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What is best and at what cost?

Cross-national differences in the treatment of ageing-related diseases

Norwegian perspective from a comparative OECD-project

Grete Botten and Terje P. Hagen

Center for Health Administration, University of Oslo

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Health Economics Research programme at the University of Oslo
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Forword

In spring 1999 the Social Policy Division in OECD approached the Ministry of Health in Norway and asked if Norway would like to contribute to a large international comparative study on treatment of diseases that would become an increasing burden to the economy in the OECD countries. The ministry of Health gave priority to two diseases; breast cancer and heart infarction. Centre of Health Administration was asked if they would be responsible for the project in Norway, as part of a collaboration between the Ministry of Health and the centre. At the Centre for Health Administration Professor Grete Botten took the main responsibility for the Breast cancer project and Professor Terje P.Hagen for the Hearth infarction project. Grete Botten coordinated the overall Norwegian project.

In the breast cancer group the Norwegian institute for epidemiological cancer research contributed through its director dr. Frøydis Langmark and dr. Steinar Lundgren. Dr. Haakon Melsom (specialist in oncology) represented the clinical expertise in that project group. Professor and cardiologist Aasmund Reikvan contributed in the heart infarction project. The overall project was closed at a meeting in OECD June 2002.

This report presents shortly the idea of the project, some data on comparing Norway to other countries, the two final case-reports prepared by OECD and some general lessons to be drawn from the study.

Centre of Health Administration, Oslo, Oct 2002

Grete Botten Terje P. Hagen

Main objectives of the project

Aggregated medical spending differs widely across countries and large variations exist in the frequency and the mix of medical services provided, as well as the type of technology applied. The outcomes (mostly measured as survival rates) do not, however vary to the same extent as the spending. Policy makers in many countries compare their spending to each other, with no clear consensus about how systems are effective in treating patients. In each of these debates the issue of what medical care is buying arises: When countries spend more or less on health care, how does that affect resource allocation in the medical sector and ultimately the health outcomes?

The goal of the project[1] was to examine how different medical care systems will affect the allocation of resources in the medical sector. As the existing available macro data at an international level does not allow for satisfactory answers to such questions, this project wanted to use a microeconomic approach. An international comparison of treatments of conditions in older populations that lead to high expenditures could help to identify treatments that might be more effective in improving outcomes at lower cost. Therefore the project focused on international comparisons of treatments for a spectrum of conditions in older populations with high aggregate medical spending, well identified episodes of care, high prevalence and high policy relevance. Norway participated in studies on myocardial infarction and breast cancer [2]. The choice of focus on older patients was partly motivated by the fact that in the future the elderly will probably take an increasingly proportion of the total spending in the health care sector.

More specifically the study should make it possible to address the following key questions:

1. How much does the treatment of particular conditions differ across countries?
2. Why does the use of these treatments differ, in terms of incentives, health policy, planning and regulation?
3. Might these differences affect survival rates and functional capacity in an objectively measurable way?
4. What are the implications for future monitoring of health care systems?

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[1] The goal of the project was stated in the invitation letter to the first meeting in Paris, May 27, 1999.
[2] Studies on cerebrovascular disease (stroke), osteoporosis and hip fracture, cataracts and diabetes were also proposed to be included in the overall study. Of these only cerebrovascular disease was included. The component of cerebrovascular disease had some Norwegian data, but as Centre of Health Administration not was involved in that study, it is not included here.

Specific research objectives for the selected diseases

Based on a literature review on medical background and epidemiological trends for the different diseases, more specific research hypotheses were proposed for acute myocardial infarction and for breast cancer. The specific questions on each disease are linked to the overall objectives of the project.

Acute myocardial infarction

Ischemic heart disease, more specifically acute myocardial infarction, is one of the leading causes of mortality across OECD countries. The main issues for this disease are linked to decreasing trends in mortality, improving outcomes and increasing medical spending across countries. Therefore, the project would investigate the contribution of the diffusion of high technologies to both growth in medical spending and trends in outcomes. The potential of such research has earlier been demonstrated by the early pioneering work of the existing Stanford TECH network. Further work will strengthen these investigations while increasing the link with the macroeconomic aspects of health care systems.

Breast cancer

Breast cancer is the most common cancer in women. Current related work has highlighted some significant differences in five-year relative survival rates across countries (EUROCARE). Early detection via screening and appropriate management appear to play an important role both in maximising health gains and also in influencing relative survival rates. Therefore, a first issue will be to investigate the consequences of incentives and institutional features for screening programmes (technology forms an important component of screening with mammography). Further, the project will investigate whether patterns of treatment after diagnostic (surgery, chemotherapy) and available medical resources (oncologists) may differ across countries and also contribute to variations in survival. A specific aspect would be linked to the situation for older women, as there seems to be an important age gradient in the screening and also in survival results obtained for some countries.

For both diseases medical interventions are the product of an epidemiological context and specific economic and institutional incentives. Prevention itself, both in terms of screening and intervention on risk factors or in an early phase of the disease, can both highly involve high technologies and be sensitive to various incentives. The relative contributions of various high technology techniques versus different methods of medical and less intensive methods of drug management will be investigated in each of the disease cases.

A key variable of interest to analysts and policy-makers is to analyse the contribution of medical technology to variations in medical spending, and to explore the microeconomic determinants of the diffusion of technologies in health care systems. The project could therefore provide information on key levers in health care systems, which influence both the supply and demand for medical care, and possibly for the ultimate outcome of intervention in the health care sector.

The methodological approach

The study included three components:

(i). a review of national information on epidemiological trends and qualitative assessment of changes in medical treatments over time.

(ii). a review of national information on how incentives, health policy and regulation differ across countries for the treatment. Information was also collected on variations in health expenditure, clinical policy, incentives and regulations, which could contribute to variations in treatment.

(iii). an analysis of micro data obtained from either administrative records, national individual registers or specific data sets or surveys. The analysis will

- compare treatment patterns by age and gender
- explore outcomes with regard to survival rates, and possible comorbidities and rehospitalisations
- compare treatment costs and prices

The reviews (i) and (ii) will gather available national data describing prevalence and incidence of disease, utilisation rates and total number of procedures, number of treatments, total direct costs of these treatments and mortality rates. This will provide a global description of treatment patterns for the OECD countries and the institutional background to those patterns.

Main findings

Here we will focus mostly on the situation in Norway compared to other countries and we will very shortly comment some of the overall conclusion. The final report on the two diseases is included in this report as supplement I (myocardial infarction) and supplement II (breast cancer). These reports are also available on web-site http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-194-5-no-27-29601-0,00.html which in addition contains various other documents from the project as well as a link to presentations from the final meeting in Paris, June 2002. The document "Project introduction" by Stephane Jacobzone, who headed the project at OECD, presents more details about the overall concepts and approach. Other documents give the main conclusion and perspective from various parts of the project and the questions raised in the project. When reference to a chart or table is given, it relates to the attached report on that specific disease.

Acute myocardial infarction; Norwegian perspective

There is no information about the incidence of myocardial infarction in Norway. This was the case in most other countries as well. The hospital admission rates and the mortality rates indicate that we belong to the high incidence rate countries, as OECD classified the countries. The mortality rates (in the period 1970-80 to 1980-95) are declining in Norway as in most OECD-countries, however, many of the high incidence countries seem to have experienced a steeper decline than Norway (Table 1). Norway has had an huge increase (47%) in use of lipid lowering drugs from 1990-1998, and ranges second after Australia. The consumption is twice that in Sweden and Finland and about 4 times as high as in Denmark (1998) (table 2). For diuretica the differences between the Nordic countries are also striking, the consumption being lower in Norway. Admission rate for acute care treatment for myocardial infarction has decreased in Norway from 1990-1998, and the % annual decline is higher in Norway than in any other country (Table 3) [3].

The rate for acute invasive treatment has been increasing in all countries that have longitudinal data (no data in Norway), particularly for PTCA (per cutan cateterization) compared to CABG (coronary by pass). The rates in Norway per 100 000 inhabitants

[3] Based on data submitted to this project, Reikvam and Hagen have published data on the declining admission rate in Norway. (Markedly changed age distribution among patients hospitalized for acute myocardial infarction. Scand Cardiovasc J, 2002;33: 221-224)

40 years or older in 1998 are on the average (Table 3). The rates for acute infarction patients were not available in Norway, however for the other countries it varied considerably, US being at the top and England at bottom. Linear regressions gave a small correlation between the level of myocardial infarction and utilisation rates for revascularisation. To analyse if supply constraints would have any impact on utilisation of revascularisation procedures, the countries were grouped in various categories (see overhead from presentation of summary of the results for the ischemic heart disease study on http://www.oecd.org/EN/document/0,,EN-document-194-5-no-27-32316-0,00.html). A link between supply constraints and utilisation of invasive revascularisation procedures was identified. USA is an example of a country with small constraints and high utilisation rates, whereas England is the opposite, strong constraints and low utilisation rates. Norway is in the middle. There is also a weak linkage between utilisation rates and outcome.

There is no data on case fatality rates from Norway. One year case fatality rates varied in the seven countries that were compared, and in1997 the rate was lowest in Sweden and highest in Finland. Average length of stay was short in Norway already in 1990 and had declined to 7.8 days in 1998, which is in the lower range of the countries (Table 7).

Summary of results on heart infarction from an OECD-perspective

OECD underlined that the project represented one of the first full-scale attempts at comparing the performance of health care systems using a comprehensive disease-based framework, utilising large hospital administrative databases with individual medical records, supplemented with other sources of relevant information. The study suffered however, many limitations, which OECD pointed to.

First, this was not a medical study and the analysis of medical interventions remains fairly incomplete from a clinical perspective. In the interests of time and comparability, OECD were unable to use all the detailed information on clinical status, comorbidities and inpatient drug therapy treatments available in some of these large administrative data sets. In addition, the project was not able to fully reflect patients' episodes of care through lack of information on ambulatory care practices. Finally, it was not possible to address the issue of quality of life. Collecting data on this aspect would be an extremely resource intensive task, one that fell beyond the scope of the present study.

The strength of this study was, according to OECD, the demonstration of the link between health care system supply-side incentives and the level and diffusion of invasive revascularisation procedures. The study showed that universal coverage does not necessarily guarantee the same utilisation rates for treatments across countries, since OECD countries devote very different levels of resources to health care, each within their own "universal system". However, higher “activity rates” (utilisation of revascularisation procedures) observed in some countries do not necessarily translate into improved outcomes that parallel the investment in resources, as some lower spending countries are able to achieve similar or even better results. Higher activity rates do exert pressures on the financing side. However, in particular, the financers of health care in the United States pay more per unit of treatment than in other OECD countries. The results indicate that an effective health care system is one where expenditures are sufficient to minimise resource restrictions that would unduly affect patients, yet are not so high that the financial sustainability of the system is potentially jeopardised.

Finally, this study showed the irreplaceable value of information systems for evaluating health care systems. The study took advantage of an enormous wealth of information sources to provide an extensive analysis of how health care systems treat ischemic heart diseases, yet the assessment remains incomplete since not all data were available. Improvements in the utility of these information systems require long-term investments, as well as the goodwill and participation of patients and physicians. These are more likely to participate if a project can demonstrate that the information these resources have to offer, can be used to improve health care systems in the long run.

Breast cancer; Norwegian perspective

Many countries supplied data on incidence of breast cancer and for comparison data from 1995 are used. The age standardised incidence rate for Norwegian women 40 years and older was in the lower range (about 215 cases per 100 000 women), whereas Sweden, USA and Manitoba in Canada had the highest rates at about 250 cases per 100 000 women[4]. The comparison should include stage distribution, and a significant increase to diagnose more cases in early stages during recent years was observed, likely due to participation in screening. The relative five-year survival rate (data from

[4] This might to some extent mirror mammography screening, which will detect more tumors during the first years of screening. Norway had at that time only limited organised screening program.

1985-1995) varied considerably[5]. Japan was at the top with 85%, US second (84%) and then Sweden and France (82%). England had the lowest overall survival rate (75%). Norwegian women with breast cancer had a five-year survival of 78%, clearly below average, particularly for women 60 years and older (Table 5). The increasing proportion of early stage breast cancer cases has also boosted the overall increase in breast cancer incidence. Cross-national variations in survival might correspond to differences in incidence and stage distribution. The comparison of survival and breast cancer mortality is therefore hampered by lack of stage classification, making the link between mammografi screening, treatment and survival difficult.

The treatment procedures varied across countries. Norway differed considerably form all other countries in having very low rates for breast conservative surgery (BCS)[6]. Data from Norway goes until 1995 as no more recent reliable data could be traced. In 1995 24 % of the women with breast cancer had BCS, compared to France (65%), Sweden (43%), Ontario (54%), England (47%), Belgium 64% and US 51% (Table 1). In Norway the rate of BCS was remarkable low among all women aged 65 years or older (Table 2), but was low i all age groups.

Norway has been late to establish national screening programmes. All countries with aggressive screening programmes have experienced strong reduction in mortality for women aged 40 years and over in the 1990s, most prominent in Sweden. However, it was not possible to establish causal link between screening and mortality and 5 years survival. The project did not identify any linkage between available technology (radiotherapy and mammography machines) to outcome, with an exception for the UK. For whereas Norway was an out-lier in breast conservative surgery, England was a clear out-lier when it came to breast cancer mortality, and also the reduction from 1980 until 1995 was small (Table 3).

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[5] The number is not related to cancer stadium, as there was no such information across countries. The presence of mammografi screening could affect the stadium at diagnosis and thus influence the relative survival. In addition the presented data are mostly from the early nineties and one should be careful to interpret them as an indication of the present situation.

[6] It is claimed (Haakon Melsom, personal communication) that the proportion of women getting breast conservative treatment is now increasing.

Summary of results on breast cancer from an OECD-perspective

For breast cancer, assessing performance was a complex task, involving multivariate analysis of variations in survival; however, the data available for the OECD-study for international comparison was very limited. OECD attempted to examine the impact of technological inputs (e.g. mammography or radiotherapy machines) on a variety of outcomes: recommended treatment, screening rate, and finally survival rates as a preliminary step. No conclusions could be drawn, except for the UK, with a much lower availability of machines and poorer survival. In other countries survival rates did not seem to depend on the availability of state-of-the-art technology.

The study confirmed the variation in treatment patterns that persist, despite protocols for recommended care. Screening seems to have impact on the survival rates of several countries, evident in Europe, but the interpretation was not easy due to lack of consistent data. The UK is one country, which clearly stands out, with a poorer survival rate. It would seem from available evidence that, given the restrictions in terms of the availability of qualified medical staff, screening and radiation treatment equipment, financial constraints in terms of treatment may have had an impact on outcomes in that country.

Some essential pieces of the puzzle are still missing, and an analysis of this sort, unfortunately, remains highly limited. The data gathered, as part of this study, is not patient level data linked for all variables under question (e.g. treatment, stage and survival) and the data available on potentially important independent variables (e.g. on economic factors) is fragmented. In addition, some of the country data only reflects portions of the country and therefore, treatment patterns or survival cannot be generalised to the entire country. Studies examining international comparisons face huge limitations, as it is difficult to present available data in a standard manner. To perform such comparative OECD recommend some alternative steps that are likely to provide more information for future debate:

- Further development of registry data, to include standardised data on cancer stage or extent of disease, and also on initial and follow up treatment.

- Further development of infrastructure and a legal climate to encourage links between registry data, hospital separation data and physician claims data as well as death records. Such links are currently available in some countries (the United States, Canada at the

Provincial level, and Sweden), but could be developed further as they provide invaluable results.

- A systematic population-based measurement of women's participation in either organised, or timely breast cancer screening.
- Large cost-effectiveness trials assessing the relevance of cancer screening programmes, and the various options for treatment.

The "ex post" evaluation allowed by population-based assessment programmes, such as breast cancer registries, is valuable and should be continued together with further cost-effectiveness trials. These help raise public awareness and, in a number of countries, have played a significant step in the renewal of the general health policy agenda, such as in the UK.

The study has for the first time compiled information on health care system factors, treatment, costs, and outcomes on breast cancer. In addition, the study's preliminary results generate several hypotheses and identify where further data needs to be collected. Better performance seems to be achieved through a mix of rigorously organised population- based breast cancer screening programmes, combined with treatment protocols that follow the most recent clinical guidelines, and that are not unnecessarily limited by economic constraints. However, the availability of up-to-date, state-of-the-art technology appears to be insufficient in itself to achieve high performance rates in OECD's health care systems.

Conclusion and future steps

OECD perspective

One of the objectives of the overall project in bringing together information on health policy, epidemiology, treatments, costs and outcomes was to determine which countries were getting the best value for their health care spending. However, in spite of much efforts to collect available data form the OECD-countries, no definite conclusion could be drawn form the study concerning variation in health outcome, related to the health care system. One reason was lack of comparable data and the study revealed a number of specific shortcomings and OECD pointed out the major obstacles.

- Countries differed in their progress in developing health outcome information. Even for much of the core health outcome information, data were only available for a subset of countries.

- The majority of health outcome data was related to mortality, whereas morbidity data and quality of life data were not available

- Countries that could track a patient over a number of admissions and from hospital to hospital delivered more valuable data than those which had a hospital register system that could only count events. This was underlined as a major shortcoming, hampering both studies within the countries and international comparisons.

- Not all countries had health information system that allowed linking patient information form hospital data and disease register to death information. For those countries that do not have such a system, there is a potential for large improvement.

- In this study it was often not possible to control for severity of the disease. This was especially the case for breast cancer. Thus variation in early detection could affect the data to an extent that made comparison and interpretation difficult.

As a main conclusion OECD strongly recommend that the OECD-countries (and others) develop health information systems that will make it easier to get answer to the question this project wanted to raise and answer.

Norwegian perspective

OECD concludes that there is a potential for developing international information system for evaluating health care as it varies over countries, as shown in these two cases. If Norway wants to contribute to such an information system and be more prepared to join international comparative studies on performance in the health care, two steps need to be taken.

- There is a large need to develop health information systems and registers that may track patients over time. There is an ongoing effort in Norway to establish more disease registers (sometimes combined with quality registers) and to link those to data on use of services. These efforts should be strengthened, and for international comparison, it will be important to develop them according to the same lines as those registers that already exist or are being developed in many other countries.

- The OECD project showed the potential for combining knowledge and data from clinicians, epidemiologists and health policy analysts. If Norway wants to join such international projects, there is a need for a milieu that may contribute to and co-ordinate such projects. Such a milieu need to have access to and knowledge about health data registers, included data on use of services and performance, knowledge about the health care system and health economy, included both care and prevention, and close collaboration with leading clinicians. Financial resources need to be considered.

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Working Party on Social Policy. Ageing-Related Diseases.

SUMMARY OF RESULTS FROM ISCHAEMIC HEART DISEASE STUDY

WHAT IS BEST AND AT WHAT COST?
OECD STUDY ON CROSS-NATIONAL DIFFERENCES OF AGEING-RELATED DISEASES: CONCLUDING WORKSHOP

To be held at the International Conference Centre, 19 Avenue Kléber, 75016 Paris
from 20 to 21 June 2002, starting at 9h30 on the first day

Further details regarding the Ischaemic Heart Disease study can be obtained from Pierre Moïse, email: pierre.moise@oecd.org

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SUMMARY OF RESULTS FROM ISCHAEMIC HEART DISEASE STUDY

1. Ischaemic heart disease is the world's leading cause of mortality, causing an estimated 7.1 million deaths in 1999 (WHO 2000). Heart disease is also one of the greatest contributors to health expenditures, comprising about 10% of total health expenditures in OECD countries (Moore *et al* 1997; Hodgson and Cohen 1999; Mathers and Penm 1999). This makes it an ideal disease for studying health care systems.

2. Ischaemic heart disease (IHD) is a complex condition. Several risk factors for IHD can be tackled using a population health approach, while drugs can be used in primary and secondary prevention of the disease. It is the nature of treatment for the acute phase of ischaemic heart disease (IHD), generally involving high-cost, high-technology procedures that makes it an ideal disease to observe patterns of technology diffusion, a major component of this study.

3. This paper summarises the work of the IHD part of the Ageing-Related Diseases (ARD) study. In the first section I introduce the characteristics of health care systems that exert an influence on treatment patterns. The second section explores some of the epidemiological indicators collected for the study, providing a measure of the underlying demand for IHD health care services. In the third section I describe treatment variations across countries in the light of demand patterns established in the previous section. However, our interest in studying IHD is not only to examine treatment patterns, but also to explore the relationship with health outcomes. This is done in the fourth section. Since health care decisions invariably require us to ask how much all of this costs, an examination of the economic aspects of IHD is provided in the fifth section. In the final section I discuss some of the results uncovered in this study, drawing some tentative conclusions.

1. Policies and regulations: influence on the demand and supply of health care for IHD[1]

1.1. Demand

4. There is virtual universal coverage for health care in all OECD countries. Health insurance coverage is not a significant hindrance on the demand for acute care for IHD, with the possible exception of the United States where several studies have demonstrated that individuals without health insurance face constraints to obtaining high-tech, high-cost procedures for treating IHD (Wenneker *et al.* 1990; Hadley *et al.* 1991; Sada *et al.* 1998; Canto *et al.* 1999).[2]

1 . We collected an enormous amount of information for the IHD part of the study. Size limitations prevent us from placing all relevant information in this paper. This paper provides a summary of the trends in the data. The reader should contact the author for more detail regarding the information used in this report. A more comprehensive version of this report will be available in 2002.

2 . Other factors, especially socioeconomic status, can affect access to health care. For example, see Alter *et al.* 1999.

5. While most health care services related to treating IHD are usually covered through health insurance, this is not necessarily the case for drugs delivered in ambulatory care. These tend to be drugs used for treating chronic cases of IHD, since drugs delivered inhospital are provided as part of the overall care during the stay. Where ambulatory care drug coverage is not universal, supplemental private insurance is available to cover expenditures that the public system does not.

6. The greatest potential impact on the demand for drugs is patient cost sharing, under public and private health coverage, for drugs to treat chronic cases of IHD. However, much of this is mitigated by the fact all countries in our survey have policies with some form of exemption for co-payments for drugs, mostly based on socio-economic status and age. There are also some specific policies related to chronic diseases, including IHD. These policies focus on exemptions from payment, reductions in the co-payment and annual ceilings on the accumulated cost borne by the patient.

1.2. Supply

7. As the point of entry for the majority of health care services, physicians are an important aspect related to the supply of IHD health care services. Hospitals are also important since acute care is a significant aspect in the treatment of IHD. Methods of remunerating physicians and hospitals can influence the mix of health care services as well as the volume (OECD 1994; MCCLELLAN 1997; GILMAN 1999; OR 2000). We collected information on these two aspects of the supply-side of health.

8. Physicians in Belgium, Korea and Switzerland are mainly paid fee-for-service, and would therefore be expected to have higher volumes of services per physician, especially high-cost procedures, such as coronary artery bypass graft (CABG) and percutaneous transluminal coronary angioplasty (PTCA), which are commonly used in treating IHD, where fees are likely higher.[3] Therefore, we would expect higher rates of utilisation of revascularisation (CABG and PTCA) procedures in these countries. At the other end of the scale, physicians in the GBR and the Nordic countries are mainly salaried so we would expect much lower utilisation rates for revascularisation procedures in these countries.

9. Hospitals in Belgium, Japan, Korea and Switzerland are mainly paid on a fee-for-service basis. The volume of acute care services in these countries should therefore also be higher than non fee-for-service countries for reasons similar to the incentives for fee-for-service physicians to provide a greater volume of services. On the other hand, we would expect a lower use of acute care services in global budget countries, such as Canada, the GBR and the Nordic countries.

10. The volume of health care services will depend on the availability of resources. In the IHD part of the study we concentrated on the supply of cardiac care specialists and facilities used for revascularisation procedures (cardiac surgery facilities and cardiac catheterisation laboratories). We also collected information on regulations used to restrict their numbers.

11. Very few countries applied explicit limitations on the supply of cardiac specialists, yet there was significant variation in the number of specialists per 100,000 inhabitants across countries. The reasons for this variation are not clear, but it does not appear to be related to the level of ischaemic heart disease.

3. This will depend on the time required per procedure since economic agents value time. For example, *ceteris paribus*, the financial incentives for physicians are greater for performing a PTCA procedure with a fee of $50 that takes 1 hour to complete instead of a CABG procedure with a fee of $125 that takes 3 hours to complete. In 3 hours the physician would have earned $150 performing 3 PTCAs as opposed to $125 for 1 CABG.

12. We found the Beveredgian countries[4] were most likely to restrict the number of revascularisation facilities, which coincided with the fact they tended to have the lowest number of these facilities per 100,000 persons. Sweden and Australia, which had numbers closer to the high-end countries (Germany, Japan, United States), were exceptions to this trend. This may be due to the fact constraints in these two countries were not as strong as in Canada, Denmark, Norway and the Great Britain. Regulation of facilities are weakest in Belgium, Germany and Switzerland, all of which are social insurance countries, plus the United States, which has a strong private health insurance industry. These countries had the highest number of facilities per 100,000, although the number of cardiac surgery facilities for Germany was surprisingly low. The important point to remember will be to see how these regulations translate into the volume of CABG and PTCA that are performed.

2. Epidemiology of IHD

13. We collected epidemiological information on IHD to provide a sense of the level of the disease across countries, but also as a measure of the underlying demand for health care services related to treating this disease.

14. There are several well-known risk factors of IHD, but national level data are difficult to obtain since they must be collected through costly surveys. We collected information on body mass index, tobacco use, cholesterol levels and hypertension for both sexes. Among the group of countries with the highest burden of IHD are included some of the countries with the highest relative levels of risk factors: Australia and the United States (body mass index), Denmark (number of daily smokers, especially in 1980), Germany (cholesterol level) and Finland (hypertension).

15. Information on prevalence of IHD, the number of persons with the disease at a given point in time, an appropriate measure of the demand for IHD health care services, were not available. Another appropriate indicator of demand is the number of new cases of IHD (incidence), but these data too were not available. However, the incidence of IHD can be proxied using the number of new cases of heart attacks (acute myocardial infarction - AMI), which generally account for more than half of all new cases of IHD (AHA 2000). Unfortunately, there exist remarkably few sources of incidence data for AMI, so we had to rely on a small number of data sources.

16. We were able to collect information on the incidence of AMI for only three countries, Australia, Denmark and Sweden, and regional data from three others, Germany, Japan and Great Britain. The patterns exhibited by these data show that higher incidence rates are positively associated with age and male gender, as expected. There appears to be a slight decline over time in incidence rates in Australia, Sweden and Great Britain (Oxford region), by age and gender. The trends in these data are supported by the World Health Organisation (WHO) MONICA Project which reported declining coronary-event rates in many of the countries in our study and over a period of 10 years from the mid-80's to the mid-90's (TUNSTALL-PEDOE *et al.* 1999).

17. The only consistently reliable epidemiological measure available is IHD mortality. We collected IHD mortality rates for all of the countries in our study and these are shown in Table 1. IHD mortality rates are separated by gender and presented for three separate periods, 1970, 1980 and 1995, with corresponding rates of change calculated for 1970-1980 and 1980-1995.

Table 1 Trends in IHD mortality rates for Males and Females: 1970-80 and 1980-95

4. See OECD (1992) for a description of a typology of health systems (we refer to Beveredgian and social insurance countries in this paper).

18. Since 1970 there has been a general decline in IHD mortality rates, however, there were exceptions. From 1970 to 1980, IHD mortality rates in Germany, Hungary, Spain and Greece increased. Since the 1980s the general decline in IHD mortality rates has been more widespread, with the only exception being Germany, which experienced a brief increase following reunification (191(414) per 100,000 (wo)men aged 40 and over in 1989, prior to reunion and 245(516) per 100,000 (wo)men aged 40 and over in 1990) but with rates that have been on the decline since the early 1990s, and Hungary following the collapse of the former communist regime (396(757) per 100,000 (wo)men aged 40 and over in 1989 and 425(807) per 100,000 (wo)men aged 40 and over in 1993).

19. Also of note is that the decline has been the greatest for the countries with the highest mortality rates. These trends are supported by the MONICA study where there was a tendency for coronary-event rates to fall in high-rate countries and increase in low-rate countries. Confirming our observation for Germany and Hungary, the former communist bloc countries of Eastern Europe also had increases in coronary-event rates (TUNSTALL-PEDOE *et al.* 1999).

20. Not surprisingly, mortality rates for men are much greater than for women. During the 1970s mortality rates for IHD fell at the same rate for men as they did for women. However, since 1980 mortality rates have been falling faster for men than women. This is supported by the MONICA study which found coronary event rates for men were falling faster than for women. Even with the gap narrowing over the past 20 years as mortality rates fall faster for men, as a group, men still have higher rates of mortality for IHD than women.

21. We also collected information from some countries on IHD mortality rates by age. The results show, as expected, that IHD mortality increases with age.

22. The epidemiological data presented above provide a picture of the level of IHD prevailing in the countries in our study. They also provide a useful glimpse at the underlying demand for health care services related to IHD, which is important for the next section when we compare treatment. Unfortunately, the more appropriate indicators of demand, prevalence and incidence of IHD, are not available for most of the countries in our study. The only reliable indicator available is the mortality rate from IHD.

23. In order to have an indication of the level of disease across all 17 countries in our study, we needed an indicator that was comparable and widely available. The mortality rate from IHD is the only indicator available that fits this need. Combining IHD mortality rates with the data on incidence we collected, the results of the MONICA study and other international comparative studies, evidence exists to separate countries with relatively high levels of IHD from those with lower levels. In other words, we use mortality as a *relative* proxy of the demand for IHD health care services. Therefore, we can make a generalisation regarding relative demand across the countries in our study by assuming that countries with high IHD mortality rates will also tend to be countries with a high incidence and high prevalence of IHD.

24. Using the epidemiological data we have collected we classify the countries in our study into two basic groups:

- Countries with the highest mortality rates, meaning those countries who would be considered as countries with a high demand for IHD health care services: Hungary, Finland, Great Britain, Denmark, Australia, Sweden, United States, Germany, Norway and Canada.

- Countries with the lowest mortality rates, meaning likely low demand for IHD health care services: Switzerland, Italy, Greece, Belgium, Spain, Japan and Korea.

3. Dealing with IHD: Preventing, Diagnosing and treating

3.1. Ambulatory care and prevention

25. The only information we collected concerning ambulatory care and the prevention of IHD was on drug consumption. We collected drug consumption information on cholesterol and triglyceride reducers, diuretics, ACE inhibitors, beta blocking agents, calcium channel blockers and antihypertensives, drugs used in treating chronic cases of IHD as well as primary prevention of the disease.

26. Generally speaking, consumption of all these drugs, with the exception of diuretics, has been increasing across OECD countries. The category of diuretics we examined include some of the oldest drugs used in the treatment of IHD. It would appear from this observation that some substitution away from diuretics toward newer, and subsequently more expensive, drugs is taking place. How much of this is a genuine substitution for treating IHD is difficult to tell since we do not have information on the indications for which these drugs were prescribed.

Table 2. Consumption of Drugs Related to the Treatment of IHD

3.2. Acute care

27. Admission rates for IHD reflect the demand for acute care services and are a function of the supply of facilities that provide these services, but capacity constraints and provider incentives can alter the provision of these services. However, we collected admission rates for AMI rather than IHD because the micro-data we collected for the study were based on hospitalisations for AMI.[5] The data we collected on AMI admissions rates are more relevant for informing the discussion of the micro-data results.

28. Generally, admission rates for AMI in OECD countries have remained steady, or decreased slightly, throughout the 1990s (Table 3), with the exception of Norway which saw a substantial decline in admissions for men (87.1% between 1991 and 1998) and to a lesser extent women (50% between 1991 and 1998). As demonstrated earlier, there has been a general decline in underlying demand, as measured by the level of IHD, during this same period. It is possible that declining demand for IHD health care services has resulted in a decline in admissions for AMI.

Table 3. Selected Aggregate Indicators of Acute Care Treatments for IHD

29. There are basically three alternative treatments for AMI and IHD in acute care settings: thrombolytic drugs, percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass graft (CABG).[6] The latter two can be considered as the "high-tech" alternatives to the use of drugs. Due to difficulties in identifying thrombolytic drug use from hospital inpatient databases our analysis was limited to the study of PTCA and CABG. We can combine both of these intensive treatments into one treatment modality, revascularisation, which is often used for identifying these procedures.

5 . It was decided at a meeting of experts involved in the IHD part of the ARD study to collect micro-data based on AMI hospitalisations rather than IHD. There were several reasons for doing this, but the main consideration was that cohorts based on AMI admissions provide a more homogenous group of patients, which facilitates comparisons.

6 . There is no strict differentiation between these procedures since thrombolytic drugs are often used prior to the use of PTCA or CABG. When we refer to the use of thrombolytic drugs we mean the use of these drugs without subsequent PTCA or CABG.

30. Using aggregate level utilisation rates for PTCA and CABG (Table 3), the countries can be divided into three groups:

- Countries with the highest utilisation rates: Australia, Belgium, Germany, Switzerland and the United States.
- Countries in the middle in terms of utilisation rates: Canada, Denmark, Finland, Greece, Japan, Korea, Norway, Spain and Sweden
- Countries with the lowest utilisation rates: Great Britain, Hungary and Italy

31. It is the interplay between the incentives for providers, health system characteristics and the underlying demand for IHD health care services that determines utilisation patterns. The high levels of utilisation observed for the United States, Germany and Australia would not appear to be unusual given the high relative levels of IHD observed in these countries. However, high demand cannot explain the high utilisation rates observed for Belgium and Switzerland, where levels of IHD are not as great, and are actually lower than IHD levels in some countries with lower utilisation rates of PTCA and CABG. For these latter two countries, it is the lower supply-side constraints that are the main contributing factors to the high utilisation levels.

32. In order to examine treatment patterns in greater detail we collected micro-data from hospital inpatient databases from several countries. As mentioned earlier, these data were collected for AMI admissions only.[7] The treatment data we collected were the proportion of AMI patients who had received a PTCA and the proportion who had received a CABG. Ideally we would have liked to have used patient-based data, which help track patients movements in and out of hospitals, since these present a more accurate picture of treatment episodes. For example, most AMI patients who receive a CABG do not undergo this procedure during the initial admission. The patient is usually stabilised and then referred for a follow-up admission for CABG. Therefore, we collected information on CABG use for up to 90 days following the initial admission for AMI. We did the same for PTCA. Unfortunately, patient-based data were not available for all countries. In this paper we only describe the trends using the patient-based data. The trends from the event-based data are similar (see note 1 to obtain further information regarding the study, including a more complete description of the differences between patient-based and event-based data).

33. The micro-data show that the proportion of AMI patients undergoing PTCA has steadily increased during the 1990s in all countries (Table 4). What is more, the increase does not appear to be confined to younger age groups. This is most apparent in the US where the use of PTCA for treating the oldest AMI patients in our study (85-90 years) has increased 2.7 times for males and 3.9 times for females between 1990 and 1996.

Table 4. Proportion of AMI patients undergoing PTCA and CABG

34. In general, there do not appear to be any significant differences between males and females in the use of PTCA, except in Perth (Australia) where the proportion of women under 80 years receiving PTCA is greater than the proportion for men. The use of PTCA decreases with age, as expected. AMI patients in the US are far more likely to undergo PTCA than patients in other countries, mirroring the same pattern seen with the aggregate data, although the proportion of women in Perth aged 40-64 undergoing PTCA was slightly greater than the corresponding proportion of women in the US. This latter result may not

7 . We also collected information based on angina admissions but these are not presented here.

reflect national trends since they are based on regional data; California for the US data (only for the 40-64 year age group) and Western Australia.

35. Similar to the trends with PTCA, the proportion of AMI patients undergoing CABG has increased in all countries during the 1990s, for all age groups, except for males and females aged 40-64 in the US. The proportion of US males and females AMI patients in this age group receiving CABG decreased from 23.4%(20.4%) in 1993 to 19.2%(14.4%) in 1990. In 1996 the level was roughly the same as three years earlier. It is not only the fact that this is an exception to the rule that makes this an interesting case. The data collected for this age group come from hospital administrative data for the state of California only, unlike the data for persons aged 65 and over which come from Medicare files and are therefore national in scope. Through Medicare, persons aged 65 and over have universal health insurance coverage, while a significant number of persons aged less than 65 years do not have health insurance coverage. However, this is only circumstantial evidence, we did not collect information on insurance status, so we cannot say that this is the cause of the drop in use of CABG for the younger age group in the US.

36. There also appears to be no significant differences between the proportion of males undergoing CABG and the corresponding proportions for females, with the exception of the United States, where the proportion of males undergoing CABG is higher than females for all age groups. As expected, the proportion of AMI patients undergoing CABG decreases with age. The gap in utilisation between the US and the other countries is even greater for CABG than PTCA, even for people aged 40-64.

37. The increase in revascularisations among the elderly is indicative of a pattern of expanded indications of use. As providers gain experience performing revascularisations they will operate on progressively more complicated cases over time (see paper on diffusion of technology for more details). We did not collect data on severity of cases admitted, but older persons will generally comprise more severe cases.

38. For the use of PTCA there may have been a further impetus to increasing utilisation. In the mid-1990s there were several published trials that showed the use of intracoronary stents helped to reduce the occurrence of restonosis following PTCA, one of the major complications of PTCA (SCHÖMIG *et al.* 1996; LINCOFF 2000). Following the publication of these trials there was a noticeable increase in the proportion of PTCA using stents and this may have had a positive effect in increasing the use of PTCA (see note 1).

39. Finally, one of the issues not dealt with in this paper is the issue of substitution of PTCA for CABG. As a whole, the number of revascularisation procedures being performed is increasing, but utilisation of PTCA is growing faster than CABG (see note 1). These data suggest the possibility that PTCA may be replacing CABG as the preferred means of revascularisation, but without information on case-mix it is difficult to measure this effect.

4. Outcomes: The consequences of dealing with IHD

40. The analysis on health outcomes focused on two indicators: fatality and readmissions. We collected data from both event-based and patient-based hospital administrative databases, but only the patient-based data are described here.

41. For case fatality rates we collected information on inhospital fatality, 90-day case fatality and one-year case fatality rates for AMI patients. Our interest in collecting outcomes information lies on being able to examine a relationship between outcomes and acute care treatments for persons admitted for AMI. Ideally, we would want to compare as homogenous a group of patients in terms of case severity as

possible, but collecting this information was beyond the scope of our study. We eliminated some of this problem by choosing to collect information on AMI admissions rather than IHD admissions (see note 4). The focus here is on one-year case fatality rates.

42. It is not surprising that case fatality should rise with age since older persons will tend to have more complicated cases. The general trend by gender is somewhat more mixed. In the Oxford region of Great Britain for example, in the two older age groups men tend to have slightly higher fatality rates than women. On the other hand, a larger proportion of younger women in Oxford hospitalised for AMI died than in the comparable group of men. As for the general time-trend for case fatality rates, these have tended to decrease in all countries. These results are consistent with the results obtained from the data on inhospital, and 90-day case fatality rates.

Table 5. One year case fatality rates

43. Cross-country comparisons of one-year case fatality rates show Finland to generally have the highest rates, with Sweden, Great Britain (Oxford region) and the United States in a middle group, and Canada (Ontario) and Perth (Australia) with the lowest fatality rates. However, this depiction is not an exact one since there are some nuances within this group of countries, the United States for example. For the youngest age group, case fatality rates for both men and women in the US are about in the middle of the studied countries. However, for subsequently older age groups, case fatality rates for US men and women are relatively lower than the other countries. Fatality rates in the oldest age groups in the US are among the lowest among these countries.

44. The other outcome measure we collected was readmission (Table 6). Readmissions are another negative consequence of acute care interventions and are more indicative of quality of life following intervention for an AMI than case fatality which is a more direct measure of outcome. The information we collected was on readmissions within one year from admission for the following conditions: AMI, IHD, congestive heart failure and all causes.

Table 6. Readmissions one year following initial admission for AMI, by sex

45. Cross-country comparisons of readmission rates reveal little variation, with rates for 1996 varying from 4% of all patients admitted for AMI in Oxford having been readmitted for the same condition to 7% in Sweden. There were slight differences by gender and readmissions for AMI were generally on the decline during the period of investigation. The most noticeable thing about these statistics is the lack of any age gradient for AMI readmissions. There are several plausible explanations for this. This may be because older persons are more likely to be admitted for a whole range of conditions apart from AMI and they are more likely to have died, reducing the pool of potential readmissions. Finally, it may be that older persons are less likely to be scheduled for follow-up treatment, which many of these readmissions will represent.

46. There is considerable variation across countries for readmissions for IHD. In the US, 11% of AMI patients were readmitted for IHD in 1996, compared to 27% for Sweden. This result may reflect the greater reliance in the US on PTCA for treating AMI, which has been shown to reduce angina. It may also be partially attributable to differences in coding, patients readmitted for AMI being more likely to be classified as IHD patients in hospital discharge records.

5. Economic Aspects

47. Expenditure on IHD represents one of the largest components of health expenditures by disease. The greatest proportion of spending for treating IHD occurs in the hospital sector, where up to 75% of direct health expenditures can be attributed. The economic consequences of IHD extend beyond direct

costs. Indirect costs such as diminished or lost worker productivity or the burden of care placed on family members of disabled persons also have a significant economic impact, although this aspect of the health care costs of IHD are difficult to estimate.

48. For acute conditions that require hospitalisation such as AMI, measures of length of stay are positively correlated with the cost of providing treatment, therefore, they represent useful indicators of resource use for acute care.[8] The following analysis focuses on the mean length of stay since it is the most readily available indicator of length of stay (we use the more common term of average length of stay). Statistics on other measures of central tendency for length of stay were also collected and are presented in the main IHD report.

Table 7 Average length of stay for AMI patients

49. There has been a gradual decline in average length of stay for all countries during the 1990s. The largest declines are observed in Germany, Finland and Sweden. Our study shows length of stay for hospitalisation for AMI in Japan to be 30 days, twice the length of stay of the next highest country Germany. There is no distinction between acute care beds and long-term care beds in acute care institutions in Japan; the excessive lengths of stays in Japan likely reflect a significant amount of hospitalisations unrelated to treating AMI.

5.1. Unit costs

50. We evaluated the economic implications of providers' treatment decisions with information we collected on unit costs for certain acute care treatment "bundles". The bundles of goods were based on diagnosis-related groups (DRG) which allow for a certain level of comparability across countries. The information on expenditures these for bundles are supplemented with cost information taken from studies on cost-effectiveness (to obtain a more detailed explanation see note 1).

51. Using the French DRG grouping (Groupes homogènes de malades) as a guide, we collected unit cost information for six bundles of treatment goods, but only show the results for three: (1) complicated AMI where PTCA was used, (2) elective PTCA excluding AMI patients, and (3) CABG regardless of reason for admission. We divide the unit cost figures, which are in national currency units, by GDP per capita to express the final figure as a percentage of GDP/capita.

Table 8. Unit costs for selected acute care treatments

52. What is most striking about these data is the large difference between the unit costs for PTCA in the US and all other countries, particularly with regards to PTCA for patients admitted with AMI. The unit costs of using PTCA in the US are about 3 times greater then the next highest country (Belgium) for complicated cases of AMI and about 1.6 times greater than the next highest country (Japan) for uncomplicated cases.

53. In Denmark, Finland and the United States, the difference in cost for treating complicated cases of AMI with or without PTCA is negligible. If using PTCA to treat complicated cases of AMI is no more costly than not using PTCA than a favourable environment for opting for PTCA may exist. In the US this may partly explain the greater use of PTCA in treating AMI patients than in other countries, especially given the fact that physicians are paid fee-for-service which encourages greater volume of procedure use

8 . Excessive lengths of stay for reasons unrelated to the original admission for AMI can lead to overestimating the true resource use for AMI admissions.

(OECD 1994; Mcclellan 1997; GILMAN 1999; OR 2000). In Denmark and Finland, the majority of physicians are paid salary which would create an environment less conducive to using PTCA.

54. There is less variation in the unit costs for CABG across countries than PTCA. Unit costs for CABG in the United States are larger than other countries, but costs in Japan are not much smaller, when taking into account the possible measurement errors, the unit costs in both countries may be similar. Unit costs for CABG are higher than the unit costs for PTCA. Although the unit costs for a complicated AMI with PTCA in the US is comparable to the unit cost of CABG, the more direct comparison, with elective PTCA, shows there to be a considerable difference in unit costs between CABG and PTCA in the United States.

55. It is well documented that the United States spends more on health care than any other country in the OECD. These data on unit costs shed some light on this issue. From Section 4, we know utilisation of PTCA and CABG is higher in the US than elsewhere. Assuming relative cost differences across countries for treating IHD are similar for other diseases, if the costs of PTCA and CABG in the US are also higher, than it should come as no surprise that health expenditures in the US are higher than other countries.

6. Discussion

6.1 Does utilisation reflect demand?

56. In Section 2 countries were divided into two groups depending on their relative level of IHD, using IHD mortality rates as a proxy for the relative level of IHD. In the ensuing section a similar exercise grouped these countries according to their relative utilisation rates for revascularisation procedures (coronary artery bypass graft and percutaneous transluminal coronary angioplasty). The purpose is to obtain a picture of the relationship between the demand, relative level of IHD, and supply, relative level of utilisation per 100,000 inhabitants, for revascularisations. The use of IHD mortality rates as a proxy for the level of IHD may not be ideal, but it was the best compromise given the available data. The method of dividing countries into two groups, high versus low level of IHD, avoids the pitfall of inferring differences in IHD mortality rates imply proportionally equal differences in relative demand.

57. The underlying level of IHD in a country should be a fairly reliable indicator of the demand for revascularisation in that country. Table 9 shows this is the case with Australia, Germany and the United States, countries with relatively high levels of IHD and correspondingly high utilisation rates for revascularisation procedures. Conversely, the same relationship holds for Italy, which has a relatively low level of IHD and correspondingly low utilisation rate for revascularisations. However, Table 9 also shows that this relationship is far from perfect. Belgium and Switzerland, two countries with relatively low levels of IHD have higher utilisation rates for revascularisations than most countries, higher even than Great Britain and Hungary, two countries with much higher levels of IHD.

Table 9. Level of IHD, Supply constraints and utilisation of revascularisations

58. Circumstantial evidence from Table 9 show the relationship between the level of IHD and utilisation rates for revascularisation procedures across countries may not be as strong as expected. How strong then is the relationship? Chart 1 plots utilisation rates for revascularisation procedures on the level of IHD for several countries.[9]

9. Much of this analysis is based on cross-sections of data for 1997, but not all countries. This static analysis is not the most appropriate method given the fact utilisation rates for CABG and PTCA tend to increase over

Chart 1. Utilisation rates of revascularisation procedures and relative level of IHD

59. The trendline shows there to be a weak relationship between the level of IHD and utilisation rates for revascularisation procedures. The dashed trendline does not take into account the US data, which has much higher utilisation rates than any other country. Without making any inferences regarding what would be considered the optimal utilisation rate for a given level of IHD, countries significantly above the line can be considered as performing relatively higher numbers of revascularisations given their level of IHD. Countries below the line can be considered as performing fewer revascularisations relative to other countries with similar levels of IHD.

60. In addition to the US, Belgium and Germany, and to a lesser extent Australia, also appear to be performing more revascularisations than one would expect given their respective levels of IHD. This reinforces the observation for these countries from Table 9. On the other hand, the data points representing Italy, Spain, Great Britain and Denmark are well below the trendline compared to other countries. For Italy and Spain, the fact utilisation rates for revascularisation procedures are low is not surprising given their relatively low levels of IHD. Given the relatively high levels of IHD in Denmark and Great Britain, they appear to be performing particularly lower numbers of revascularisations.

6.2. The influence of supply-side constraints

61. It is clear that something other than the level of IHD is driving the utilisation of revascularisation procedures. What are the main driving factors?

62. Both CABG and PTCA require special equipment, which not all hospitals are equipped to provide. It seems reasonable to assume that the number of facilities equipped to handle these two procedures is strongly correlated with the utilisation levels for these two procedures. Chart 2 and Chart 3 plot these relationships.

63. To examine the effect of facility availability on the utilisation of PTCA and CABG, we explored the relationship between available facilities and the utilisation rates for each procedure. This is shown in Chart 1 and Chart 2, where we plot the number of facilities available for performing CABG and PTCA against respective utilisation rates for each procedure. The trendlines in each graph represent the relationship across countries in terms of relative "production" levels; that is, they provide a rough approximation to an appropriate number of procedures given the stock of available facilities.

64. The United States performs a much larger number of CABG procedures per 100,000 inhabitants than other countries (Table 3), which may be driven from the fact the United States also has the largest number of cardiac surgery facilities per 100,000 inhabitants. Chart 2 shows that, even when taking into account the large number of cardiac surgery facilities, the US still performs more procedures than the other countries relative to the relationship between facility availability and procedure utilisation suggested by the trendline (which was calculated excluding the US).

Chart 2 Rate of CABG procedures and cardiac surgery units per 100,000 inhabitants

65. The relationship between available facilities and the number of procedures performed is even stronger for PTCA (Chart 3). Similar to the situation with CABG utilisation, the US performs more PTCA per 100,000 persons than any other country, but unlike PTCA, the number of PTCAs performed in the US

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time. However, it is doubtful that utilisation rates, for countries with data prior to 1997, would have increased substantially enough to distort the analysis.

given the available facilities is much closer to the relationship in other countries. In fact, judging from the trendline, Norway (for example) appears to be performing more PTCA procedures relative to available facilities than the US.

Chart 3 Rates of PTCA procedures and catheterisation laboratories per 100,000 inhabitants

66. Charts 2 and 3 demonstrate that considerable variation across countries exists regarding the number of cardiac surgery facilities and catheterisation laboratories available. What then, is the cause of this variation? In Section I provided some detail regarding the regulation of facilities. The Beveredgian countries tend to have stronger 'constraints', that is greater regulation of facilities, than the social insurance countries, and they also have fewer facilities for revascularisation. In Table 9 countries are grouped into 3 rows according to the strength of the regulatory environments for facilities which is set against their relative levels of utilisation rates for revascularisations (see note 1 on where to obtain more information regarding the grouping).

67. Not surprisingly, none of the countries with the strongest constraints, Canada, Denmark, Norway and Great Britain, were among the group of countries with the highest utilisation rates for revascularisation procedures. Belgium, Germany, Switzerland and the United States, countries with much weaker regulation of facilities, have the highest utilisation rates for revascularisations. Three other countries, Hungary, Japan and Korea are also characterised as having weak constraints, but they differ because of their low utilisation levels. For Japan and Korea, this is probably due to their correspondingly low levels of IHD. In the case of Hungary, which has one of the highest levels of IHD, the issue is probably more related to other factors, for example GDP per capita or physician payment methods, than facilities regulation.

68. When juxtaposed with the information from Chart 2 and Chart 3 the inter-relationship between constraints on facilities, the number of facilities and number of revascularisations performed is not as straightforward. Certainly for Canada and Denmark, strong constraints have created an environment that is less conducive to having a large number of facilities per 100,000 than the US. However, in Germany there are fewer cardiac surgery facilities per 100,000 population than in Denmark, yet CABG utilisation rates in Germany are higher. Why Germany would have a relatively high number of catheterisation laboratories but not cardiac surgery facilities is not entirely clear. It is plausible that regulations for catheterisation facilities are less stringent than for cardiac surgery facilities, especially given the high capital and resources costs associated with the latter. However, it is difficult to say since we did not collect differentiated information regarding regulation of these different facility types.

69. Table 9 provides supporting evidence that the combination of regulation of facilities and the subsequent effect on the number of facilities exert a stronger influence on treatment patterns than underlying demand, especially in countries with relatively high levels of IHD. However, in cases such as Germany, where the relationship between regulation and the number of facilities is weaker, or Japan and Korea, where lax regulation has not meant higher utilisation rates for revascularisations, there must be other factors at work. Several studies have shown that how providers are financed is a significant determinant of utilisation levels for health care services (OECD 1994; MCCLELLAN 1997; GILMAN 1999; OR 2000). Similar to what was done for facility regulation, preferred methods of remuneration for physicians and hospitals are shown in Table 9 alongside utilisation levels for revascularisations.

70. The story regarding provider payment methods is similar to what has been observed for facilities regulation. In Belgium and Switzerland, two countries where fee-for-service is the dominant method for paying hospitals and physicians, utilisation of revascularisation procedures is high. Conversely, in Great Britain, where global budgets for hospitals and salaries for physicians are the dominant forms of payment, revascularisation rates are among the lowest. Of particular note is the fact that the countries below the

trendline in Chart 1, Spain, Denmark, Sweden and Great Britain are all countries where the majority of physicians are paid on a salaried basis.

71. The above discussion demonstrates the significant effect supply-side incentive have on utilisation rates for revascularisations. Another important determinant of utilisation is GDP per capita. As was shown in the case of Hungary, despite a high level of IHD and relatively weak constraints on hospital, utilisation of revascularisations are low compared to other high IHD level countries. Chart 4 shows that the relationship between the number of revascularisations and GDP per capita is very strong.

Chart 4. Utilisation rates for revascularisations and GDP per capita in $US PPP

72. A few words of caution regarding the above analysis should be noted. First, this production level analysis is limited to "throughputs," that is we cannot draw conclusions from this in terms of the adequacy of care delivered with regard to potential needs, nor can we draw any conclusions in terms of the effectiveness of the care delivered. Second, in the case of PTCA, not all catheterisation laboratories are equipped to perform PTCA. If we only included the number of labs able to do PTCA the data points would shift to the left, but not all to the same degree. The effect on the trendline would be more ambiguous; it would shift to the left, but it would not be a parallel shift since the proportion of catheterisation labs not equipped for PTCA to the total number of catheterisation laboratories would vary by country.

73. It is difficult to quantify the interrelationships between the qualitative variables, supply-side constraints, and utilisation of revascularisations without econometric estimations. We have conducted some preliminary empirical analyses on these relationships to investigate further any evidence of the link between supply-side constraints and utilisation of CABG and PTCA. Preliminary results reveal a strong influence on utilisation levels of relative GDP per capita, capacity constraints and the diffusion of technology, while relative health need, defined as IHD mortality, has a lesser influence.

74. As mentioned above, the cross sectional nature of this analysis has some limits but fundamentally does not alter the story. However, one aspect that has not been discussed in any detail is the diffusion of technology intensive procedures such as CABG and PTCA. This topic is discussed in greater detail in a related paper with respect to the effect of technology on health care expenditures. High per capita income coupled with the early adoption and rapid diffusion of health technologies can help explain why the United States is such an outlier in the utilisation of revascularisation procedures, even compared to other country with similar supply-side characteristics (TECH 2001; SLADE and ANDERSON). This may also help explain the higher utilisation rates of Norway, vis-à-vis other countries such as Denmark and Sweden with similar supply-side characteristics and levels of IHD. The higher than expected utilisation of revascularisation procedures, particularly for PTCA (which is a newer procedure than CABG), compared to the other countries may be due to earlier adoption by Norway because of its higher per capita income (SLADE and ANDERSON).

6.3. Conclusion

75. We have only laid the groundwork with this extensive study. This represents one of the first full-scale attempts at comparing the performance of health care systems using a comprehensive disease-based framework, utilising large hospital administrative data bases based on individual medical records, supplemented with other sources of relevant information. We hope this study will serve as a reference for understanding patterns of care for ischaemic heart disease, in relation to the health care system environment. Of course, this study suffers many limitations. First, this is not a medical study, as such the analysis of medical interventions remains fairly incomplete from a clinical perspective. In the interests of time and comparability, we were unable to use all the detailed information on clinical status, comorbidities

and inpatient drug therapy treatments available in some of these large administrative data sets. In addition, we were not able to fully reflect patients' episodes of care through lack of information on ambulatory care practices. Finally, it was not possible to address the issue of quality of life. Collecting data on this aspect of IHD would be an extremely resource intensive task, one that fell beyond the scope of the present study.

76. The strength of this study is the demonstration of the link between health care system supply-side incentives and the level and diffusion of invasive revascularisation procedures. We show that universal coverage does not necessarily guarantee the same utilisation rates for treatments across countries, since OECD countries devote very different levels of resources to health care, each within their own "universal system". However, higher “activity rates” (utilisation of revascularisation procedures) observed in some countries do not necessarily translate into improvements in outcomes that parallel the investment in resources, as some lower spending countries are able to achieve similar or even better results. Higher activity rates do exert pressures on the financing side. However, in particular, the financers of health care in the United States pay more per unit of treatment than in other OECD countries. Our results indicate that an effective health care system is one where expenditures are sufficient to minimise resource restrictions that would unduly affect patients, yet are not so high that the financial sustainability of the system is potentially jeopardised.

77. Finally, this study shows the irreplaceable value of information systems for evaluating health care systems. We have taken advantage of an enormous wealth of information sources to provide an extensive analysis of how health care systems treat IHD, yet the assessment remains incomplete since not all data were available. Improvements in the utility of these information systems require long-term investments, as well as the goodwill and participation of patients and physicians. These are more likely to participate if we can demonstrate that the information these resources have to offer can be used to improve health care systems in the long run.

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CHARTS AND TABLES

Table 1. Trends in IHD mortality rates for Males and Females: 1970-80 and 1980-95

	Men					Women				
	Mortality			Slopes		Mortality			Slopes	
	1970	1980	1995	[70-80] (5)	[80-95]	1970	1980	1995	[70-80] (5)	[80-95]
Australia	1138	825	447	-3.1%	-4.4%	555	392	241	-3.3%	-3.5%
Belgium (2)	551	443	285	-1.7%	-3.8%	247	185	135	-1.9%	-3.2%
Canada	983	774	421	-2.4%	-4.3%	506	381	217	-2.9%	-3.9%
Denmark	895	890	513	1.0%	-3.6%	463	422	266	-0.2%	-3.0%
Finland	1092	970	690	-1.0%	-2.5%	439	386	325	-1.2%	-1.2%
Germany (3)	433	442	505	1.2%	-0.6%/-0.7%	189	189	252	2.2%	0.2%/0.2%
Greece	223	272	299	2.3%	0.7%	105	103	136	0.5%	1.9%
Hungary	715	693	785	0.5%	0.5%	451	359	427	-0.9%	0.9%
Italy	418	413	288	0.6%	-2.7%	247	207	138	-0.8%	-3.0%
Japan	175	155	143	-1.3%	-1.9%	104	92	78	-1.1%	-2.6%
Korea (4)		22	77		13.3%		10	38		13.7%
Norway	791	738	502	-0.8%	-2.8%	353	296	217	-2.1%	-1.9%
Spain	172	267	236	5.4%	-1.0%	85	122	107	5.8%	-1.1%
Sweden	880	947	528	0.3%	-4.1%	483	438	239	-1.5%	-4.0%
Switzerland (2)	374	411	332	1.6%	-1.4%	162	162	159	0.3%	-0.2%
United Kingdom	908	873	585	-0.5%	-2.8%	405	380	287	-0.7%	-1.8%
United States	1133	804	463	-2.6%	-3.9%	589	402	262	-3.0%	-3.0%

Source: Under the column "From the country reports" - Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports (Australia, Canada, Finland and Norway). Under the column "From the health database" - WHO Cause of Death Statistics.

Note: (1) The age groups vary: Australia and Greece are for persons 40 - 90; remaining countries persons aged 40+; (2) 1994 data for Belgium and Switzerland; (3) For Germany, the slopes have been computed over two different time periods to avoid the time series disruption with reunification: 80-90, 90-95; (4) Data are available only for the period 1985-1995 for Korea from the database. The trend from the country report has been computed over 1995-1998 (5) The period is 70-78 to avoid time series disruption for Belgium, Germany, Hungary, Spain, Switzerland and the United States and 70-76 for Denmark.The data have been age-standardised to the European population aged 40 and over.

Table 2. Consumption of Drugs Related to the Treatment of IHD

	C02			C03			C07		
	1990	**1998**	**%**	**1990**	**1998**	**%**	**1990**	**1998**	**%**
Australia	14.9	6.7	-9.6	89.3	56.1	-5.6	29.0	21.3	-3.8
Denmark	2.3	1.3	-6.9	105.6	101.5	-0.5	13.2	17.5	3.6
Finland		1.3		63.9	59.9	-0.8	32.4	51.1	5.9
Germany		12.8		55.8	55.5		20.6	30.6	5.8
Greece	9.3	5.5	-6.4	30.4	33.5	1.2	12.0	19.0	5.9
Hungary (a)		11.0			32.7			35.2	
Italy		7.0		25.0			12.1		
Norway	7.8	8.6	1.2	43.1	40.4	-0.8	24.5	29.6	2.4
Sweden	2.5	0.7	-14.2	81.7	66.8	-2.5	38.3	38.1	-0.1

Source: Responses to OECD questionnaire “Core set of indicators for ischaemic heart disease” and ARD country reports; Responses to OECD questionnaire “Core set of indicators for stroke” and ARD country report (Hungary); Farmetrika S.A. (Greece); NMD (Norway); OECD Health Data Base 2000 (Germany)
Note: ATC C02 - cholesterol and triglyceride reducers; ATC C03 - Diuretics; ATC C07 - Beta blocking agents

Table 2 (continued). Consumption of Drugs Related to the Treatment of IHD

	C08			C09			C10		
	1990	**1998**	**%**	**1990**	**1998**	**%**	**1990**	**1998**	**%**
Australia	24.3	46.5	8.4	22.4	60.4	13.2	5.3	41.6	29.4
Denmark	12.7	33.8	13.0	7.4	26.8	17.4	0.7	7.8	34.7
Finland		32.3			53.7			15.8	
Germany		44.1					14.9	13.9	
Greece	23.0	41.2	7.6	14.3	46.4	15.9	3.5	12.9	17.6
Hungary (a)		51.1			87.0			8.5	
Italy	25.5	52.9						12.1	
Norway	16.7	37.8	10.8	16.7	39.8	11.5	1.7	37.7	47.3
Sweden		29.4			30.0		2.4	18.8	29.3

Source: Responses to OECD questionnaire “Core set of indicators for ischaemic heart disease” and ARD country reports; Responses to OECD questionnaire “Core set of indicators for stroke” and ARD country report (Hungary); Farmetrika S.A. (Greece); NMD (Norway); OECD Health Data Base 2000 (Germany)
Note: ATC C08 - Calcium channel blockers; ATC C09 - ACE inhibitors; ATC C10A - cholesterol and triglyceride reducers

Table 3. Selected Aggregate Indicators of Acute Care Treatment of IHD

	No. of AMI admissions per 100 000 population			No. of PTCA per 100 000 population aged 40 and over			No. of CABG per 100 000 population aged 40 and over		
	1990	*1998*	% annual change	*1990*	*1998*	% annual change	*1990*	*1998*	% annual change
Australia	-	180	-	76	231	14.9	177	223	2.9
Belgium	-	152	-	-	279	-	-	207	-
Canada	194	199	0.3	98	141	5.4	117	147	3.3
Denmark	-	199	-	9	155	43.6	32	131	19.3
Finland	307	253	-2.4	30	102	16.7	104	175	6.7
Germany	-	162	-	88	386	20.4	70	185	12.9
Greece	131	150	1.7	14	126	31.2	42	129	15.1
Hungary	-	243	-	-	-	-	-	-	-
Italy	137	149	1.2	-	99	-	-	91	-
Japan	-	-	-	-	-	-	-	-	-
Korea	-	24	-	-	-	-	-	-	-
Norway	325	263	-2.6	-	195	-	-	161	-
Spain	71	104	4.9	22	112	22.6	-	39	-
Sweden	339	329	-0.4	27	150	27.9	106	188	8.5
Switzerland	-	-	-	-	-	-	-	-	-
United Kingdom	250	-	-	33	80	11.8	62	76	2.6
United States	268	287	0.8	284	396	4.8	409	541	4.1

Source: (Admissions) - OECD Health Data Base 2002; (PTCA) - OECD Health Data Base 2000 (Canada, Hungary, Switzerland and the United Kingdom); "Report on Survey of Medical Care Activities in Public Health Insurance", Shakai Iryo Shinryo Kouibetu Chosa Houkoku (Japan); Mannebach 1998 (Germany); others Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports; (CABG) - OECD Health Database 2000 (Hungary, Switzerland, the United Kingdom and the United States); Responses to OECD questionnaire "Core set of Indicators for ischaemic heart disease".
Note: The population aged 40 and over was used as the denominator for PTCA and CABG. Greece – after 1996 only includes 17 out of a possible 24 hospitals. Japan – estimated number of procedures performed during a one month period (eg., June 1997), since 1994.

Table 4. Proportion of AMI patients undergoing PTCA and CABG

	MEN						WOMEN					
	PTCA		CABG		Revascularisation		PTCA		CABG		Revascularisation	
	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84	40-64	80-84
Australia	26.9	4.9	12.1	3.3	39.0	8.2	34.1	1.6	9.9	0.9	44.0	2.5
Canada	12.2	1.2	8.9	2.3	21.2	3.5	14.7	2.4	7.2	1.2	21.9	3.7
Spain	12.7	-	3.0	-	15.7	-	8.1	-	3.1	-	11.2	-
Sweden	18.2	1.7	6.4	1.2	24.6	2.9	16.8	1.1	4.8	0.7	21.5	1.8
United Kingdom	5.2	-	2.9	-	8.1	-	7.7	-	3.0	-	10.7	-
United States	38.7	16.0	19.5	12.4	58.2	28.4	32.7	13.4	14.9	8.5	47.5	22.0

Source: The data for Australia (Perth), Canada (Ontario), Finland, Sweden and the US were provided by the TECH Research Network; Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports (Spain and UK (Oxford).
Note: PTCA – percutaneous transluminal coronary angioplasty. CABG – coronary artery bypass graft. Revascularisation are PTCA + CABG.

Table 5. One year case fatality rates

	MEN						WOMEN					
	40-64			80-84			40-64			80-84		
	1990	*1998*	% annual change	*1990*	*1998*	% annual change	*1990*	*1998*	% annual change	*1990*	*1998*	% annual change
AUS	9.11	3.11	-12.6				8.73	8.70	0.0			
CAN		6.50			40.95			7.45			38.91	
DNK	17.54	9.64	-9.5	48.49	36.88	-4.5	19.48	10.59	-9.7	49.17	39.41	-3.6
DIN	14.51	10.23	-4.9	59.69	53.77	-1.5	15.44	12.66	-2.8	54.30	47.92	-1.8
SWE	11.48	6.86	-7.1	50.79	34.12	-5.5	13.26	7.37	-8.0	50.11	34.75	-5.1
GBR	8.68	8.47	-0.3				12.99	10.15				
USA	12.90	7.95	-7.7	46.40	35.75	-4.2	12.24	12.76	0.7	43.13	35.09	-3.4

Source: The data Canada (Ontario), Finland, Sweden and the US were provided by the TECH Research Network; Responses to OECD questionnaire “Core set of indicators for ischaemic heart disease” and ARD country reports (for Australia (Perth) and UK (Oxford).

Table 6. Readmissions one year following initial admission for AMI, by sex (TECH)

Both Genders

	Acute myocardial infraction			Ischaemic heart disease			Congestive heart failure			All causes		
	1990	1993	1996	1990	1993	1996	1990	1993	1996	1990	1993	1996
Canada (Ontario)		5	5		18	16		6	5		37	34
Denmark	8	7	6	18	21	26	3	4	4	33	37	42
Finland	7	7	6	22	25	27	1	0	3	32	34	37
Sweden	8	7	7	15	19	20				29	34	34
United Kingdom (Oxford) *	4	3	4	9	12	20	0	0	7	25	32	36
United States	6	6	6	12	11	11	9	9	8	39	39	38

Men

	Acute myocardial infraction			Ischaemic heart disease			Congestive heart failure			All causes		
	1990	1993	1996	1990	1993	1996	1990	1993	1996	1990	1993	1996
Canada (Ontario)		5	4		23	20		4	3		38	34
Denmark	8	7	6	19	22	28	3	4	4	34	37	43
Finland	6	6	6	22	27	27	1	0	3	33	36	36
Sweden	8	7	7	16	21	22				30	35	35
United Kingdom (Oxford) *	5	4	5	10	14	22	0	0	6	26	31	38
United States	6	6	5	12	11	11	8	8	8	38	38	37

Women

	Acute myocardial infraction			Ischaemic heart disease			Congestive heart failure			All causes		
	1990	1993	1996	1990	1993	1996	1990	1993	1996	1990	1993	1996
Canada (Ontario)		6	6		17	17		7	5		38	36
Denmark	7	7	6	16	19	22	4	5	5	32	36	40
Finland	7	7	6	23	23	27	1	1	4	32	33	38
Sweden	8	8	8	13	16	17				29	33	33
United Kingdom (Oxford) *	4	3	3	9	11	17	0	0	9	24	33	33
United States	6	6	6	12	12	11	10	10	10	39	40	41

Note: In some countries the representativeness of the data may be limited to some hospitals and/or certain geographical areas. Data on Ischaemic Heart Disease refer to ICD-9 codes 411 (Other acute and subacute forms of ischemic heart disease), 413 (Angina) and 414 (Other forms of chronic IHD), except 414.1x.

Source: The data were provided by the TECH Research Network. See Table 20 and ANNEX Data sources.

Table 7. Average length of stay for AMI patients

	1990	*1998*	% annual change
Australia	8.5	6.5	-3.3
Belgium		9.6	
Canada		8.3	
Denmark	8.0	6.9	-1.8
Finland	22.3	14.5	-5.2
Germany	19.7	13.8	-4.4
Greece	11.0	8.0	-4.4
Hungary	15.4	11.6	-3.5
Italy	15.6	10.3	-5.1
Norway	8.6	7.8	-1.2
Spain	12.9	11.4	-1.5
Sweden		6.9	
Switzerland	15.1		
United Kingdom	9.7		
United States	8.4	5.9	-4.3

Source: Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports (Belgium, Canada, including Ontario, Finland, Greece, Italy, Norway). OECD Health Data base 2000 (Denmark, Germany, Hungary, Spain, Switzerland and the United Kingdom).
Note: Data for Australia are for the fiscal years 1993-94 to 1998-99.

Table 8. Unit costs for selected acute care treatments

	Complicated AMI with PTCA	**Elective PTCA excluding AMI patients**	**CABG**
AUS	30.23	17.11	55.55
BEL	36.96	18.23	58.21
CAN	25.80	11.09	31.67
DNK	27.88	14.83	45.31
FIN	16.54	21.09	37.38
GBR		27.59	52.20
GRC	31.06		
ITA		33.63	70.07
JPN		49.33	109.82
USA	122.08	78.82	133.68

Note: Costs are presented as a percentage of GDP/capita.
Source: See note 1

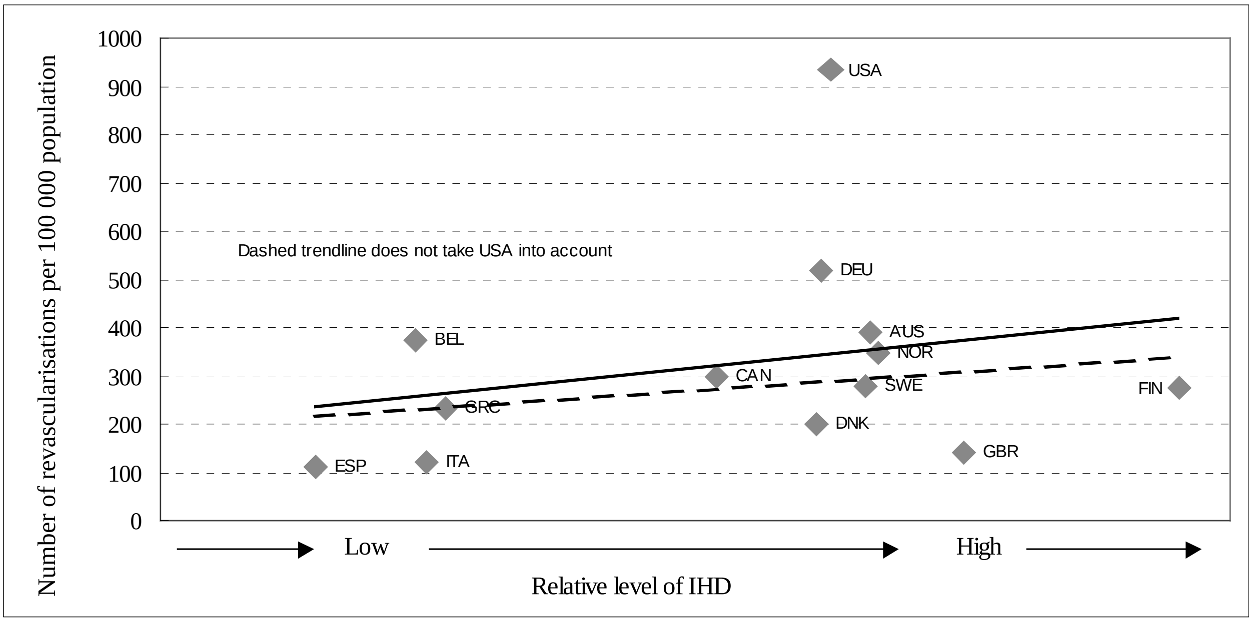
Table 9. Level of IHD, Supply constraints and utilisation of revascularisations

	Utilisation of revascularisation procedures		
	High	**Medium**	**Low**
High level of IHD	AUS, DEU, USA	CAN, DNK, FIN, NOR, SWE	*HUN, GBR*
Low level of IHD	*BEL, CHE*	ESP, GRC, JPN, KOR	ITA

SUPPLY CONSTRAINTS			
REGULATION OF FACILITIES	**Utilisation of revascularisation procedures**		
	High	**Medium**	**Low**
Strong constraint		CAN, DNK, NOR	GBR
Medium constraint	AUS	FIN, GRC, ITA, SWE	
Low constraint	BEL, CHE, DEU, USA	ESP, JPN, KOR	HUN
HOSP PAYMENT METHODS	**High**	**Medium**	**Low**
Global budgets		CAN, DNK, ESP, GRC, NOR, SWE	GBR
Mixed financing	AUS, USA	FIN	HUN, ITA
Fee-for-service	BEL, CHE, DEU,	JPN, KOR	
PHYS PAYMENT METHODS	**High**	**Medium**	**Low**
Salaried		DNK, ESP, FIN, JPN, NOR, SWE	HUN, ITA, GBR
Mixed remuneration	AUS, DEU	CAN, GRC	
Fee-for-service	BEL, CHE, USA	KOR	

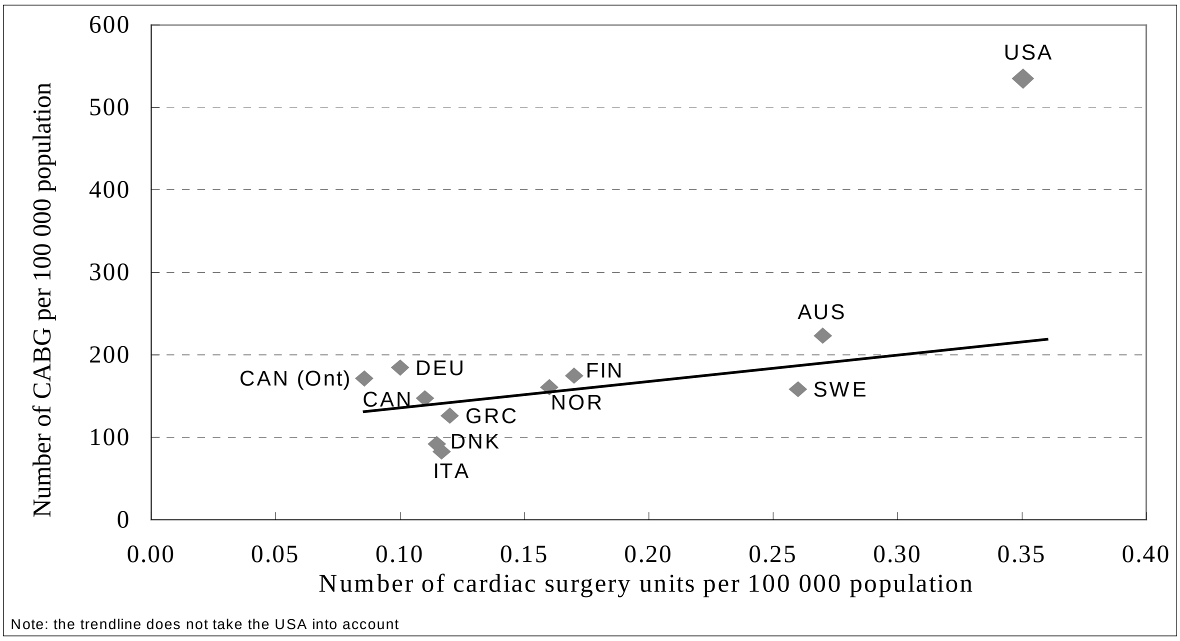
Note: The categorisations according to level of IHD and utilisation of revascularisation procedures are to be found in Sections 2 and 3 respectively. For each category of supply-side constraints (regulation of facilities, hospital payment methods and physician payment methods), the constraints are arranged in order from top to bottom in terms of their limiting effect on utilisation of revascularisations, ie the countries with the strongest constraints on activity levels, for example where the majority of physicians are paid salary, are in the first row. The third row is for the countries with the weakest constraints, such as where the majority of physicians are paid fee-for-service.
Source: See note 1

Chart 1. Utilisation rates of revascularisation procedures and relative level of IHD



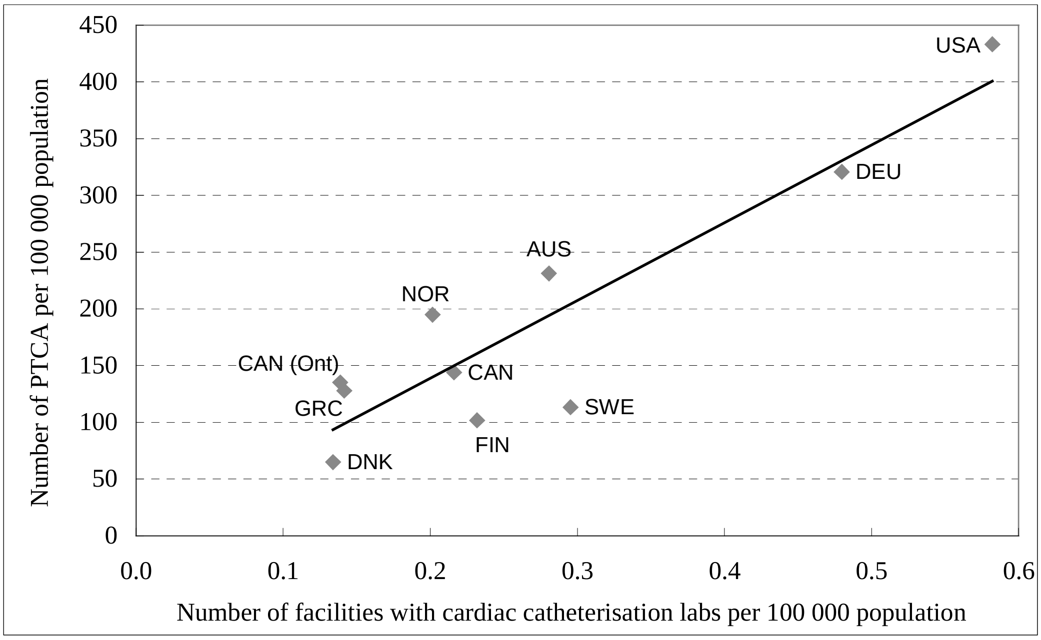
Note: Age-standardised IHD mortality rates are used as a proxy for relative levels of IHD. Belgium, Australia, Spain (1995); Denmark, Finland, Sweden (1996); Canada, Germany, Greece, United Kingdom, United States (1997); Italy: mortality (1995) and revascularisations (1996); Norway: CABG (1996), PTCA (1998), mortality (1995). Data standardised to the European population aged 40 and over.
Sources: Revascularisations - see Table 4. IHD mortality - OECD Health Database (2001).

Chart 2. Utilisation rates for CABG and number of cardiac surgery units, per 100 000 inhabitants



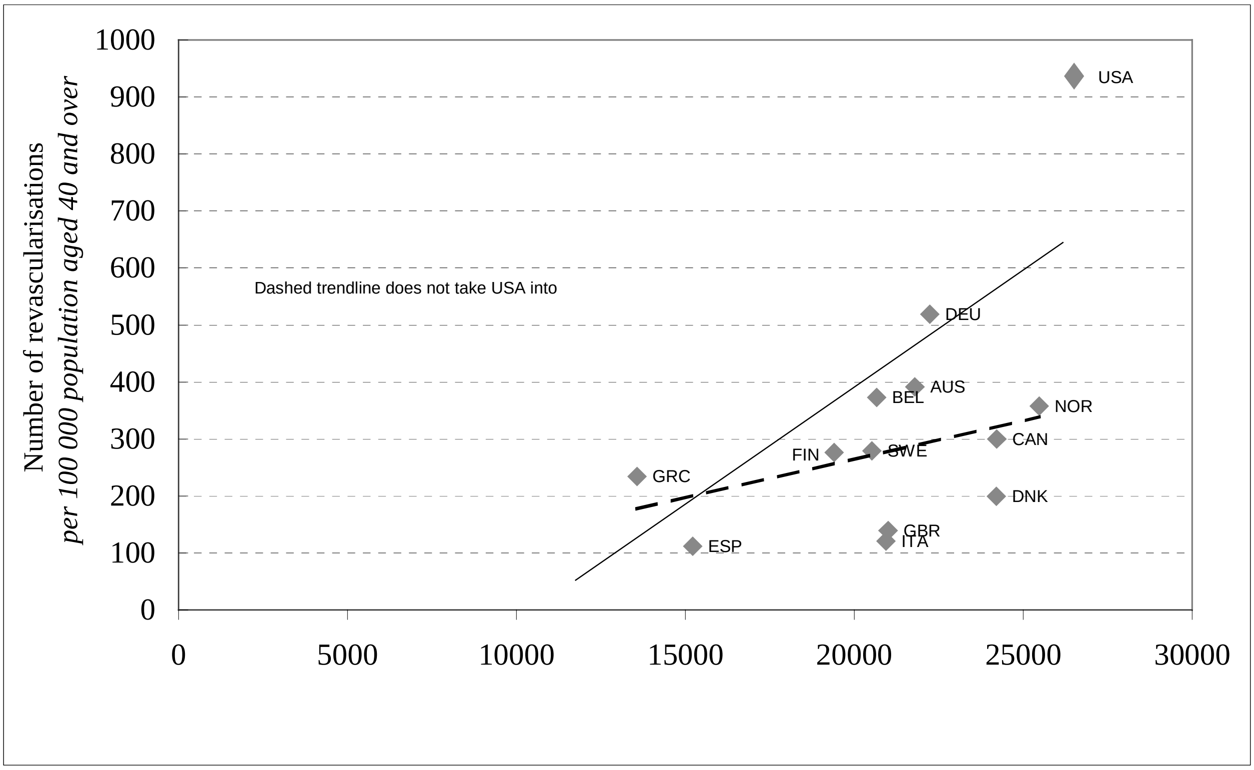
Note: Canada, Denmark, Sweden (1995); United States (1996); Italy (1997); Australia (1998). For Ontario, Finland, Greece and Norway: CABG (1998), cardiac surgery units (2000). Refer to Chart 4 for additional notes.
Source: CABG per 100,000 population - see Table 4. Cardiac surgery units per 100,000 population - Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports

Chart 3. Utilisation rates for PTCA and no. of catheterisation facilities, per 100 000 inhabitants



Note: Canada, Ontario, Denmark, Sweden (1995); Germany, United States (1996); Greece (1999). For Australia, Finland and Norway: PTCA (1998), catheterisation laboratories (2000). The figures for facilities includes all facilities able to do cardiac catheterisation due to the difficulty of separating these facilities from those additionally equipped to do PTCA.
Source: PTCA per 100,000 population - see Table 4. Catheterisation laboratories per 100,000 population - Responses to OECD questionnaire "Core set of indicators for ischaemic heart disease" and ARD country reports.

Chart 4. Utilisation rates for revascularisations and GDP per capita in $US PPP



Note: Belgium, Australia, Spain (1995); Denmark, Finland, Sweden (1996); Canada, Germany, Greece, United Kingdom, United States (1997); Italy: mortality (1995) and revascularisations (1996); Norway: CABG (1996), PTCA (1998), GDP per capita (1997). Data standardised to the European population aged 40 and over.

Source: Revascularisations - see Table 3. GDP per capita - OECD Health Data 2001.

Unclassified **DEELSA/ELSA/WP1/ARD(2002)2/FINAL**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development **17-Jun-2002**

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Unclassified

Working Party on Social Policy. Ageing-Related Diseases.

SUMMARY OF RESULTS FROM BREAST CANCER DISEASE STUDY

WHAT IS BEST AND AT WHAT COST?
OECD STUDY ON CROSS-NATIONAL DIFFERENCES OF AGEING-RELATED DISEASES: CONCLUDING WORKSHOP

To be held at the International Conference Centre, 19 Avenue Kléber, 75016 Paris
from 20 to 21 June 2002, starting at 9h30 on the first day

Further details regarding the breast cancer study can be obtained from Ms Lynelle Moon (lynelle.moon@oecd.org), Mr. Stephane Jacobzone (stephane.jacobzone@oecd.org), or Mr. Pierre Moise (pierre.mosie@oecd.org), at the OECD Secretariat, and from Ms Melissa Hughes of the Dana Farber Cancer Institute, Harvard University, Boston (melissa_hughes@dfci.harvard edu).

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SUMMARY OF RESULTS FROM BREAST CANCER DISEASE STUDY

1. There is growing concern that we do not completely understand how health care systems are performing in return for the level of human and financial investments made in them. While much of our understanding is based on an abundance of studies comparing aggregate spending on health care as a measure of resources and life expectancy or potential years of life lost as outcome measures, these are often inadequate for understanding a health care system's performance. The OECD embarked on answering this question through a trio of micro-level, disease-specific studies focusing ageing-related diseases -- one of which is breast cancer.

2. Breast cancer is the most common cancer site for women across OECD women and the incidence rate of breast cancer has been increasing steadily, particularly for those women over 50 years of age. There exists variation in standard of care treatment for breast cancer across countries, despite published results from clinical trials. There is also marked variation in five-year survival rates from breast cancer on an international level. These differences in treatment patterns and outcomes are significant among the older populations across the OECD. Along with a variety of clinical factors, economic and regulatory factors may be contributing to the different patterns of care and outcome rates that exist across countries.

3. Two other studies have examined this topic. The first study by the McKinsey Global Institute examined variations in productivity at a disease level and recent trends to variations in incentives and supply constraints for three countries (Germany, the United Kingdom and the United States) (Baily and Garber, 1997). Baily and Garber found that differences in productive efficiency between the US and UK were inconclusive in terms of care for breast cancer; however, the UK did devote fewer inputs for lower outcomes. Screening, in particular, had an effect on the differences in input consumption and overall productive efficiency. In addition, McClellan presents cross-national estimates of differences in high technology related treatment rates that are closely linked to supply side incentives in countries' health care systems (McClellan et al., 2001). A team of European and US researchers have also explored trends in rates of survival in American and European Cancer patients (Gatta, Capocacccia, Coleman, et al. 2000). They found the survival rates to be higher in the United States than in Europe, particularly for those cancers, such as breast cancer, where treatment and screening can make a difference.

4. To examine the possible impact that differences in incentives related to regulatory and economic constraints may have on patterns of breast cancer care and survival rates across countries, we conducted a qualitative and quantitative study of 13 OECD countries. We compiled information on a country's health care system as it relates to breast cancer and registry and/or linked administrative and registry data on treatment and outcomes. We focused primarily on the use of breast-conserving therapy and mastectomy for breast cancer treatment. We then sought to explore whether variations in economic and regulatory factors in the health care delivery and financing systems could explain any differences in treatment use and outcomes.

1. Cross-national patterns of breast cancer care

5. As part of this study, treatment data were obtained using either administrative, cancer registry or linked registry-administrative datasets from the following countries: Belgium, Canada, Canada (Manitoba

and Ontario), France, Italy, Sweden, United Kingdom, and the United States. Registry data collect surgical therapy up until 6 months post diagnosis, but radiation therapy data needs to be interpreted with caution since it is difficult to obtain treatment information if the patient received radiation therapy outside of the hospital setting. Between 1980 and late 1990s (year when most recent data was available), treatment data are presented as 1) proportion of women receiving *mastectomies* as their definitive surgery; 2) proportion of women receiving *breast conserving therapy* (BCS) as their definitive surgery; and 3) proportion of women receiving *breast conserving therapy and post operative radiation therapy* (RT after BCS) according to current standard of care recommendations.

Breast conserving therapy with radiation therapy vs. mastectomy

6. In 1985, randomised controlled trials published in the medical literature reported that most women who were diagnosed with early stage breast cancer could avoid mastectomy by undergoing BCS plus radiotherapy. Both types of treatment demonstrate similar local recurrent-free and overall survival rates, while BCS allows for preservation of the breast (Fisher et al., 1985, Veronesi et al., 1981).

7. The proportion of women over 40 who receive breast-conserving surgery compared to mastectomy as primary surgical treatment varies dramatically across countries (Table 1). Proportion of women receiving mastectomies ranged from above 75 percent of women diagnosed with breast cancer in Japan and Norway to about 20 percent in the United Kingdom. Uptake of breast conserving surgery was faster in France, Belgium, and United States – where BCS was the treatment of choice for more than 50 percent of women diagnosed with breast cancer in 1995. Japan and Norway clearly have adopted BCS at a slower rate than other countries, with only 20 percent of women diagnosed with breast cancer receiving BCS. It should be noted that a significant decline of use in BCS between 1989 and 1994 occurred in Sweden due to a large scale randomised clinical trial undertaken in 1991 that resulted in radiotherapy (RT) being given only to half of the patients undergoing BCS.

Table 1. Proportion of women diagnosed with breast cancer and received type of treatment.

8. The proportion of women 70 years and older receiving BCS was lower than younger age groups in the countries included in this study (Table 2). Clearly, younger women are more likely to receive breast conserving surgery treatment. The gap between younger and older age groups' utilisation of BCS varies widely across countries. Belgium, Canada, France, Italy, Norway, and United States all observe slightly lower levels of BCS utilisation in the older age groups, starting at 70 to 79 years of age, in comparison to the younger age groups. A more significant drop in BCS utilisation across older age groups is evident in Sweden and the UK. Women who are 80 years and older in Sweden and the UK tend to be twice less likely than women 70 to 79 years to receive BCS (about 15 percent vs. 30 percent, respectively) in 1994-1995.

Table 2. Proportion of women received BCS

9. One notable difference in surgical treatment rates is in the UK where both mastectomy and BCS rates for older women of age 80+ are at much lower levels than other countries (Tables 2 and 3). Mastectomy rates tend to increase with age across countries; while the UK reports rates around 10 percent for those over 80 undergoing a mastectomy. While most countries show a wide age differential in use for BCS, across both younger and older age groups, the UK has one of the lowest levels of BCS use with only 15 percent receiving the procedure. Surgery in older patients may be discouraged in the UK, while there might be a greater reliance on tamoxifen to control breast cancer in advanced ages.

Table 3. Proportion of women received mastectomy

10. Use of adjuvant breast RT after BCS varies across countries– ranging from 57 percent in Italy to 95 percent in France between 1990-1997 (Table 4). Lower rates of RT after BCS in some countries suggest that many women are not receiving radiation, despite recommended standards of care. Women who choose BCS over mastectomy have likely agreed to proceed with post-operative radiotherapy for their treatment plan, and have already taken into account if RT is not readily accessible or contraindicated. Therefore, the level of receipt of RT after BCS likely reflects more the issue of quality of care rather than the issue of patient preferences.

Table 4. Women receiving radiation therapy after breast conserving surgery

11. Use of radiotherapy among those who received BCS varies dramatically by age, with a sharp decline in use for those over 70 or 80 years of age across countries, though there have been increases in RT use over time. The age gradient is not as pronounced in all countries. Some countries observe a more significant drop at 70 (Canada (Manitoba), Italy, Sweden, and UK) in the use of RT after BCS compared to other countries. However, in Belgium, France, and the US, women aged 70 to 79 years receive RT after BCS at a similar rate on average as the younger age groups and those women 80 years and older receive RT after BCS much less often.

12. Several factors can explain the differences in treatment patterns such as patient age, sociodemographic characteristics, hospital characteristics, geographic area, comorbidity, marital status, physician and patient preferences, type of health care system, availability and proximity to radiation therapy and costs (Farrow et al., 1992, Nattinger et al. 1992, Samet et al. 1994, Lazovich et al., 1991, Barlow et al., 2001). We first examined whether demand or supply side constraints might be a barrier or an influence on breast cancer treatment choice. We then specifically explored possible associations with BCS rates and RT rates after BCS and independent variables such as type of health care system and reimbursement levels and availability of radiation therapy centres.

13. Based on the country reports' description of their health care systems, there is little evidence of any constraint on the demand for health care related to breast cancer. However, access barriers due to supply side constraints such as payment system, supply of providers, availability of technological resources may exist. For example, many experts in OECD countries are concerned that the number of cancer specialists and resources for RT are too low to meet the current and future demands of cancer care. In several country reports, experts cited serious problems with delays in radiation therapy (e.g. Canada, Norway, Sweden and the United Kingdom) that can be related to resource availability and productive efficiency (Grunefeld et al., 2000, Sainsbury et al., 1995, Royal College of Radiologists, 1991). Data obtained from countries was not comprehensive for supply of cancer specialists such as oncologists so we were unable to explore an association with this independent variable.

14. We were able to test the hypothesis that there is a relationship between the overall proportion of women diagnosed with breast cancer receiving RT after BCS and the availability of radiation therapy machines. Researchers have found lower rates of radiation therapy after breast conserving surgery to be associated with poor distribution and supply of specialised treatment centres with capacity for radiotherapy (Iscoe et al, 1997, Guadagnoli et al., 1998, Nattinger 1990). Rates of radiation therapy machines across countries vary. There has been an increase in the number since 1980s to meet the increasing demands. However, from our data there does not appear to be a strong relationship between the availability of RT machines and proportion of women receiving RT after BCS for those over 40 years of age (Chart 1). When looking more specifically at the 70 to 79 age group (without Sweden) a stronger relationship may exist between the availability of RT machines and rates of RT after BCS (Chart 2).

Chart 1. Patients receiving RT after BCS, and availability of RT machines

Chart 2. Patients aged 70-79 receiving RT after BCS, and availability of RT machines)

15. In countries with fixed payment systems there may be a disincentive to pursue more complicated and costly treatments such as BCS and series of subsequent RT. In contrast, in countries with more flexible payment systems such as France, Belgium and US, each patient is seen as a source of revenue so there is more incentive to refer. Interestingly, based on initial review, countries that use global budgets (Norway, Sweden, Canada, and United Kingdom) tend to demonstrate lower rates (generally less than 50%) of BCS utilisation than those that rely on fee-for-service or diagnostic-related group (DRG) payment methods (France, Belgium, and the United States). In the United States, studies have reported that higher reimbursement levels for BCS influenced providers' propensity to choose breast conserving surgery (Mandelblatt et al. (2001). Recent European studies also found that reimbursement practices varied and influenced the extent of treatment across European countries (Lievens et al. 1999, Norum et al., 1997). In countries, or in hospitals where global budgets or per diem payment are used, the total number of fractions for radiation therapy was lower, and the total dose was lower. On the contrary in countries with fee-for-service systems, treatments tended to be more aggressive and higher dosed.

16. Generally, the data available from participating countries appear to show that older patients might be treated less frequently and less intensively than younger patients. Most countries have lower RT utilisation rates among the 80+ age-group, though there have been relative improvements over time in some countries—where utilisation rates have reached the level of their younger counterparts. The lower rates of BCS and RT among older women based on cross-national estimates presented here are consistent with the literature in the US and other countries (Farrow et al., 1992, Samet et al., 1994, Ballard-Barbash et al., 1996, Paszat et al. 1998, Mandelblatt et al., 2000, Tyldesley et al. 2000). Many of these studies have shown that older women do not receive recommended treatments for breast cancer as frequently as younger women, even when controlling for comorbidity. Many hypothesise that older women receive different therapy than younger women for reasons unrelated to their disease, despite findings that older women equally tolerate and benefit from these treatments (Greenfield S., Blanco D., Elashoff R., Ganz P. 1987). Silliman et al. (1989) found that age had a significant impact on the probability of receiving follow-up treatment, such as radiation therapy, after BCS, and adjuvant chemotherapy for patients with a regional disease and undergoing a mastectomy. A more recent study, on a larger cohort of 18 000 patients based on US SEER data linked with Medicare claims (Ballard-Barbash 1996), shows that, after adjustment for multiple clinical and non-clinical factors, chronological age remains an important factor associated with a lower probability of receiving radiation therapy after breast-conserving surgery among women aged 65 years or more who were diagnosed with early-stage breast cancer. Further research is needed to determine what are the reasons behind the fact that older women are getting treated less aggressively – and perhaps, providers are not feeling confident on how to treat the older population effectively due to a lack of clinical evidence on how to treat breast cancer for this age group.

2. Performance: Description of costs and outcomes

2.1 Costs of care

17. Overall, most countries tend to spend about 0.5 to 0.6 percent of total health expenditures on breast cancer. However, when analysing the unit costs for initial treatment, countries' spending is variable. Initial treatment is defined often as all therapies that occurred six months post diagnosis which typically includes surgery, any preoperative therapies, and sometimes the start of any adjuvant chemotherapy or radiation therapy if no chemotherapy is involved. Cross-national estimates are based on country-specific studies that calculated costs with different methodologies. Unit costs of initial phase of breast cancer treatment are presented as percent of GDP per capita. Norway tends to have the lowest costs among those

observed at 26.4 percent of GDP per capita. Unit costs are slightly higher in France and in Canada for women more than 50 years of age (34.4% and 32.8%), with the US studies presenting the highest unit costs (41% to 62.4%).

18. Costs of breast cancer treatment may also differ by type of treatment. In most cases, breast-conserving surgery associated with radiotherapy appears to be more expensive than a mastectomy, when considering the initial six-month episode of care. It seems that in some countries, such as Norway, the higher costs related to breast-conserving surgery, when compared with mastectomies, might be influencing treatment patterns (Norum, 1997). However, a recent US study found that mastectomy in fact may be more expensive, when a longer time period is analysed (Barlow and Taplin, 2001). When analysed over a five-year period. higher expenses are often incurred for continuing care after a mastectomy, that is likely to include reconstruction surgery and adjuvant therapies. Breast conserving surgery appears to be relatively more cost effective, when examined over a five year period, even when radiation or adjuvant therapy are taken into account.

19. Although results by age groups could not be presented due to the heterogeneity of data, most studies show that costs are higher in the younger age groups. Higher costs for younger age groups have been found in the United States and in Canada (Fireman et al. 1997). In addition, in most countries costs for more advanced stages are higher than for earlier stages. Such data have been obtained for a number of countries. The gradient in costs by stage exists for all countries, but with different patterns. The country rankings from the initial costs comparison remain largely unchanged when examining costs by stage, with the United States spending more than Australia and France, and Canada spending less. Some partial Italian data were available, which suggest that Italy is among the lower spending countries.

2.2 Five-year relative breast cancer survival rates

20. Outcomes data collected as part of this study include relative five-year survival rates, adjusted using the World Standard Cancer Patient Population (Black and Bashir et al., 1998). The majority of countries presenting data are from the EUROCARE project. Similar methods have been used for the countries participating in the EUROCARE project (Berrino et al., 1995; Quinn et al., 1998). Several countries who have not participated in the EUROCARE project have provided survival rate estimates, that are likely to not be comparable to the EUROCARE estimates so cross-national interpretation should be undertaken with caution.

21. Table 5 displays overall five-year relative breast cancer survival rates in the mid-1990s, or latest available data. There are marked variations in breast cancer survival rates, ranging from 72 percent in England to 84 and 85 percent in United Status and Japan. Data from the EUROCARE studies, from 1978 to 1985 and 1985 to 1989 present similar differences (Berrino et al., 1995; Quinn et al., 1998). Survival was above the European average (73 percent in 1985-1989) in Iceland, Finland, Sweden, Switzerland, France and Italy; while Denmark, the Netherlands, Germany, and Spain were around the average and England, Scotland were below average.

Table 5. Relative five-year survival rates

22. Older women have lower breast cancer survival rates than their younger counterparts in several countries. For example, England and Wales experience a stable survival rate at around 80 percent in the younger age groups up until 50-59 years, when there is a fairly dramatic decline to 53 percent for those women 80 years and older. Older women in the United States, however, experience fairly equal outcomes as compared to their younger counterparts in 1989-1995 (at around 82 percent).

23. Since the mid-1980s, overall and age-specific five-year relative survival rates improved for breast cancer across countries. Most countries experienced dramatic increases in survival rates among the younger age groups between 40 to 65 years. This differential improvement in survival across age groups may reflect the increased use of mammography and more aggressive treatment in the younger age groups. Sweden and Norway both observed notable increases among female breast cancer patients aged 50 to 59 years.

24. Older women, over time, have been living longer with breast cancer in some countries. Sweden has made the largest relative improvement among its female breast cancer patients aged 80 years and older, increasing their five-year survival rate to the level of their younger female breast cancer population at 87 percent. England and Wales, however, demonstrated no survival improvement between 1986-1990 and 1991-1993 for the oldest age groups (70 percent for 70-79 age group and 53 percent for the 80+ group).

3. Discussion

25. These marked differences in the levels and improvement of the rates of breast cancer survival across OECD countries highlight the need to understand the determinants behind these variations. Possible contributing factors include overall stage distribution, patterns of cancer care utilisation including screening and treatment, and socio-economic factors such as income and education[1]. While much of the survival improvement is mediated through changes in the stage distribution, it is very difficult to disentangle the relative contribution of the remaining factors in influencing access to and availability of appropriate and timely health care. Below, we seek to explore each of these topics separately, based on the data and reports in the country studies for the OECD project.

3.1 Screening

26. Breast cancer screening influences survival rates as it has a direct impact on the stage distribution of cases in a country as well as the number of newly diagnosed cases. Stage distribution across countries – particularly when examined across age groups – is an important explanatory factor when examining estimates of survival rates over time. Based on the data available from country reports, significant increases in the percentage of milder cases are evident in many of the participating countries in more recent years, likely due to the implementation of organised screening programmes and improvements in technology. This trend is coupled with a reduction of the number of cases with more advanced disease over time in the same countries. However, dramatic increases or decreases were not observed in those diagnosed with the most advanced disease with largest tumour size and distant metastases across these countries. Generally, over 50 percent of newly diagnosed breast cancer patients have early stage disease and less than 10 percent are diagnosed with distant metastases across OECD countries.

27. Sant et al., 1998 present findings that suggest that in the UK, advanced stage is an important factor in explaining its low survival rates. Excess risk of death for breast cancer patients within the first six months of diagnosis was higher in the UK than for Europe overall; while after the six-month diagnosis period, the difference in excess risk of death narrowed. Patients with breast cancer who die within six months of diagnosis typically have advanced stage disease. Countries with more severe stage distribution might be experiencing lack of access to mammography screening and other diagnostic services – whether it is the supply of machines or human resources that causes delays in diagnosis.

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1 Research is underway to assess the various role of these factors. See Quaglia, project on understanding survival patterns in Europe. Capocaccia, Micheli and others for a US/Europe comparison.

28. The increasing proportion of early stage breast cancer cases has not just shifted the stage distribution observed in countries over time, but also has boosted the overall number of incident breast cancer cases. Cross national variations in survival might correspond to differences in incidence and stage distribution of breast cancer – that in turn reflects the level of screening activity in the country. Therefore, countries with higher incidence tend to have higher survival rates. So-called “minimal breast cancers” such as those less than 5 mm, are being detected more and more frequently mammographically. These are in fact not likely to result in death due to breast cancer, but are included in the numbers of incidence and the calculations of survival rates. Experts argue that real survival rate differences may be due to these type of statistical or registration artefacts, lead time bias due to earlier tumour detection and length bias where screening will pick up indolent cancers that may never become clinically apparent or result in death due to breast cancer. It is difficult, therefore, to draw any significant associations between survival and stage at diagnosis or higher incidence.

29. Age differentials in stage at diagnosis across countries were observed in the data available from countries, where older age groups had a higher likelihood of being diagnosed with advanced disease. These trends are likely to be a key factor behind the lower breast cancer survival rates for the older age groups. Older women may not be receiving timely mammography screening. Most of the country's organised screening programmes do not target older women over 70 years, and it appears that older women are having a mammogram less often than their younger counterparts. In Canada and the US, sixty-five to 70 percent of women between ages 50-69 surveyed in their national health survey reported receiving a mammogram in the past two years. This percentage dropped to about 44 to 49 percent of women aged 70 years and older in Canada. Wider age differentials were found in countries such as the United Kingdom with only 3.2 percent of women surveyed over 70 years reporting having a mammogram in the past year in comparison to 40 percent of women between 50 to 59 years of age; in Belgium, with only 10.5 percent of women over 70 years old, as compared to 32.2 percent of younger women; and finally, Sweden with 20 percent of women over 70 years old, as compared to 70 percent of women between 50 to 59 years of age. Though these estimates of screening levels in the population are not comparable cross-nationally, the data highlights the infrequent use of mammography in countries such as UK and the possible contribution to the low survival rate in those countries.

30. Overall participation rates of mammography screening are only weakly related to the overall availability of mammography machines. Wide variation in the rate of mammography machines per million women over 40 years of age exists across countries, with France and United States having the highest supply of mammography machines. Countries with explicit regulatory constraints on technology diffusion tend to have lower rate of mammography machines per capita such as Canada, Norway and the United Kingdom. Other countries such as Hungary and Japan also have lower rates of mammography machines when compared to OECD countries. However, when examining the impact of technology availability on participation rates, some countries, and particularly the Nordic countries, achieve a fairly high rate of screening, although they have fewer machines than countries such as France or the United States. It appears that countries with integrated public systems achieve high rates of screening as part of organised programmes, whereas insurance-based countries such as France, do not achieve such a high rate even if they have more machines. In the insurance countries, the primary role devolved to opportunistic screening tends to distribute this screening unevenly and does not necessarily allow for the most cost-effective use of the technological resources available.

3.2 Access and quality of care

31. The second factor that can help explain the cross-national survival differences is access and quality of care of breast cancer-related treatment. However, several factors contribute to the differences in treatment patterns, including the availability of screening and diagnostic examinations; availability of

agreed-upon treatment protocols and rate of adoption of these recommended treatments; provider and patient preferences; and supply of technology and manpower. The relationship between stage at diagnosis and survival is discussed above. Differences in stage distributions across countries are due in large part to the participation rates in screening programmes. Stage at diagnosis determines the type of treatment that can be offered by the provider, the response to treatment, and ultimately the prognosis. In addition, lack of agreed-upon treatment protocols might explain some of the cross-national variations in survival – particularly in the 1980s – when very few consensus statements on therapeutic interventions for breast cancer existed. Since the mid-1980s, more and more consensus statements and treatment protocols have been developed based on recent clinical trial findings on this topic on a national and international level. This movement has encouraged a more unified approach to breast cancer treatment than in earlier years. For instance, there has been much discussion on the positive impact of tamoxifen – once evidence of its effectiveness was published in the literature in the early 1990s -- on survival (EBCTCG, 1992).

32. Further exploration should be given to other possible factors related to the organisation of the health care systems, such as supply of oncologists and other cancer-related specialists as well as RT resources. As an exploratory analysis, we examined above if there is any relationship between the overall proportion of women diagnosed with breast cancer receiving additional radiation therapy after BCS and the availability of radiation therapy machines. There does not seem to be a strong relationship overall. Looking specifically at the 70-79 age group, a stronger relationship between the availability of radiation therapy machines and rates of RT after BCS exists that should be explored once more detailed data are obtained (see Charts 1 and 2).

3.3 Socioeconomic and demographic factors

33. Finally, socioeconomic factors have been researched as a determinant of poor cancer survival (Kogevinas et al., 1997) where these factors have created barriers to access of care – specifically in reports focusing on variations within their country. Several studies have found that low socioeconomic status could explain the differences in survival, after controlling for stage, histological type and type of treatment received. For instance, patients living in affluent areas within specific regions had higher survival than those living less affluent areas of the same region (Coleman et al., 1999). Similar findings have provided supporting evidence that the socioeconomic level of a country is an important determinant of cancer survival – in terms of inequality of access to and availability of health facilities (Sant et al.,1995). However, it would remain to be seen whether these socio-economic factors would differ substantially across countries. Are women aged 50 to 80 and above significantly poorer in some countries and does this impact their health status? The analysis of pension data and micro data for income distribution shows single elderly women may suffer higher poverty rates in countries such as the US (which experiences very high survival rate on average) and in the United Kingdom (which experiences lower survival rate). The evidence suggests that socio-economic factors, although they can play a role within countries and between individuals in a given country, and also play a major role in explaining cross national differences as a whole.

34. The decline in survival among older women is one area of concern, which needs further research. Differences in survival from breast cancer across ages is likely due to several issues covered in this paper such as stage at diagnosis and screening and treatment patterns where we also observed significant age differentials. First of all, stage at diagnosis may prove to be even more important prognostic factor in treatment planning for older women (Vercelli et al., 1999). There is an even wider age differential in one-year survival rates than five-year survival rates among older women, suggesting that older women are being diagnosed with much more advanced disease and experiencing a worse prognosis than younger women.

3.4 Mortality rates and screening

35. Mortality rates can be used to provide an additional perspective on health outcomes, particularly given the complexities involved with interpreting survival rates in the presence of lead time and length time biases. However, while mortality rates do not have these biases, they have other limitations (such as they do not control for variations in incidence, and they are more affected by influences outside the health care system). While neither the mortality nor the survival data are able to establish a causal link between screening and mortality, it is nevertheless useful to examine mortality rate levels and trends in the context of differing screening practices.

36. In countries such as Sweden, Italy, Australia, US, and Canada, there have been moderate levels of mortality overall, with strong reductions in levels of mortality for women aged 40 and over in the 1990s (Chart 3). All these countries have aggressive screening programmes, either through organised programmes such as in Australia, Sweden, and Manitoba, or through aggressive opportunistic screening in the United States, or through a mixture of both in Italy and most Canadian provinces. In the United States, a decrease in mortality is observed for all age groups, with modest decreases for the youngest age groups. However, the US also has significant reductions in the 70-79 age group, which may also reflect more aggressive treatment for women in this age group.

Chart 3. Trends in age-standardised breast cancer mortality

37. The United Kingdom has one of the highest mortality rates, yet at the same time experienced a minor reduction in mortality according to the data available for this study. (For a more detailed earlier account, see Quinn Allen 1995.) The data needs to be updated before making a final conclusion, but it is possible that these reductions reflect the introduction of organised screening in this country at the end of the 1980s following the Forrest report in 1986 (Patnick 2000). Further publications (Moss et al. 1995, Blanks Moss Patnick 2000) provide an account of the NHS Breast Cancer Screening Programme with a majority of targets being met. The programme detected more carcinoma in situ at the beginning of the programme (1988-1993), but fewer invasive cancers than expected. It has been estimated that the programme has been responsible for a third of the fall in the death rate from breast cancer among women aged between 55 and 69 years (Patnick 2000).

38. More definitive observations regarding the link between treatment variations (including screening) and health outcomes would be possible if internationally comparable data were available on survival rates classified by the stage of the cancer. This would allow differences in the stage distribution between countries to be controlled for in the analysis of the data. Thus, the confounding effect of some countries having higher proportions of early cancers detected compared to other countries (because they are better at detecting them either through higher participation rates in screening programs or better screening techniques) could be removed.

4. Conclusion

39. One of the objectives of the ARD project in bringing together information on health policy, epidemiology, treatments, costs and outcomes was to determine which countries were getting the best value for their health care spending. The first objective in determining which countries are getting the best value for their health care spending is to determine the relative performances of their health care systems.

40. In terms of breast cancer, assessing performance is a complex task, which would involve multivariate analysis of variations in survival; however, the data available to us for international comparison is very limited. We attempted to examine the impact of technological inputs (e.g. mammography machines or RT machines) on a variety of outcomes: recommended treatment, screening

rate, and finally survival rates as a preliminary step (Charts 1-2, 4-6). No conclusions can be drawn, except for the UK, with a much lower availability of machines and poorer survival, similar to the findings made by Baily and Garber. Survival rates do not seem to depend on the availability of state-of-the-art technology.

Chart 4. Patients receiving a mammography and availability of mammography machines

Chart 5. 5-year relative survival rate and availability of mammography machines

Chart 6. 5-year relative survival rate and availability of radiotherapy machines

41. This study, however, confirms the variation in treatment patterns that persist, despite protocols for recommended care. Screening seems to be impacting the survival rates of several countries, evident in Europe. However, the UK is one country which clearly stands out, with a poorer survival rate. It would seem, from available evidence that, given the restrictions in terms of the availability of qualified medical staff, screening and radiation treatment equipment, financial constraints in terms of treatment may have had an impact on outcomes.

42. As some essential pieces of the puzzle are still missing, an analysis of this sort, unfortunately, remains highly limited since the data gathered as part of this study is not patient level data linked for all variables under question (e.g; treatment, stage, survival) and the data available on potentially important independent variables (e.g. on economic factors) is fragmented. In addition, some of the country data only reflects portions of the country and therefore, treatment patterns or survival cannot be generalised to the entire country. Studies examining international comparisons face huge hurdles as it is difficult to present available data in a standard manner. To assess the performance rates of health care systems, the present exercise is limited by the availability of current data: several of the key data sources are still in their infancy from a cross national perspective and require further development. In a recent article, Irwig and Armstrong (2000) propose some alternative steps that are likely to provide more information for future debate:

- Further development of registry data, to include standardised data on cancer stage or extent of disease, and also on initial and follow up treatment.

- Further development of infrastructure and a legal climate to encourage links between registry data, hospital separation data and physician claims data as well as death records. Such links are currently available in some countries (the United States, Canada at the Provincial level, and Sweden), but could be developed further as they provide invaluable results.

- A systematic population-based measurement of women's participation in either organised, or timely breast cancer screening.

- Large cost-effectiveness trials assessing the relevance of cancer screening programmes, and the various options for treatment.

43. The "ex post" evaluation allowed by population-based assessment programmes, such as breast cancer registries, is invaluable and should be continued together with further cost-effectiveness trials. These help raise public awareness and, in a number of countries, have played a significant step in the renewal of the general health policy agenda, such as in the United Kingdom.

44. The study has for the first time compiled information on health care system factors, treatment, costs, and outcomes on breast cancer. In addition, the study's preliminary results generate several

hypotheses and identify where further data needs to collected that can then be studied. Better performance seems to be achieved through a mix of rigorously-organised population- based breast cancer screening programmes, combined with treatment protocols that follow the most recent clinical guidelines, and are not unnecessarily limited by economic constraints. However, the availability of up-to-date, state-of-the-art technology appears to be insufficient in itself to achieve high performance rates in OECD's health care systems.

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Table 1. Proportion of women diagnosed with breast cancer and received type of treatment.

		Breast conserving surgery			**Mastectomy**			**Breast conserving surgery and radiotherapy**		
		as a proportion of women diagnosed with breast cancer						*as a proportion of women receiving breast conserving surgery*		
		1985-87	*1990-93*	*1995-97*	*1985-87*	*1990-93*	*1995-97*	*1985-87*	*1990-93*	*1995-97*
Belgium		na	46	64		61	53	na	na	90
Canada	(c)	39	46	43	54	49	39	na	na	na
Canada (Manitoba)		39	57	70	76	71	55	80	74	74
Canada (Ontario)	(b)	34	43	54	45	39	31	45	67	76
France		na	58	65	na	35	32	na	95	93
Italy		na	31	na	na	62	na	na	57	na
Japan	(a)	1	7	22	98	90	77	na	na	na
Norway		na	23	24	na	78	76	na	na	na
Sweden		na	29	43	na	62	48		81	60
United Kingdom (England)		35	49	47	31	22	23	78	70	72
United States		26	40	51	69	55	43	40	42	43

Notes: Reflects most invasive surgical procedure.
(a) crude proportion for breast conserving surgery and mastectomy; standardised for breast conserving surgery and radiotherapy.
(b) for the "Breast conserving surgery and radiotherapy" column only: one clinic with incomplete radiation treatment information was excluded; it represents the number of women diagnosed with breast cancer, receiving a breast conserving surgery and a radiotherapy as a proportion of only women diagnosed with breast cancer.
(c) For the 1995-1997 data, breast conserving surgery number is underestimated since day surgeries are not included.

Table 2. Women receiving breast conserving surgery as a percentage of women diagnosed with breast cancer

Country	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+
Belgium (1997)	67	69	64	59	51	44
Canada (1995)	45	45	42	42	38	29
Canada Manitoba (1995-98)	71	75	67	71	62	54
Canada Ontario (1995)	53	56	56	53	51	44
France (1997)	66	71	65	65	53	39
Italy (1990-91)	38	26	31	26	21	21
Norway (1995)	26	30	19	17	13	23
Sweden (1994)*	49	51	43	na	32	13
United Kingdom - England (1995)	56	56	55	45	34	14
United States (1995-97)**	na	54	52	50	48	43

Notes:
* Sweden estimates for 60-64 years reflect 60-69 years.
** United States estimates are not available for 40-49 years.

Table 3. Women receiving a mastectomy as a percentage of women diagnosed with breast cancer

Country	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+
Belgium (1997)	52	46	51	57	62	66
Canada (1995)	39	39	40	39	42	40
Canada Manitoba (1995-98)	57	50	57	57	57	42
Canada Ontario (1995)	33	30	29	31	33	29
France (1997)	31	26	32	33	43	49
Italy (1990-91)	56	69	58	67	68	47
Norway (1995)	74	70	81	83	88	77
Sweden (1994)*	47	45	51	na	60	58
United Kingdom - England (1995)	24	21	22	22	25	11
United States (1995-97)**	na	42	43	45	46	42

Notes:
* Sweden estimates for 60-64 years reflect 60-69 years.
** United States estimates are not available for 40-49 years.

Table 4. Women receiving breast conserving surgery and radiation therapy as a percentage of women receiving a breast conserving surgery

Country	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+	All ages (standardised)
Belgium (1997)	87	92	91	94	98	56	90
Canada Manitoba (1995-98)	71	82	83	81	64	18	74
France (1997)	91	97	94	95	93	63	93
Italy (1990-91)	65	58	65	43	39	9	57
Sweden (1994)*	73	73	62	na	38	6	60
United Kingdom - England (1995)	73	74	76	79	65	28	72
United States (1995-97)**	na	71	72	71	66	36	43

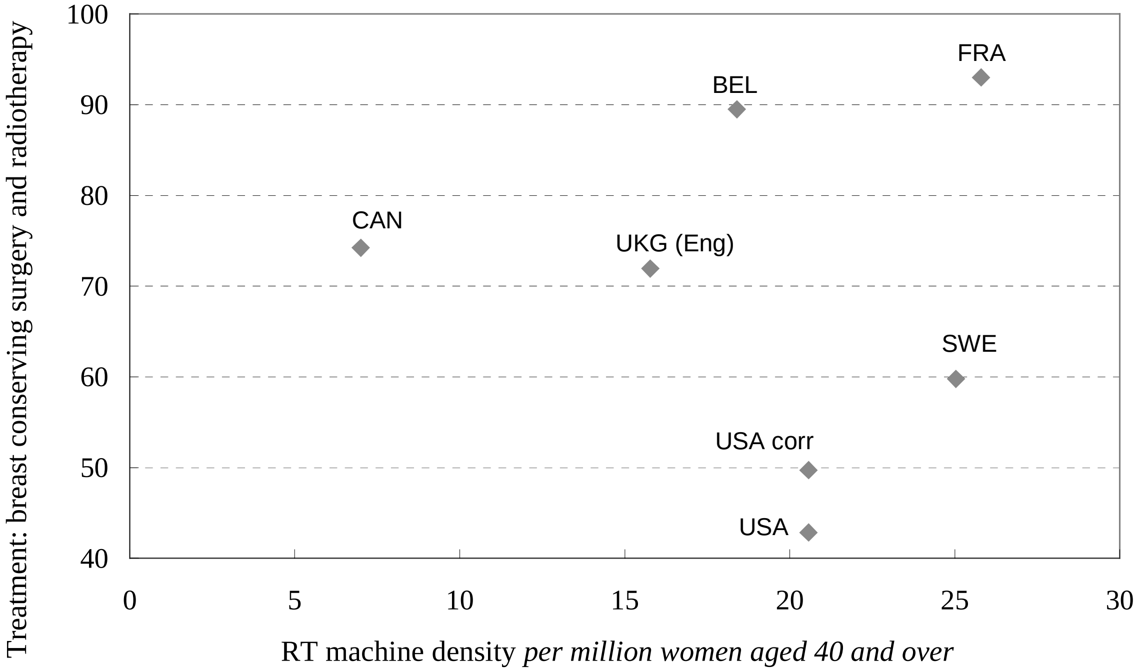
Notes:
* Sweden estimates for 60-64 years reflect 60-69 years.
** United States estimates are not available for 40-49 years.

Table 5. Relative five-year survival rates (percent)

Country	Age 40-49	Age 50-59	Age 60-64	Age 65-69	Age 70-79	Age 80+	Adjusted overall
Canada (Manitoba) (1985-89)	78.5	76.5	76.9	82.1	77.7	79.4	78.4
Canada (Ontario) (1985-89)	79.4	75.7	75.9	80.9	77.5	68.4	76.5
France (1985-89)	82.6	79.6	88.0	81.2	83.2	78.4	82.0
Italy (1985-89)	82.2	75.8	77.6	78.6	82.2	75.7	79.0
Japan (1992)*	90.5	85.9	86.3	na	81.4	76.4	84.9
Norway (1990-94)	80.5	79.2	75.2	79.8	74.1	74.6	77.9
Sweden (1989)*	81	79	88	na	85	73	82.2
United Kingdom - England (1993-95)*	79.5	81.7	77.5	na	69.6	53	74.1
United States (1989-95)**	82.6	82.5	84.7	na	82.7	na	83.8

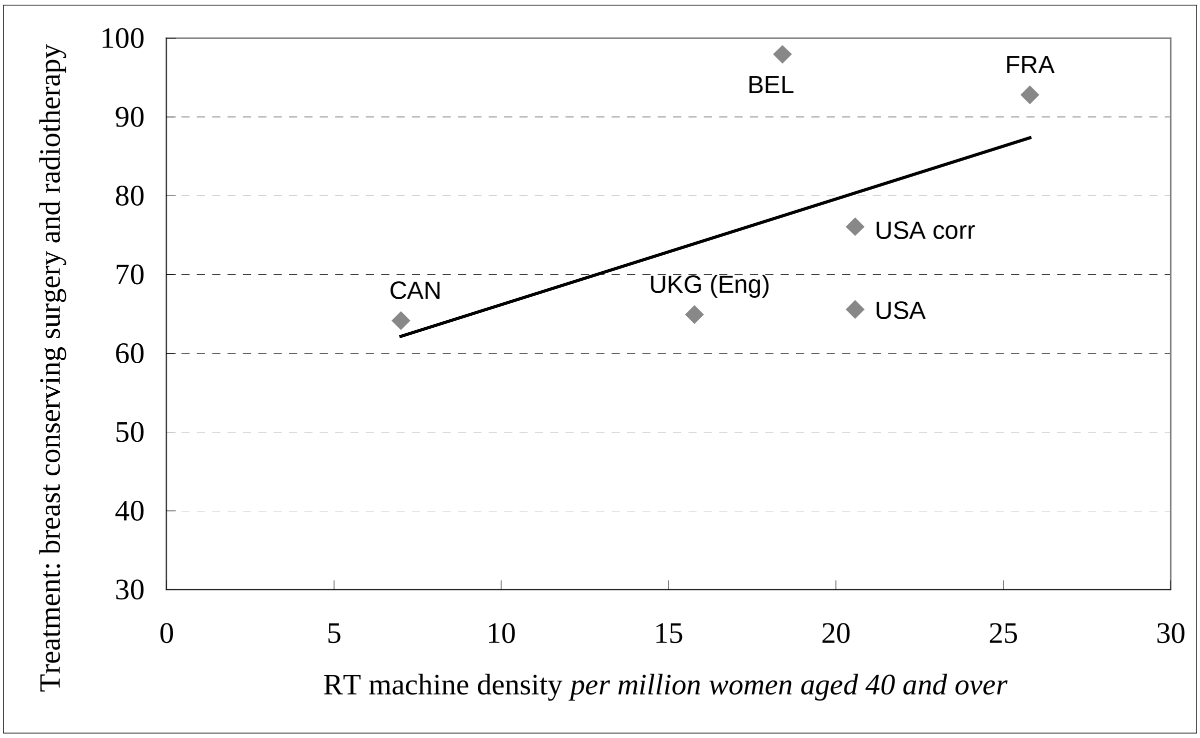
Notes:
* Estimate for 60-64 years reflects 60-69 years.
** United States' estimates for 40-49, 50-59, 60-64, and 70-79 reflect 45-54, 55-64,65-74, 75+ respectively.

Chart 1. Proportion of women diagnosed with breast cancer and treated with BCS, who also received RT and availability of RT machines (1995-99)



Note: a corrected point has been inserted for the US (+ 16 %). See Du and Freeman, 1999.

Chart 2. Proportion of women aged 70-79 diagnosed with breast cancer and treated with BCS, who also received RT and availability of RT machines (1995-99)



Note: a corrected point has been inserted for the US (+ 16 %). See Du and Freeman, 1999.

Chart 3. Trends in age-standardised mortality rates for breast cancer (rate per 100 000)

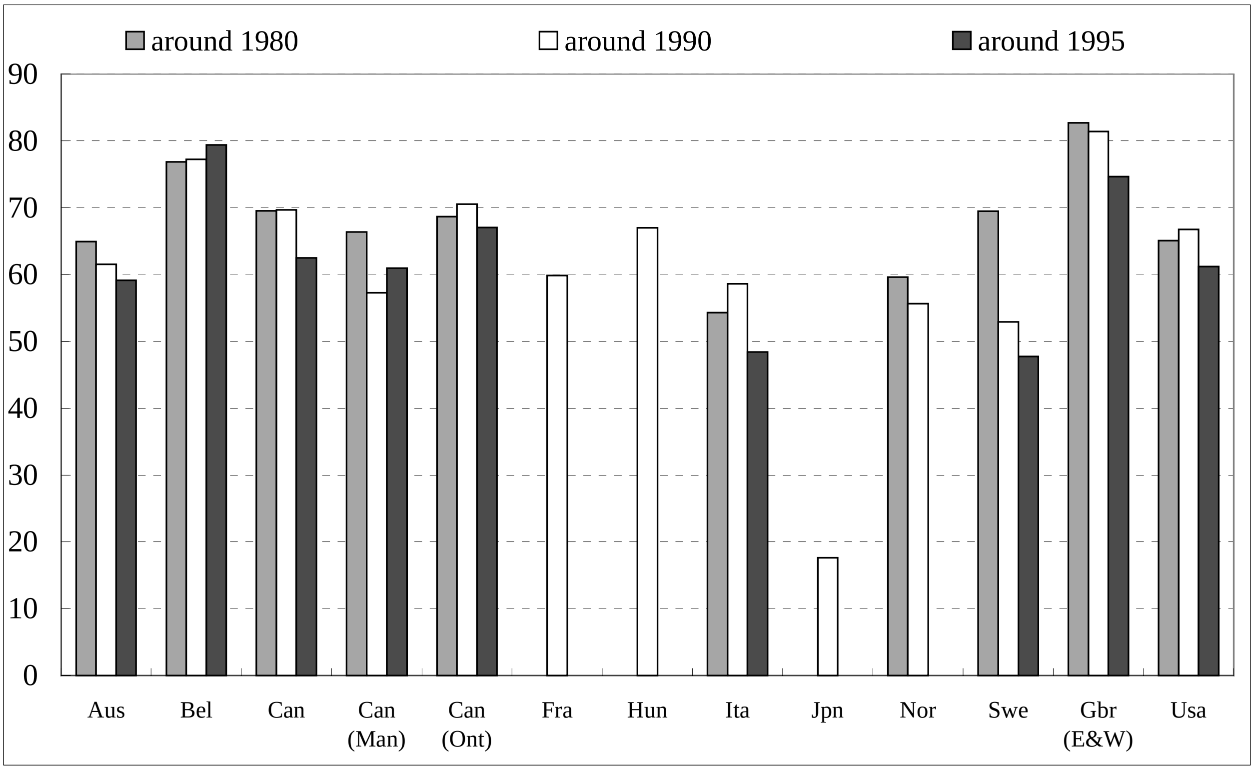
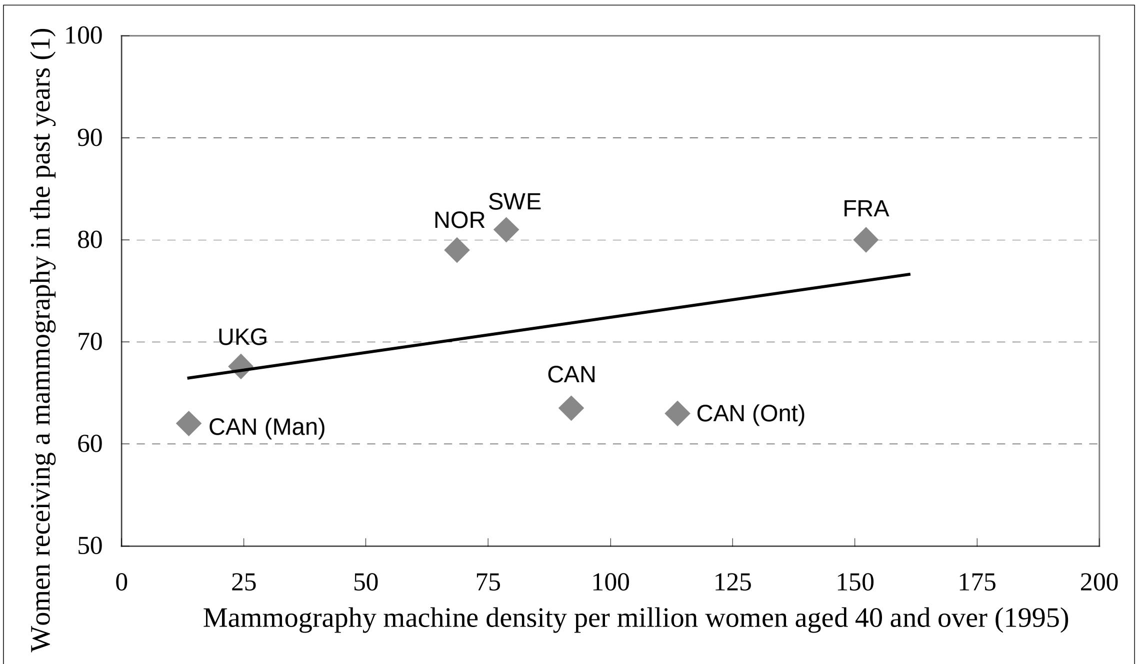


Chart 4. Proportion of women receiving a mammography and availability of mammography machines



(1) For United Kingdom, proportion of English women aged 50 to 64 receiving a mammography in the past years

Chart 5. 5-year relative survival rate and availability of mammography machines in a recent year

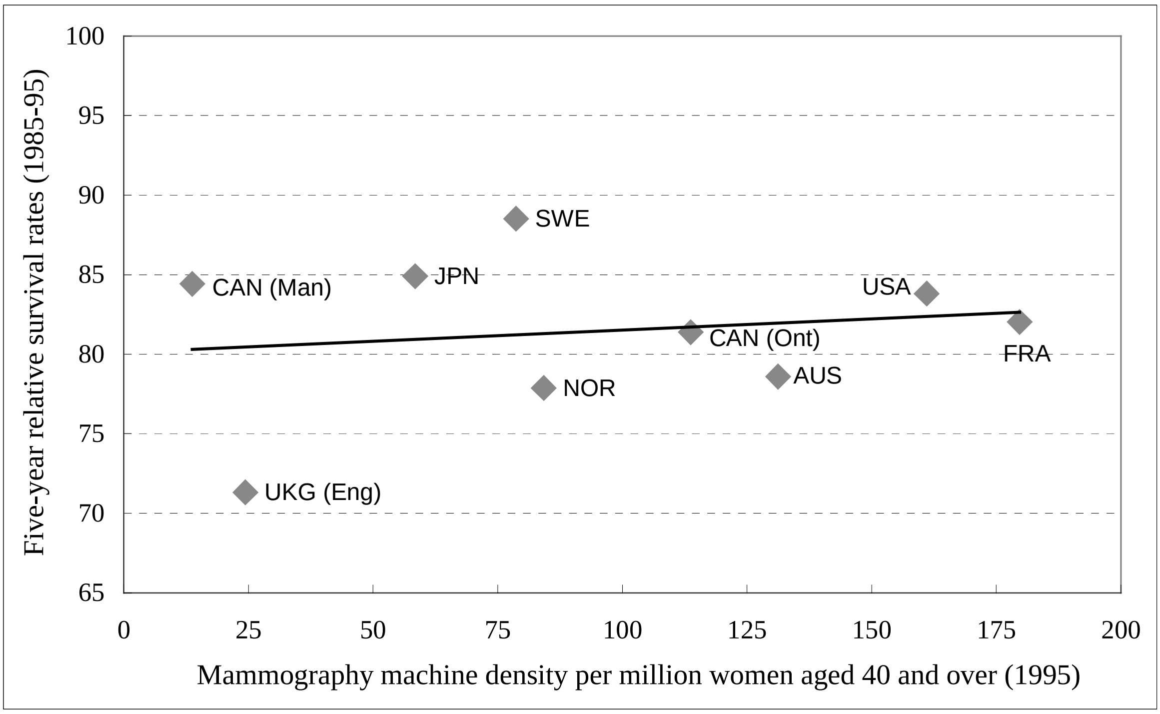


Chart 6. 5-year relative survival rate and availability of radiotherapy machines in a recent year