Sweden	Denmark	Iceland	Faroe Islands
A=B*C =B*C2*D=B2*C2	Cost per capita	0.91	1.11	0.98	1.03	0.92	0.82**
Not standardized:							
B	Prevalence rate*	0.94	1.00	1.05	1.00	0.83	
C=Ca*Cb	Cost per prevalence	0.97	1.11	0.94	1.03	1.11	
Ca	(Weighted) activity per prevalence	1.16	1.06	0.85	1.07	1.22	
Cb	Cost per (weighted) activity	0.85	1.05	1.11	0.96	0.91	
Standardized:							
D	Cancer prevalence case-mix index	1.07	0.99	0.91	1.10	1.09	
B2=B×D	Standardized prevalence rate	1.01	0.99	0.95	1.10	0.90	
C2=C2a*C2b	Standardized cost per prevalence	0.91	1.13	1.03	0.94	1.02	
C2a	Standardized (weighted) activity per prevalence	1.09	1.07	0.93	0.97	1.12	
C2b=Cb	Cost per (weighted) activity	0.85	1.05	1.11	0.96	0.91	

* Five-year prevalence

** Missing costs for outpatient activity for patients treated in The Faroe Islands.

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