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OECD Study of Cross-national Differences in the Treatment, Costs and Outcomes of Ischaemic Heart Disease

Pierre Moise, Stéphane Jacobzone
and the ARD-IHD Experts Group

3

OECD HEALTH WORKING PAPERS

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ACKNOWLEDGEMENTS AND COLLABORATIVE AUTHORS

Participating Countries

Australia – Australian Institute of Health and Welfare: **Sushma Mathur**, **Susana Senes**, **Gabrielle Hodgson**; University of Western Australia: **Michael Hobbs***; Commonwealth Department of Health and Aged Care: **Kim Webber**.

Belgium – Ministères des Affaires sociales, de la Santé publique et de l'Environnement: **Dirk Moens**, **Pincé Hilde**; INAMI: **Laurence Jaskold**; Centre Interdisciplinaire en Économie de la Santé: **Marie-Christine Closon***, **Julian Perelman***.

Canada – Institute for Clinical Evaluative Sciences (ICES): **Jack V. Tu***, **Pamela Slaughter**, **Peter C. Austin***, **Curry Grant***; Health Canada / Heartland Stroke Foundation: **Seema Nagpal**. This work was supported by an operating grant from the Medical Research Council (MRC) of Canada. Dr. Tu is supported in part by an MRC Scholar Career Award.

Denmark – Department of Public Health, University of Southern Denmark, Odense University: **Terkel Christiansen***; DIKE, Danish Institute for Clinical Epidemiology: **Mette Masden***, **Søren Rasmussen***.

Finland – National Research and Development Centre for Welfare and Health (STAKES): **Dr. Unto Häkkinen***, **Dr. Ilmo Keskimäki***; National Public Health Institute, **Dr. Veikko Salomaa*, Dr. Markku Mähönen*.**

Germany – Hanover Medical School: **Dr. Matthias Perleth**

Greece – Department of Cardiology, Euroclinic of Athens: **Demosthenes Katritsis**; Center for Health Care Management and Evaluation, Faculty of Nursing, University of Athens: **Lykourgas Liaropoulos**, **Vicky Papakonstantinov**.

Hungary – The Hungarian National Institute for Health Care Research: **Àgnes Czimbalmos**.

Italy – Ministero della Sanità: **Teresa Di Fiandra, Marco Alfò, Laura Arcangeli**: Laboratorio di Epidemiologia e Biostatistica, Instituto Superiore di Sanità; **Simona Giampaoli, Emanuele Scafato**, **Luigi Palmieri**.

Japan – Kyoto University: **Yuichi Imanaka*, Tatsuro Ishizaki, Toshio Ogawa**; National Cardiovascular Center: **Shunichi Miyazaki**; Yokohama City University: **Shunsaku Mizushima**; Kameda Medical Center: **Toshitada Kameda**.

Korea – Health Care Policy for the Elderly, Korea Institute for Health and Social Affairs (KIASA): **Duk Sunwoo**.

Norway – Center for Health Administration, University of Oslo: **Grete Botten, Terje P. Hagen**; Department of Pharmacotherapeutics, University of Oslo: **Åsmund Reikvam**; SINTEF Unimed: **Charlotte Haug*** SINTEF.

Spain – Agency for Health Technology Assessment, Health Institute "Carlos III"National School of Public Health, **Antonio Sarría**

Sweden – Department of Community Medicine, Health Economics and Biostatistics and Lund University Centre for Health Economics, Lund University: **Alexander Dozet*, Sören Höjgård* and Carl Hampus Lyttkens***, Department of Mathematical Statistics, Lund University: **Anna Lindgren***, Department of Cardio-Pulmonary and Renal Sciences and Ethics, Lund University: **Hans Öhlin***. Helpful contributions made by MD PhD Per Albertsson at the Swedish Register for PTCA, Curt-Lennart Spetz at the Swedish National Board of Health and Welfare and Lars-Olof Åkesson at the Swedish National Board of health and Welfare are gratefully acknowledged for this research project.

Switzerland –Institute of Social and Preventive Medicine (IUSMP), University of Lausanne: **Vincent Wietlisbach*, Bernard Burnand* and Fred Paccaud***; Institute of Health Economics and Management (IEMS), University of Lausanne: **Alberto Holly*, Lucien Gardiol* and Yves Eggli***.

United Kingdom – University of Oxford: **Michael Goldacre***, **David G. R. Yeates***, **Stephen Roberts**. They thank Leicester Gill and Glenys Bettley for their work in constructing the linked files. The Unit of Health-Care Epidemiology is funded by the South East Regional Office (SERO) of the National Health Service Executive. The work described in this paper was funded by SERO and the Department of Health.

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Country reports:

3.   The following country reports were used as the basis of this synthesis report. Data and other information included in this report come from these reports or associated data submissions unless otherwise noted.

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COUNTRY ABBREVIATIONS TABLE

ISO country abbreviations used in this report

AUS   Australia

CAN   Canada

CHE   Switzerland

DNK   Denmark

ESP   Spain

GBR   United Kingdom

GRC   Greece

HUN   Hungary

ITA   Italy

JPN   Japan

KOR   Republic of Korea

MEX   Mexico

NLD   Netherlands

NOR   Norway

PRT   Portugal

SWE   Sweden

USA   United States

SUMMARY

4.   The Ageing-Related Diseases study compares treatment trends and health outcomes on a disease-by-disease basis. Most of the day-to-day decisions that determine health care system performance are made in treating specific diseases. Therefore, the ARD's bottom-up approach to comparing health care system performance at the disease level, rather than the more common top-down approach, goes to the heart of health care system performance. This paper presents such an analysis for ischaemic heart disease.

5.   There is considerable variation in treatment trends for the same diseases across countries and much of this variation can be explained by differences in structural characteristics of health care systems. A disease-level analysis begins with an examination of these characteristics: the economic incentives, policies and regulations that affect individual providers' decisions for treating a specific disease, defining a particular health care system's approach. In order to properly assess health care system performance, this analysis must be accompanied by an examination of the health outcomes emanating from these treatment trends. Finally, analysis of health care system performance is not complete from an economic point of view without an analysis of the cost of the various health systems' approaches to treatment.

6.   This report focuses on ischaemic heart disease. The results show substantial variation in the utilisation of revascularisations (bypass grafts and angioplasties) across countries, replicating the variations commonly observed across smaller areas. However, these variations cannot be explained by differences in the underlying demand for ischaemic heart disease procedures, expressed as the level of ischaemic heart disease. Utilisation rates for angioplasty, as an example, are considerably higher in Belgium than in the United Kingdom, despite the latter's higher level of ischaemic heart disease.

7.   What can explain these variations? The results show that regulation of health care technology can explain much of the variation, which in turn can help explain variations in spending on health care for ischaemic heart disease. Not surprisingly, the United States, with by far the highest utilisation rates for both angioplasty and coronary artery bypass graft, is also the country that spends most on health care for ischaemic heart disease. Yet, more spending on treating ischaemic heart disease does not necessarily translate into better health outcomes; the United States has lower case fatality rates for older persons than other countries, but not so for the youngest age group used in the study (40-64 years), where several countries which spend less on treating ischaemic heart disease have better results.

8.   This report is a useful tool for comparing how ischaemic heart disease is treated across countries. More importantly, it represents a first step for improving our understanding of how health care system performance through a disease-based analysis.

RESUME

9.	L'étude sur les maladies liées au vieillissement compare les tendances en matière de traitements et de résultats par type de maladie. La plupart des décisions prises quotidiennement et qui déterminent la performance des systèmes de soins de santé le sont au moment du traitement d'une maladie spécifique. Ainsi, lors de la comparaison de la performance des systèmes de soins de santé par maladie, le projet des maladies liées au vieillissement effectue une approche du bas vers le haut plutôt que l'approche plus habituelle, et va ainsi au cœur de la performance des systèmes de soins de santé. Ce document présente une telle analyse en ce qui concerne la cardiopathie ischémique.

10.	Les tendances dans les traitements préconisés varient considérablement d'un pays à l'autre pour les mêmes maladies et peuvent s'expliquer par des différences caractéristiques structurelles propre à chaque système de santé. Une analyse par type de maladie commence par l'examen de ces caractéristiques : les incitations économiques, les politiques et les réglementations qui influencent les décisions prises par des fournisseurs individuels dans le traitement d'une maladie spécifique et qui définissent l'approche de chaque système de santé. Afin d'évaluer correctement la performance des systèmes de santé, cette analyse doit s'accompagner d'un examen des conséquences qui résultent de ces tendances dans le domaine des traitements. Pour finir, l'analyse de la performance des systèmes de santé ne sera pas complète d'un point de vue économique sans une analyse du coût des approches des divers systèmes de santé face au traitement de la maladie.

11.	Ce document présente la cardiopathie ischémique. Les résultats montrent une variation importante dans les différents pays dans le choix d'interventions telles que des pontages coronariens et des angioplasties dans les différents pays, reproduisant ainsi les variations observées habituellement lors de comparaisons moins étendues. Cependant, ces variations ne trouvent pas leur explication dans les différences fondamentales en matière de demande d'interventions en cardiopathie ischémique, exprimée par le niveau de cardiopathie ischémique. Les taux d'intervention par angioplastie, par exemple, sont considérablement plus élevés en Belgique qu'au Royaume-Uni, malgré le niveau plus important de cardiopathies ischémiques chez ce dernier.

12.	Quelle peut être l'explication pour ces variations ? Les résultats montrent que la réglementation de la technologie dans le domaine des soins de santé peut en grande partie expliquer cette variation et à son tour peut fournir une explication en ce qui concerne des variations dans les dépenses de soins de santé pour la cardiopathie ischémique. Il n'est pas étonnant que les Etats-Unis, avec le plus fort taux d'interventions aussi bien pour les angioplasties, que les pour les pontages coronariens, soit aussi le pays qui dépense le plus dans les soins de la cardiopathie ischémique, ce qui reflète le niveau du pays en ce qui concerne les dépense globales de santé. Néanmoins dépenser plus pour traiter la cardiopathie ischémique ne se traduit pas forcément par de meilleurs résultats de santé. Aux Etats-Unis les taux de décès en ce qui concerne les personnes âgées sont plus bas que dans les autres pays, mais ceci n'est pas le cas pour le groupe d'âge plus jeune (40-60 ans), alors que plusieurs pays obtiennent des meilleurs résultats en dépensant moins dans le traitement de la cardiopathie ischémique.

13.	Ce rapport constitue un outil précieux pour la comparaison des modalités de traitement de la cardiopathie ischémique dans différents pays. Qui plus est, il représente un pas en avant pour améliorer notre compréhension de la performance des systèmes de santé à travers une analyse selon la maladie traitée.

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1. INTRODUCTION

14.   Health care expenditures among OECD countries continue to grow with little evidence demonstrating a definitive link between the level of spending and health care system performance at a macro-level. Across OECD countries there exist variations in spending levels, treatment trends and health outcomes, which suggest there is room for improving the performance of health care systems. However, informed decisions on health care system performance require information at both the macro and micro-level. This information should help health analysts and health policy makers answer the crucial question:

  − Do health care systems offer the best value possible given the level of human and financial resources invested?

15.   In order to answer this question requires an understanding of the link between the underlying incentives embedded in health care systems and how they affect costs, treatment trends and outcomes. Until now health care system comparisons have largely focused on one of these aspects at a time, or have combined these elements in analysing one specific treatment, or one disease at a sub-national level. To-date two key studies are known to have taken an approach which links this complex array of information at a cross-national level. In the first, a study by the McKinsey Global Institute assessed differences in "productivity" at a disease level for three countries (Germany, United Kingdom and United States) by focusing on variations in diagnosis and treatment for four diseases, and relating these to variations in incentives and supply constraints. In the second study, the TECH Research Network also made a link between treatment patterns and health care system characteristics, concentrating on one specific disease, Acute Myocardial Infarction (AMI), commonly known as heart attacks. The strength of their approach was to use individual hospital discharge records to provide a direct link between treatments and outcomes. This report borrows aspects from each of these studies, while extending the research to facets not covered in either of them, and with a specific emphasis on system-wide policy-related issues.

16.   This report is part of a broader project, known as the Ageing-Related Disease project, which examines various conditions with high prevalence and high cost among older persons. We use a common framework for each disease, with allowances made for the different nuances of each disease. The study also includes breast cancer and stroke.

17.   The information collected for this report is based on a series of national reports on ischaemic heart disease epidemiology, treatments and costs prepared by a network of over 70 epidemiologists, physicians and health economists. This information has been supplemented with data collected from existing national and international sources in consultation with participating experts. This represents an effort that has spanned almost three years, beginning with the official launch meeting for the project in spring 1999. Following this meeting a network of experts from participating countries was put in place and a meeting was convened in spring 2000 bringing together this mulidisciplinary group.

18.   The first section of this paper reviews the health care system policies of participating countries related to ischaemic heart disease. In this section we explore the various demand and supply-side issues that have an impact on health care treatments for ischaemic heart disease.

19.   The following section describes the key epidemiological trends for ischaemic heart disease. The third section provides a descriptive analysis of treatment trends, using aggregate level data and making use

of the information collected from hospital administrative databases. In the fourth section a similar descriptive analysis is applied to health outcomes data drawn from the same hospital administrative databases. The analyses in these three sections are deliberately descriptive since the main objective of this report is to make the links between the economic characteristics and policies described in the second section and the analyses in the subsequent sections.

20.   In the fifth section we discuss some of the issues surrounding spending on health care for ischaemic heart disease. The main focus of this section is on unit expenditures for several pre-defined treatment bundles.

21.   The final section sums up the results of the report drawing tentative conclusions regarding the underlying incentives embedded in health care systems, based on the analysis of the second section, and how they affect costs, treatment trends and outcomes.

22.   In addition to the main body of the report, there are 3 appendices and 5 annexes. The first appendix is a brief introduction to some of the measurement and methodological problems associated with epidemiological statistics for ischaemic heart disease. Appendix 2 is a summary of the latest trends in the treatment of ischaemic heart disease and Appendix 3 provides some details on the data culled from the hospital administrative databases used in the analysis. The tables and charts referred to throughout the report are to be found in several Annexes. All tables are located in Annex 1. The charts for Sections 2 and 3 are located in Annex 2; the charts for Section 4 are located in Annex 3 and Annex 4; and the charts for Sections 5, 6 and 7 are located in Annex 5.

2. HEALTH CARE INCENTIVES AND REGULATIONS

23.   The aetiology of cardiovascular disease involves many interrelating factors including lifestyle choices, biological and genetic aspects. Treatment in the acute phase of this disease involves expensive and highly specialised human and technical resources. However, relatively simple preventative measures can reduce the likelihood of the disease reaching the acute phase. First, primary prevention through lifestyle changes such as quitting smoking can reduce the risks of developing cardiovascular disease. This can also be accomplished by treating important risk factors such as hypertension or cholesterol with ambulatory care drug treatment. Thus, when discussing the policy implications from an economics and health policy perspective we must bear in mind the full dimension of treating cardiovascular disease from primary prevention to treatment in the acute phase. The micro-data aspects of the project will focus on the acute phase since this provides us with the best opportunity to identify the types of treatments provided at the individual patient level, plus treatments in the acute phase are very interesting for learning about the diffusion of new technologies. This is why we have examined health care incentives and regulations, including details on incentives for accessing specialised treatments in ambulatory care settings. In the general discussion of the results this will help to present the general trade-offs involved.

24.   The use of resources involves a complex interaction between the demand and supply parameters that characterise health care systems. Monetary factors invariably play a large role in the demand for health care services. Health insurance reduces prices as perceived by the patients, but cost-sharing will provide them with a non-zero price signal. Non-monetary factors such as gate-keeping systems can also help to structure demand while avoiding the direct intervention of monetary factors, particularly when equity considerations are taken into account. Of course, in emergencies, patients are often unable to express their preferences; a familiar situation with AMI where patients are sometimes admitted to hospital unconscious. The impact of monetary factors in the demand for health care services is far greater for elective surgery, ambulatory care and other non-emergency situations than it is for emergency acute care services.

25.   On the supply side, payment systems and various regulations need to be considered, as they may impact the quantity of supply and the way health care providers are reimbursed. The most important incentives are those involved in various remuneration schemes. However, in some cases, the balance between demand and supply is not achieved through market mechanisms, and may result in queues and waiting lists for treatment.

26.   This short schematic presentation provides a rationale for the various policy-related factors we have explored. We have deliberately provided a simplified representation of a complex interactive system in order to make it possible to make international comparisons, otherwise our task would have been immeasurably too complex to accomplish. The following section will discuss the impact of various forces on the demand and supply of health care services, using information gathered by the national experts, supplemented by information from published sources. This will set the stage for a discussion on the possible factors to be investigated in the empirical analysis.

2.1. The Demand Side: few financial limitations on access

27.   With the exception of the United States, all countries in our survey have universal health insurance coverage, meaning few limitations on access to medically necessary health care exist in those countries. Since treatment for the acute phase of ischaemic heart disease involves intensive medical care in

acute care facilities, the population is generally well covered. However, this may be less the case for some ambulatory care treatments, including drugs for primary and secondary prevention, or follow-up treatment. In the United States, public health insurance for the poor (Medicaid) and the elderly aged 65 years and older (Medicare) pay for the bulk of treatment in inpatient care settings. However, the working poor[1] under 65 are often without insurance and therefore face a significant barrier to treatment for IHD.

28.   Demand side constraints are not limited to barriers to initial access to the health care system due to lack of health insurance. In countries such as Korea, patient co-payments for inpatient and outpatient services could in theory have a limiting effect on patients' access to coronary care services, at least in some private facilities. However, our survey has not produced strong evidence to support the fact that this could lead to a significant deprivation of access for large groups in the population. However, while most patients will not face out-of-pocket payments for pharmaceuticals administered in hospital, this will not be the case in the ambulatory care setting. Whether this will have a significant effect on the utilisation of drugs in ambulatory care for chronic treatment will need to be investigated.

29.   Non-monetary factors may play a role restraining access to technologically intensive cardiac procedures in several ways. In some countries, gate-keeping mechanisms may restrain access to non-emergency acute care services. Waiting lists have a particular role in restraining access to these procedures. These issues will be discussed in Section 1.3.

Table 1: Potential demand side constraints impacting IHD treatment

Constraints	Strong	Medium	Low
Health insurance coverage	United States: 14% of population without health insurance	Groups with supplemental insurance; Choice of provider: Australia, Denmark, Germany, Greece, Italy, Sweden, UK, United States (FFS plan); Canada (drugs)	Most countries have at a minimum universal public health insurance covering most acute and ambulatory care treatment Care delivered in public hospitals
Cost sharing	Korea	Access to outpatient drugs: Canada, Denmark, Germany, Norway, Spain, UK, US Access to some private care services: Australia, Greece, Hungary, UK, US Japan (some inpatient and outpatient care)	Non-existent or modest for physician and public inpatient services in most countries
Gatekeeping	Italy, UK, US (managed care)	Australia, Canada, Finland, Hungary, Norway, Spain, Sweden	Belgium, Finland, Germany, Korea, Japan, Switzerland

Note: Countries can be included under more than one column. For example, in Denmark there is no cost-sharing for physician services and they, like most countries would be included in the Low column. However, there is cost sharing for outpatient drugs in Denmark, hence the inclusion in the Medium column. Most countries are in the Low column, unless otherwise stated.

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1.   Anyone earning too much to qualify for Medicaid but too little to buy private health insurance or whose employer does not offer its employees employer-based health insurance. Approximately 14% of the US population are uninsured.

2.1.1. Health Insurance Coverage

2.1.1.1. Public health insurance

30.	This section refers to the various types of public coverage available, whether through universal social insurance or tax-financed systems of health care.

31.	Given the universal coverage afforded to citizens of OECD countries, it should come as no surprise that our survey indicates few financial barriers to access exist (Table 2). The United States is the only country in this group without universal health insurance coverage, leaving about 14% of the population uninsured and at financial risk should they require treatment for IHD. As a result, the uninsured may be less likely to undergo expensive, technologically intensive cardiac procedures than the insured[2] (Wenneker 1990; Hadley 1991). Hadley et. al also found that the uninsured were more likely to die in-hospital than the privately insured (Hadley 1991). If decisions to allocate treatments are largely based on the patient's ability to pay, this may raise serious policy concerns. Two recent studies examined the influence of payer status on the use of intensive cardiac procedures for acute myocardial infarction (Sada 1998; Canto 2000), which requires immediate treatment and thereby limits the health care provider's discretion to allocate treatment based on ability to pay. Both studies showed the same results as Hadley and Wenneker, that the uninsured were less likely to undergo intensive cardiac treatments (except primary angioplasty in the Canto study).[3] Unlike Hadley, they found no significant differences in outcomes by payer status. These studies controlled for condition upon admission and other patient-based confounding factors, but did not take into account the availability of these services. When the availability of onsite revascularisation facilities is taken into consideration, the uninsured do not substantially under-use revascularisation when they are immediately available (Leape 1999; Canto 1999), but they may be less likely to be recommended to a facility with revascularisation capabilities (Leape 1999). What remains unclear from these studies is the impact on outcomes, which is the critical factor in assessing the impact of a lack of health insurance.

32.	A possible mitigating factor not taken into account in these studies is the possibility of a safety net for the uninsured through the provision of charity care. In the absence of a formal, universal health insurance system, care for the uninsured may be dispensed through charitable organisations, cross-subsidies in not-for-profit hospitals or some public hospitals which provide a de facto safety net (Kane 2000). What impact this has had on health care for the uninsured, especially for cardiovascular conditions, is unclear.

Table 2 Coverage of public health insurance and availability and use of private health insurance

2.1.1.2. Private health insurance

33.	Private health insurance exists in a number of countries and is most often used as supplemental or complementary insurance. In Australia, Denmark, Germany, Greece and the United Kingdom, many patients use private health insurance so they can be treated by the physician of their choice or jump queues in the public sector. With respect to the treatment of IHD, private health insurance has been used mainly as a means of bypassing queues in the public sector for intensive cardiac procedures, mainly CABG and

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2.	These studies found that Medicaid patients were even less likely than the uninsured to receive intensive cardiac procedures. This may reflect both low Medicaid reimbursement rates and budgeting for "charity" cases for patients without health insurance.

3.	These studies also found the same effects for Medicaid patients as Hadley and Wenneker.

PTCA. However, this role remains marginal as the study shows that for all countries public health insurance is the key factor for treatment, including the United States since the majority of people with IHD are likely to be aged 65 years and over and therefore covered through Medicare.

34.   The lack of private health insurance can also implicitly make access to some forms of care difficult to groups of less wealthy individuals. The available empirical evidence shows that income is the key parameter in the decision to buy additional health insurance and not health status (or "need").[4] High premiums may make it impossible for poor patients to buy private health insurance and this problem is further exacerbated if premiums are risk-based where less healthy individuals, who are disproportionately poorer, pay more. However, in most countries, due to the fact that insurance is often bought in group settings, premiums remain more or less independent of health status and may therefore remain affordable for large groups of the population.

35.   In general terms, the results of the survey can be summarised as follows:

  −   In countries such as Canada and the United States, private insurance can be bought to cover services left out of the public health insurance programme such as outpatient drugs for IHD patients.

  −   In Belgium, private insurance is purchased to cover cost sharing required in public programmes, although private insurance companies are prohibited by law to reinsure the co-payment. In Australia, private insurance is used to cover the co-payment required when a person decides to be admitted as a private patient, but will not cover the co-payment for ambulatory or outpatient physician services or for drugs.

  −   In countries such as Australia, Italy and the United Kingdom, patients buy private health insurance in order to access private doctors and treatments provided in private facilities, often to avoid queues for CABG and PTCA.

  −   In countries such as Finland, Hungary, Norway, and Sweden at this time, private health insurance is not widely available. However, Norway reported that there are current efforts to establish private health insurance. In Hungary also, some private companies are starting to operate. In Japan, private insurance traditionally provides an insured person with an indemnity benefit to compensate for lost income due to hospitalization. As of 2000, private insurance also provides compensation for co-payments.

2.1.2. Cost Sharing

36.   The discussion will consider separately non-drugs related care and ambulatory drugs related care due to the particular importance of cost sharing in the utilisation of ambulatory drugs.[5] Co-payments may prevent patients from using care at point of service or may affect patients' decisions on treatment choice. From a macroeconomic perspective, as a share of total health expenditures out-of-pocket payments range from 11.9% for Germany, 11.0% for the United Kingdom and 46.5% for Korea in 1997 (OECD 2000). Therefore, in some countries cost-sharing can have a significant impact on total and public health care expenditure.

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4.   For example: (Cameron 1991). See also Section 1.1.2.2.

5.   At the June meeting the group of experts felt it was important that drugs in ambulatory care settings deserved a specific discussion.

Table 3 Out-of-Pocket Payments as a percent of total health care expenditures, 1990 and 1997

2.1.2.1. Cost sharing for non-drug related care

37.   Significant out-of-pocket payments may exist in Greece and Korea, and to a lesser extent Australia, but for most countries these are modest (Table 4) and do not present a serious limitation on the demand for acute and ambulatory care treatments for IHD. Even for Australia and Korea, this impediment would be limited by the availability of means or disease-based exemptions and complementary or "gap" insurance which covers the difference in cost to the consumer between the public insurance scheme reimbursement and the actual charge.[6] In Greece, the public insurance scheme reimbursement is usually far below the rate charged by private providers, making cost-sharing a problem only for individuals who opt for private providers.

Table 4. Cost Sharing Policies for Non-drug Related Care of Ischaemic Heart Disease

38.   For non-drug related coverage, patients in Australia (refers to hospital treatments under public health insurance – see Table 4 for further details), Canada, Denmark and the UK do not have to share any of the costs for IHD treatments. For Denmark and the UK, this applies when these treatments are delivered through public providers and some privately delivered care may not be covered. In Greece, Hungary, Italy and Norway, this applies to inpatient services only. While cost-sharing may be modest in most countries, some exemptions exist for specific groups of patients, according to socio-economic status or for severe and chronic diseases. Most of these exemptions are for individuals with low incomes, including pensioners and those on social assistance, but other exemptions include the disabled and the elderly. Annual upper ceiling exist in a number of countries, either on a yearly basis (Finland, Norway, Sweden, some US HMOs), or a monthly basis (Japan). Some countries place a limit on the co-payment at the point of service, such as Germany for inpatient care. Based on the results of our survey, cost sharing does not appear to be a serious limitation on the demand for acute and ambulatory non-drug related care treatment for IHD for the majority of the countries surveyed.

2.1.2.2. Cost sharing for drugs in ambulatory care settings

39.   Since all public health insurance schemes in our survey cover drugs administered in hospitals and do not oblige patients to share in the cost, except Australia (private patients) and Korea, we decided to focus the analysis of cost sharing for drugs on drugs delivered in ambulatory care settings. Ambulatory care drugs play an essential role in the treatment of ischaemic heart disease, particularly with regard to secondary prevention. Therefore, cost sharing for these drugs deserves careful examination since policy-makers have to balance the need to delay or avoid costly acute care interventions with the excessive consumption of drugs with low cost-effectiveness. As noted above, health insurance coverage and patient cost-sharing differ more for drugs than it for other types of treatment. The types of coverage, and especially the out-of-pocket payments involved in public health insurance schemes, vary and can be significant for some patients (Table 5). Therefore, in a number of countries private health insurance is an important player in providing basic coverage (drugs prescribed outside hospitals), supplemental coverage (drugs in same therapeutic class but not covered under public health insurance) or complementary coverage (co-payments for covered drugs). On the prevention side, the countries surveyed have not specifically targeted drugs used mainly in reducing the consequences of existing IHD risk factors in their public insurance schemes. However, several countries have made exemptions from co-payments for drugs that treat chronic diseases, including coronary heart disease.

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6.   In Australia, private insurance is available to cover this gap, but only for inpatient services.

Table 5. Cost Sharing Policies for Drugs Used in the Treatment of Ischaemic Heart Disease

40.   Co-payments for drugs at first sight do not appear to be very high, but this is mainly based on a single episode of care or a single intake and not over an extended period of time. When considered for an extended period of time, which is the case when treating chronic diseases, co-payments can accumulate to a significant degree. Where there are no upper protective ceilings or specific exemptions, patients suffering from chronic diseases can be put at significant risk. In practical terms, out-of-pocket payments will be either co-payments, where the individual pays a fixed amount of the cost of the prescription, or co-insurance, where the patient pays a proportion of the cost. This distinction can make a difference in terms of utilisation, especially for expensive drugs. Basically, half the countries in our survey require co-payments and the other half co-insurance. From a health policy perspective, the role of cost sharing should not be to fully reflect market prices, but to give appropriate signals to patients so that they can internalise the consequences of inefficient and wasteful personal consumption, so that social welfare can be maximised. This role is limited by the influence of physicians in prescribing treatments, this is particularly true for treating IHD.

41.   For countries that require co-insurance, the burden on the patient can be attenuated by various means. In Belgium, Hungary and Italy (from January 2001 IHD-related drugs are free of charge – see Table 5), patients will pay anywhere from 0 to 50% of the full cost depending on the type of drug and several exemption criteria of the beneficiary such as widows, retired persons and the disabled. Korea has a mixed system whereby the cost sharing arrangement depends on the type of facility where the drug was administered. In urban areas drugs administered in a hospital require a co-insurance rate of 55%, whereas in rural areas a fixed co-payment applies. For all countries, exemptions from cost sharing based on the socio-economic status of beneficiaries exist. Finland has included drugs for treating coronary heart disease on its list of exemptions for co-payments. A majority of countries place a maximum payment, either per prescription or for a given period of time (usually one year), which is similar to the upper ceilings implemented for non drug related-care.

42.   Private health insurance can provide coverage for drugs in countries who do not provide universal first-dollar coverage for prescription drugs (United States, Canada, Mexico) or supplemental coverage to reinsure against some of the copayments. (Reinsurance of the copayment is not allowed in Australia, Germany, Spain and Switzerland). While re-insurance does not completely offset the co-payment in most of these countries, it does in Korea which is particularly important given the significant cost sharing burden there. However, private health insurance usually does not cover the whole population and is more accessible for better off individuals. Many empirical studies show that income is a key factor in buying supplemental coverage (Gonzalez 1992; Cameron 1991).

43.   Using data culled from the OECD health database (OECD 2000), we can see the public-private mix in covering prescription drugs as a whole (Chart 1). Public coverage is lower in North America and Korea. However, for Canada and the United States, the role of employer provided health insurance can be significant, which substitutes for the social health insurance provided in Bismarckian countries. Therefore, this chart tends to overstate some of the differences across countries, even if co-payments remain substantial in these countries. For example in Canada, in 1996 out-of-pocket expenses represented approximately 16% of total health expenditure, a significant sum for a country with statutory universal, comprehensive health insurance that offers first-dollar coverage (Canadian Institute for Health Information 1999). However, almost 60% of this expenditure was for spending on pharmaceuticals, which are generally

not covered by provincial health insurance plans[7] (Health Canada 1997). The issue of prescription drug coverage for the elderly is a widely debated issue in the United States (McClellan *et al.* 2000).

Chart 1: Public pharmaceutical expenditure as a percentage of total pharmaceutical expenditure

2.1.3. Non-monetary mechanisms: gate-keeping

44.   Access to complicated procedures such as CABG or PTCA often require referral from a specialist. However, as unlimited access to specialists could lead to unnecessary and inefficient use of resources, gatekeeper systems have been implemented in a number of countries. A gatekeeper system addresses this potential source of inefficiency by imposing non-monetary constraints on the demand for specialised health care services by filtering demand through a specific access point in the system, the gatekeeper physician. More than half of the countries in our survey have adopted some type of gatekeeping system (Table 6). In Canada and Finland,[8] the gatekeeping systems have evolved informally, whereas in Denmark, Italy, the UK and the US (managed care), gatekeeping systems have been formally organised as a means of controlling the utilisation of specialist services.

Table 6. Non-financial Barriers – Gatekeeping

45.   Whether they have been formally organised or have evolved informally, gatekeeping systems typically use general practitioners as the entry point into the health care system. Once the gatekeeper determines there is a need for specialised health care services the patient is referred to the appropriate specialist. In Australia and Hungary, atypical examples of gatekeeping have evolved. These countries each have an implicit gatekeeping system even though patients can access a specialist without referral. They use demand side disincentives, through higher out-of-pocket payments for patients if they see a specialist without referral from a GP, to filter demand through the gatekeeper and in this sense have set up implicit gatekeeping systems.

46.   In a formal gate-keeping system, the physician who acts as a gatekeeper has complete control on when a patient will receive specialist services, but if the gatekeeper is too restrictive this could lead to delays in obtaining specialist services. However, delays in obtaining these services can also be caused by capacity constraints in the supply of specialised services. The problem of waiting times for specialised services will be discussed in greater detail in Section 1.3.2. If on the other hand, the gatekeeper is not restrictive enough, this can lead to unnecessary use of specialist services, undermining the efficiency of the system. This problem can be addressed through the use of provider side financial incentives to limit referrals. This is the principle behind the GP Fundholder system and Primary Care Groups in the UK where physicians manage global budgets for care delivered to their patients. Similar features exist in some US HMOs.

2.2. The supply side: effective limitations on technology diffusion

47.   Before embarking on a discussion of supply side characteristics, it is important to bear in mind that the aim of this paper is to describe the factors that affect health care at the micro-level and try to draw

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7.   Most provinces offer coverage for prescription medicines for selected groups, mainly the elderly and persons on social assistance.

8.   To access non-emergency specialised care in the public system in Finland, the patient is expected to have a referral. However, there is no formally designated gate-keeper since these referrals can come from eiter a public primary care physician or from a private practitioner.

some conclusions about how this characterizes the health care system for a particular disease, in this case ischaemic heart disease. Nevertheless, an understanding of how health care systems are financed and how services in general are delivered is important to put into context the interrelationships among the various economic factors. It would not be possible to have a proper discussion of this matter in a few short paragraphs, however, there is an abundance of literature the reader can refer to for discussions of the various financing arrangements of health care systems and how services are delivered.[9]

48.   The survey reveals that supply side limitations appear to play a crucial role in differentiating OECD countries in terms of diffusion of technologies within their health care systems. In addition to official restrictions to entry and regulations, payment mechanisms may also influence how providers are able to use these technologies. In most countries, the universality of health care systems allows governments to wield a significant degree of control over health care providers through the exertion of monopsony power. These supply side constraints have tended to be reinforced in periods of slow economic growth and when increases in health care spending were straining public budgets, as was the case at the beginning of the 1980s. Restrictions of hospital and physician payment systems, regulation of the supply of providers and of technology have been the instruments used to constrain supply side behaviour. Table 7 offers a general overview of the constraints faced by providers.

Table 7. Potential Supply Side Constraints Affecting IHD Treatment

Constraints	Strong	Medium	Low
Hospital payments	*Mainly global budgets* Canada, Denmark, Greece (public hospitals), Norway, Sweden, UK	*Mixed financing or DRG* Australia (varies by state), Finland, Hungary, Italy, US (DRGs, HMOs)	*Mainly FFS* Belgium, Germany, Japan; Private hospitals: Australia, Korea, Switzerland, US
Physician payments	*Mainly salary* Denmark, Finland, Hungary, Italy, Japan, Norway, Sweden, UK	*Mainly FFS with fixed financing or mixed payment* Australia, Canada, Germany, Greece, US (Managed Care, Medicare)	*Mainly FFS with open-ended financing* Belgium, Korea, Switzerland, US
Regulation of physician supply	Apart from Canada which has used medical school places to restrict physician supply, no country has imposed supply restrictions that have affected care.		
Macro-regulation of facilities	*Explicit and targeted funding* Canada, Denmark, Norway, UK	*Explicit constraints or targeted funding* Australia, Finland, Greece, Italy, Sweden	*No constraints* Belgium, Germany, Greece (private hospitals), Hungary, Japan, Korea, Switzerland, US

Note: For physician payments, this mainly refers to physician services delivered in hospital. Thus, the focus is on specialists delivering cardiovascular care which generally does not include general practitioners.
Refer to Tables 8, 9 and 10 for more details regarding the ranking of constraints.
In some countries hospital and physician payments are not separate.
This table reflects the period for which data were collected, mainly the mid-1980s to mid-1990s.

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9.   For example, the OECD study *The Reform of Health Care: A Comparative Analysis of Seven OECD Countries* (OECD 1992), provides a thorough discussion on the different methods of financing health care systems and methods of providing services.

2.2.1. Payment systems for hospitals and physicians

2.2.1.1. Hospitals

49.   The main focus of this study has been on the technology intensive procedures which take place in the acute care settings of hospitals. In terms of financing of hospitals, there exists three main payment systems, although in practice payers tend to use a mixture of these systems (Table 8):

-   global budgets

-   case-mix payment systems or Diagnosis-Related Groups (DRGs) (see below).

-   fee-for-service.

Table 8. Financing of Hospitals

Global budgets

50.   The use of global budgets to limit health care expenditures has been particularly effective in many countries. They are an effective means of controlling spending since they impose explicit budget constraints. In the past, global budgets were the norm for most OECD countries. Since spending on hospitals was the largest component of health expenditures this made hospital expenditure a likely target for spending cuts. Today, few of the countries surveyed rely exclusively on global budgets to finance their hospitals. Canada, the UK and the Nordic countries (except Finland and Norway) are the only countries that still rely almost exclusively on them. Most countries are using a mixture of systems, involving to some extent the use of case-mix adjusted budgets. A global budget may be effective in reducing health expenditure, but also has its drawbacks since there is no link between activity and payment, offering little incentive to provide productive and timely delivery of care.

Case-mix payment systems or Diagnosis-Related Groups (DRGs)

51.   Case-mix or diagnosis related groups (DRGs) provide more incentives by grouping treatments related to specific diagnoses and procedures into payment groups, with proper weights assigned to payments based on the intensity of the service within the DRG. In theory this should provide health care providers with a proper signal with regard to intensity of services thus allowing them to more efficiently allocate resources. In fact, this may not always be the case. A US study showed that over 40 percent of Medicare's DRGs are related to treatments and not diagnoses, which could lead to the overuse of some intensive treatments (McClellan 1997). Other studies have shown that insufficient payments associated with some procedures might have the reverse effect, reducing their use (Gilman 1999). Determining the correct reimbursement rates is a critical factor for implementing DRGs, and as production functions may differ across countries, most OECD countries have had to develop resource scales for using DRGs based on their own hospital systems' production functions so that the weights could be adjusted according to local conditions. DRGs can be a powerful tool for allocating resources efficiently, but they need to be closely monitored. Despite the potential for under or overuse of intensive treatments, DRGs represent an improvement in monitoring resource allocation decisions since they can be based on objective information and hospital activity that can be made transparent to payers. Therefore, many countries have moved towards payment systems involving DRGs combined with global budgets. Historically, Denmark (as of Jan. 2000), Finland (before 1993), Norway (mixed as of 1997) and Sweden have relied almost exclusively on global budgets. However, these countries now use mixed global budget-DRGs systems, albeit not all to the same extent and with varying degrees of success. This may be a reflection of the nature of the health care systems in these countries, which are predominantly publicly financed and delivered. Of all the

countries in our study, Canada and the UK appear to be the only ones that still rely exclusively on global budgets for publicly financed hospital services.

Fee-for-service

52.   The third method used for financing hospitals is fee-for-service. This type of system provides the most direct link between activity and payment since each service has its own fee, but resource use is usually biased towards more intensive services since these generate the largest payments. Fee-for-service is rarely used to finance public hospitals and is mostly used for private hospitals in a majority of countries. Only Germany, Switzerland, Japan, Korea and some Medicaid programs in the US finance most hospital services through fee-for-service.[10] A floating point system, with ex post adjustment of fees in case of increases beyond the budget target is used in Germany to control expenditure ex post. A similar system has been set up in Hungary. In Australia, Greece, Italy and the UK, fee-for-service is only used to finance services in private hospitals. Germany and the US through Medicaid, rely on budget constraints to mitigate financial incentives inherent in these systems.

Balancing risks

53.   The whole debate about financing hospitals is to share risks between payers and providers (Ellis 1996). Global budgets in some sense put the payer at full risk, but in this case the risk is implicitly shifted to patients as activity levels have to be adjusted. On the other hand, fee for service systems put payers at full financial risk, who have to react ex post when expenditure trends are not in line with revenue. The optimal system would allow for a proper sharing of risks between payers and providers. In this respect; DRG-related payments could offer a promising solution, even if they need to be adapted and carefully monitored to assess their empirical properties, particularly with regards to small providers. Our survey offers a brief initial institutional overview of those trends. A more detailed and specific research study would be needed to completely assess their full impact.[11]

2.2.1.2. Remuneration schemes for physicians

54.   Remuneration schemes for physicians are very much dependent on the practice setting (Table 9). The majority of ambulatory care specialists are paid fee-for-service while for hospital-based physicians, particularly those in public hospitals, salary is the dominant form of remuneration. Our survey mainly considered specialists; cardiologists, cardiovascular surgeons and radiologists in some countries. While we acknowledge the importance of general practitioners in treating and preventing ischaemic heart disease, especially in their function as gatekeepers and following patients with chronic diseases, their functions are not specific enough to this disease to be examined in detail in this survey.

Table 9. Remuneration systems for Specialists

55.   Fee for service for remunerating ambulatory care specialists tends to prevail in a majority of countries. However, as fee-for-service remuneration tends to lead to high levels of activity, some countries have imposed global budgets for physician fees at an aggregate level: Belgium, Germany and Canada have

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10.   In the US, Medicaid is administered at the state level, as a consequence financing arrangements vary state to state.

11.   It should also be noted that this would be the case if the hospital sector was a perfectly competitive market, which is generally not the case. For example, in countries that favour heavy regulated hospital sectors, there may be other underlying factors for financing hospitals besides balancing risks, such as providing hospital care in rural areas.

used global budget constraints as a means of controlling expenditures on physicians' activities while continuing to pay physicians fee-for-service individually. In Canada, some provincial governments have gone one step further by placing constraints at the individual level in order to reduce activity. For example, in 1991 Ontario imposed individual billing thresholds where physicians only received a fraction of the fee for any service once they exceeded a set amount of billings in a given year.[12] The only countries where ambulatory care specialists are not paid fee-for-service are Norway (private specialists are fee-for-service), Spain and Sweden, where they are salaried and the US where there is a mixture of capitation, fee-for-service and salary for physicians working under traditional managed care settings. In addition, in some countries such as Denmark and the UK, there are no ambulatory care based specialists since they have to act in inpatient settings. In other countries, specialists can have a mixed ambulatory care and hospital based practice (see table 9, column 2).

56.   All countries have to some degree specialists who are strictly hospital-based (Table 9 column 3 and 4). Unlike their ambulatory care counterparts, these physicians tend to be paid mostly on a salaried basis, except for Belgium and Korea where public hospital-based specialists are paid fee-for-service. However, in some countries, salary levels in public hospitals can be a constraint in keeping a high level of qualified physicians in public hospitals. Therefore, Australia, Finland, Germany, Italy and UK specialists are allowed to practice on private patients in public hospitals, with varying degrees of constraint. In Hungary, patients pay unofficial "gratitude" payments which supplement the relatively low levels of salaries of public hospital physicians. Hospital-based specialists in private hospitals are almost exclusively fee-for-service, except for the US where remuneration mode depends very much on the insurer and the hospital's status, and is usually a mix of salary and performance-related pay in managed-care settings. However, in non-managed care settings and private hospitals, physicians tend to be paid primarily with fee for service in the United States.

Analysing remuneration levels and physician income across countries

57.   We did receive some data for a limited number of countries for physician income. This data needs to be reviewed and analysed carefully, particularly with regard to the upcoming expenditure section. Therefore, at this stage, we preferred not to introduce it here.

2.2.2. Quantitative regulation of supply

2.2.2.1. Physician supply

58.   With the exception of the United States, the countries in our survey have the means to limit the number of placements available in medical schools, however for the most part they have not used this power to limit physician supply, most likely because there is a long time lag before the effects are felt. In fact, between 1985 and 1994, the number of graduates from medical schools in OECD countries increased by 26% (Bundred 2000). However, this may not be the case in all countries. For example, Canada tried to reduce physician supply by reducing the number of placements in medical schools by 10% in the early 1990s (Barer 1991). According to the Canadian Medical Forum Task Force on Physician Supply however, this reduction, together with other factors, has led to a shortage of physicians in Canada (CMF Task Force Phys Supply 1999). The UK has also had a restrictive policy in terms of placements in medical schools and as a result there is a serious lack of specialist physicians.

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12.   This is practised in other provinces as well. In Quebec for example, recent graduates are paid a fraction of the fee if they practice in urban areas and are paid at a rate higher than the regulated fee if they establish themselves in rural areas.

59.	For the majority of OECD countries, it seems that the rate of physicians, as well as of specialists, per 100 000 population has been rising over the past 20 years, although we cannot discern what differences there are across specialities. The largest increases are to be found in Germany, Hungary and Norway while the smallest increases were in Canada and Australia (since 1990). In fact, the largest increases were mainly observed in continental Europe, where physician underemployment has been a problem in the past.

Chart 2a Number of Specialists per 100 000 inhabitants

60.	Restrictions on medical placement is only one tool used to control medical supply. Another possibility is to restrain the number of licensed practising physicians, as was attempted in Germany through the Blum Seehofer reforms in the mid-1990s. The uneven distribution of physicians between rural and urban areas is another area where several countries have tried to develop strategies for balancing physician supply. This problem is particularly felt in the three largest countries of the OECD, Australia, Canada and the United States, where the problem exists not only between rural and urban areas but for remote areas as well. These countries, as well as many others in the OECD have, for various reasons, resorted to recruiting foreign trained specialists to meet their shortages (Bundred 2000).

61.	We have focused the empirical efforts on gathering supply for cardiologists and cardiovascular and cardio-thoracic surgeons, since they deliver the bulk of acute ischaemic heart disease care treatments. The results are presented in the Charts 2b,c,d. While the picture is somewhat distorted by measurement problems, they do point out some interesting results for those countries who were able to submit data Chart 2b shows that the rate of cardiologists exceeds 5 per 100 000 inhabitants in Greece, Hungary, Japan and the US. This is not surprising for Japan or the US since they are more inclined to using technologically intensive health care interventions than most countries.[13] For Greece and Hungary these data should be considered with caution, since they may include data anomalies such as the inclusion of physicians eligible to practice but who are no longer practising. The situation is similar in Italy, but will also include cardiologists practising as GPs. (These have not been displayed). On the other hand, Germany has only about 2.6 cardiologists per 100 000 population, a figure roughly equal to Canada, placing them in the bottom third of countries who provided data. This is not surprising for Canada, as some shortages have been reported, but is more surprising for Germany and may be due to differences in medical classifications, related to the role of internists. In many OECD countries general internists perform many of the functions that cardiologists do. If a significant portion of medical treatments typically done by cardiologists (angioplasties, catheterisation, treadmill testing, etc.) are being performed by internists then this could offer a partial explanation for the unexpected lower German numbers.

62.	In Chart 2c, the same methodological problems observed for measuring the supply of cardiologists are also seen as a possible problem for measuring the supply of cardiovascular surgeons. For example, Germany has a much lower rate of cardiovascular surgeons per 100 000 inhabitants than any other country and Italy the highest, also by a wide margin. Norway and Sweden have comparatively high rates of vascular surgeons, which may possibly be related to the relatively high burden of IHD in these countries, however, with the exception of Greece and Korea, the other countries with much lower rates of cardiovascular surgeons have similar epidemiological profiles.

63.	Finally, Chart 2d combines the above data for a limited number of countries. Among the countries that provided data on both the supply of cardiologists and cardiovascular surgeons, Canada, Denmark and Germany have the lowest rates, Australia has a slightly higher rates and Greece has the

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13.	Based on a combination of general knowledge of the utilisation across countries of intensive technology in treating IHD and supporting figures on the use of CATH, PTCA and CABG that will be presented in another section, as well as figures to be presented in the following sub-section on aggregate supplies of catheterisation labs and cardiac surgery facilities.

highest rate. Japan and the US, despite the fact only cardiologists are shown in Chart 2d, still have more cardiovascular specialists than the other countries, except for Greece and Hungary. The figures for Japan and the US could theoretically be higher if cardiovascular surgeons were included. On the other hand, they may already be lumped in with cardiologists and therefore the figures in Chart 2d are an accurate reflection of the supply of cardiovascular specialists in Japan and the US. (For Greece these results have still to be compared with the final outcome of the micro data analysis).

Chart 2b,c,d Number of Cardiologists and Cardiovascular Surgeons per 100 000

64.   The rates of physicians by themselves offer at best an imprecise picture of actual supply. The actual supply will be a combination of quantitative numbers of relevant physicians providing treatments (practising physicians, including some internists) and the relative labour productivity of those physicians. In this field, labour productivity seems to be highly dependent upon remuneration schemes: comparatively lower rates in some countries could be compensated with a fuller use of high powered incentives, with fee for service payments, as in other countries, comparatively high supply of physicians may not be enough to meet demand needs as the payment systems may remain exclusively low powered.

2.2.2.2. Supply of technologies and facilities

   Policies for regulating supply at a macro level

65.   The greatest contributor to rising health care expenditures among OECD countries during the 1980s has been the rapid increase in technological change, even if traditional macroeconomic analysis can only describe it as an unidentified residual in econometric regressions (Newhouse 1992). Therefore, one of the key contributions of this project will be to offer more detailed insights in the actual availability of modern technologies and its uses. The first parameter to be observed is the quantitative availability of key infrastructures providing advanced medical treatment. A number of countries have sought to limit the diffusion of new technologies in their health care system, as a tool for cost containment and also for avoiding excess use and waste. (This is in some sense public regulation trying to address the negative externalities created by the "medical arms race" with quality competition in medical markets). As a result, several countries have used explicit capacity constraints as a means of controlling diffusion. Typically, the Beveridgian countries have implemented the most restrictive policies. In Canada, the Ontario government has not only limited the availability of revascularisation centres, but it has also set explicit targets for the annual rate of CABG per 100 000 population, which was recently extended to PTCA. While in the United Kingdom, GP Fund Holders and District Health Authorities determine the number of services that are to be provided for their catchment areas by strict contracting with the hospitals that supply these services. In addition to setting explicit capacity constraints on the number of facilities and/or the number of procedures, some countries also use targeted funding as a means of controlling high technology treatments for IHD. Sweden and Italy (regional level), which do not have any formal explicit constraints on facilities, use targeted funding as an implicit means of controlling the diffusion of high technology procedures. In this sense, global budgets can also be viewed as implicit restraints for controlling the number of high technology facilities. On the other hand, when public policies have used the supply of facilities as a health policy instrument, they may also have chosen to deliberately increase it to meet unmet needs. In the context of waiting lists, several countries have had to increase their targets as an attempt to address the capacity constraints that existed in their health care systems. (See the discussion in waiting lists, and the case of Denmark).

Table 10. Macro-regulation of coronary care facilities

Some indicators on the supply of facilities

66.   A clearer picture of the effect of macro-regulation emerges when considering the availability of catheterisation laboratories per 100 000 inhabitants in Chart 3. The five countries with the most laboratories per 100 000 inhabitants, United States, Japan, Germany, Sweden and Australia, do not impose explicit capacity constraints; in Sweden, PTCA-centres were in practice restricted by a requirement to be within close proximity to a thoracic surgery centre, but in reality advances in treatments and outcomes led to hospitals performing PTCAs regardless of proximity to a thoracic surgery centre. The next four countries, Finland, Denmark, Norway and Canada all have imposed explicit capacity constraints. In Finland, as in Sweden, the hospital districts are responsible for decisions on capacity, although they differ with respect to the role of financing; in Sweden financing decisions rest with the county councils, whereas in Finland, the role of national level funding is related to a small state subsidy for investment costs. The two countries with the lowest rates of catheterisation laboratories, Greece and Hungary do not have macro-regulation of capacity. However, in Hungary, this may be a reflection of overall available resources for health care since this country has a comparatively lower per capita income and also a lower level of health expenditure (OECD 2000). For Greece, to a certain extent this may also be the case, although lower objective needs for these facilities due to the lower incidence of cardiovascular disease in Mediterranean countries may also be a contributing factor. What is interesting to note is that the level of facilities for Greece is not much lower than the level for Canada, Norway and Denmark, countries with fairly high per capita incomes and with a high incidence for cardiovascular disease.

Chart 3. Number of Catheterisation laboratories per 100 000 inhabitants

67.   In terms of cardiac surgery units, Japan with 453 (0.36 per 100 000 inhabitants) and the US with 917 (0.35 per 100 000 inhabitants) were the countries with the greatest capacity. The use of targeted funding in Sweden has not overly constrained capacity: in 1995, Sweden had 23 facilities capable of performing revascularisation procedures (0.26 per 100 000 inhabitants), the third highest concentration among countries reporting this information. Germany and Hungary had the lowest. In Germany, this may partly reflect the significant number of angioplasties that are now being done in ambulatory care settings, 18% in 1996 (Perleth 1999).

Chart 4. Number of cardiac surgery facilities per 100 000 inhabitants

68.   It is interesting to note that both Hungary and Greece reported low capacity in both catheterisation laboratories and revascularisation centres, yet also had some of the highest figures for cardiac specialists. This suggests that in these relatively less wealthy countries, the capacity constraints are more in terms of capital than in terms of the qualified labour force, as medical equipment goods have to be imported from abroad, and qualified physicians can be trained domestically. However, the underlying stories for these two countries are somewhat different. Hungary has a much higher incidence of disease than Greece which also has a higher rate of these facilities. Further investigation is needed to determine the exact cause of this phenomenon and to supplement these data for more countries and more years.

Policies for regulating supply at a micro level

69.   In addition to macro-regulation of facilities, third party payers also have at their disposal the ability to micro-regulate, that is, try to influence physician behaviour directly, mainly through the use of clinical practice guidelines (CPG). While CPGs are intended to provide physicians with guides to medical practice based on available evidence, there is little evidence of any wholesale adoption of CPGs to micro-manage individual physician decisions on treatments. The one exception is the United States where the use of guidelines in managed care has been increasing, but there is no convincing evidence that these have

influenced the use of intensive treatments for IHD. For this reason, we have not displayed the relatively scarce and disparate results that we were able to gather.

2.3. Impact of economic and medical factors on treatment patterns and outcomes and hypotheses for research

2.3.1. Impact of demand and supply side factors on treatment patterns

70.   By and large there appear to be a limited role for demand incentives for cardiac care. Access to care for uninsured individuals is a serious concern but is limited to the United States. There exists a fair amount of work done in this area which could be accessed to further investigate its potential impact on treatment patterns. Further work would also be needed to assess whether co-payments for drugs, especially in an ambulatory setting, have influenced utilisation.

71.   The evidence gathered on supply side characteristics suggests they have a stronger influence on treatment patterns than do demand side characteristics. The impact of different constraining measures will need to be further investigated to see how they counteract hospital and physician payment mechanisms. The stronger link appears to be between the use of macro-regulation and the capacity to perform intensive procedures. On the supply side, the availability of technology appears to play an important role in determining treatment patterns. As we have seen, macro-regulation of this technology may be the primary factor limiting utilisation of high technology procedures. In addition, the supply of physicians, or more specifically specialists, and the type of payment system certainly play a role in determining the levels of outputs in the health care systems. It is the interaction between these elements that determines the relative productivity of capital and labour.

72.   However, before formulating hypotheses and questions for the empirical work, we need to examine in more detail the key issues of waiting times and the role for prevention before focusing on demand as measured through epidemiological studies and treatment trends from available micro-data.

2.3.2. The imbalance between supply and demand: waiting times and waiting lists

Waiting times and their policy context

73.   Queues for intensive treatments represent a significant non-monetary limitation on the demand for IHD treatment and can lead to serious access problems. Waiting times are the result of complex demand and supply side interactions and there is a significant literature devoted to studying waiting times, including fields other than health. Despite the negative connotations, there is nothing inherently wrong with waiting before receiving treatment, so long as the outcome from not waiting is no different than if the patient had received the treatment in a timely manner. Waiting times are often accepted as a form of rationing health care services that in many respects can be considered superior to the price-based rationing of private insurance, where access is predicated on ability to pay and not need (Naylor 1991).

74.   In assessing the effects of waiting times on outcomes, our interest is not in providing precise measurements of how long patients have to wait before they receive a CABG or PTCA, but to group countries according to waiting times relative to each other. Table 11 shows the intensity of waiting lists and the methods for dealing with them across OECD countries.

Table 11. Non-Financial Barriers – Waiting Lists

75.   Basically, OECD countries have used three methods for dealing with the problem of waiting times:

-     Increasing resources in the context of public planning

76.   This method has been used for example in Denmark where funds were earmarked for specific activities of the health care sector, including intensive cardiovascular care centres, in an effort to reduce waiting times by increasing capacity. It is possible this policy has placed Denmark in the middle range of countries in terms of capacity of cardiovascular facilities.[14] However, waiting times have not disappeared since they are strongly embodied in the specific incentives for reimbursing providers. (It is plausible that providers do not have strong incentives to reduce waiting times since funding is linked to capacity targets).

-     Jumping the queue through the use of private "markets"

77.   Offering patients the choice of purchasing services in an alternative market should, theoretically, reduce waiting times by releasing demand pressure in one market as patients seek care in the other. Countries that use this solution allow alternatives to public delivery and/or public financing of health care (that is, allow patients to pay for health services through private health insurance or allow public health insurance to pay for privately delivered services). Australia and Sweden are examples of countries that have used this method as an attempt to reduce delays in time to treatment in the public sector.

-     The public management solution: triaging and priority settings

78.   Waiting times can be managed formally through a triage system. This is a method employed by Australia, Canada (Ontario) and Finland. Italy and Norway also formally manage their queues but with limited success in decreasing waiting times.

79.   The various methods used by countries to deal with waiting times are summarised in the comments in Table 11.

Understanding waiting times ?

80.   Supply side constraints are a major cause of waiting times. Countries which seem to experience the more serious waiting times, Denmark, Norway and the UK, use macro-regulation of the provision of high technology procedures, introducing a distortion into the market that ultimately leads to queues for these procedures. By contrast, most of the countries where waiting time for intensive cardiac procedures are not a problem, Belgium, Germany, Switzerland and the US, are also the most technologically intensive countries. These countries do not impose restrictive regulations on high technology medical care.

81.   Another potential cause of waiting times is the method of financing health care services. All of the countries in our survey who indicated that waiting times for CABG and PTCA were a concern finance their health care systems primarily through taxation, including Australia which is near the top of the list of countries that use these procedures frequently. In addition, these countries make extensive use of public global budgets, whereas the countries with virtually no queues rely upon open-ended financing arrangements, through social or private health insurance mechanisms. However, the apparent unfettered

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14.   The implementation of the Heart Plan in Denmark has considerably reduced waiting times; in 2000 it has been estimated that less than 12% of patients waiting for pre-surgery examinations wait more than 3 months, and less than 5% of those waiting for surgery following referral wait more than 3 months.

access this latter group of countries benefit from is somewhat offset by increases in premiums or in the rates of social contributions, which are a key policy concern.

82.   The problem of queues is a rather complex one. While capacity constraints and financing arrangements appear to be important predictors of waiting times for intensive cardiac procedures, there are other factors that at play. Numerous studies exist that have made international comparisons on waiting times for cardiac procedures (Bernstein 1997). It is not only constraints on the number of facilities or number of procedures that can be performed that create queues. Other factors such as physician affiliation (Alter 1999), provider preference (Anderson 1989) and inadequate information systems (Naylor 1991) need to be taken into consideration. More importantly, are patients waiting in queues any worse off than if they had received the procedure earlier? Some work seems to suggest that it is not necessarily the case that waiting in a queue for cardiac services will lead to adverse outcomes (Naylor 2000).

Table 12. A brief qualitative link between waiting times and general health system features

83.   While capacity constraints are likely to contribute to queues, they may also provide a needed check on overutilisation of intensive cardiac procedures. Macro-regulation may constrain the number of procedures performed over a given period of time but it may also funnel these procedures into a few high volume centres, such as is the case with regionalisation. This may help to raise overall quality of care as well as the marginal cost-effectiveness of care being delivered. Through "learning by doing," these high volume centres may become better at providing intensive coronary care treatment, resulting in better outcomes for patients referred to them (Thiemann 1999; Dudley 2000). However, this may be a reflection of hospital quality so this needs to be taken into consideration to eliminate the possibility of selective referral. We felt the issue of waiting times was important enough that it needed to be discussed at some length in this report, where we could provide a few insights relevant to the treatment of ischaemic heart disease. A more thorough investigation of waiting times will need to be analysed at length in a specific study.

2.3.3. The role of prevention

84.   As noted above, the focus of this project is on the care component of ischaemic heart disease treatment, particularly the acute care component. However, seminal work by the MONICA research network has provided a unique glance into the impact of the prevention of coronary heart disease on long term trends in cardiovascular disease. There appears to be evidence supporting the important role of preventive behaviour and public health measures in explaining the differences in reduced levels and trends in mortality (Tunstall-Pedoe 1999).

85.   Prevention can lead to increased access to treatments for ischaemic heart disease by reducing demand as defined by the number of persons needing acute care. Primary prevention aims to reduce risk factors for a given disease while secondary prevention aims to limit the consequences of those risk factors for existing diseases, such as atherosclerosis. Smoking, high cholesterol and obesity are all well established risk factors for IHD. These risk factors can be reduced, to varying degrees, through alterations in lifestyles. Reductions in risk factors are a key instrument in improving welfare, while avoiding the need for expensive unnecessary medical procedures. Most countries have developed public health programmes such as campaigns to reduce smoking that attack these risk factors as a means to improving population health.

86.   Smoking, high cholesterol and obesity can lead to atherosclerosis, with obesity also a risk factor for hypertension. These two conditions, atherosclerosis and hypertension, are inherently linked with the advent of acute events and heart attacks at a later stage. Secondary prevention through drug treatment is aimed at decreasing the progression and limiting the impact of these conditions in IHD patients. Access to

ambulatory care drugs can be critical in this perspective. Individuals without any coverage, or where cost sharing is high may forego these treatments increasing the possibility of suffering from more serious ischaemic heart disease in the future. For individuals already suffering milder forms of ischaemic heart disease, such as angina, but who have not yet had a heart attack, CABG and angioplasty can both be seen as secondary prevention measures for reducing the risk of later heart attacks. In the US for example, the high prevalence of the use of CABG is often justified on the grounds that it helps to reduce anginal symptoms.

87.   Therefore, we will try to shed light on these issues in this project, both by examining consumption for ambulatory care drugs, and also treatments for milder forms of ischaemic heart disease such as angina.

2.3.4. Questions and hypotheses for empirical work

88.   Based on the review of health care incentives and regulations, several questions can be raised as hypotheses to be "tested" with the empirical material which we have gathered.

- What are the relative role of demand side and supply side incentives in influencing access to treatment ?

- How has the evolution of medical interventions influenced the diffusion of technology and how has this impacted treatment patterns across countries ?

- What are the relative roles of medical knowledge and economic constraints in shaping the patterns of treatment use ?

- Can we assess the impact of the diffusion of various interventions on trends in outcomes ? How can this be relevant to health policies as a whole?

- What are the broader economic implications of different rates of technology use combined with different unit prices for inputs across countries?

89.   The diffusion of technology is an important aspect to the continuing success of intensive cardiac procedures. This work also builds strongly on existing work from the TECH Research Network, through mutually beneficial collaborative exchanges of information.

90.   We will first explore the epidemiological context, as we wanted to consider the broader environment in which the acute event takes place. We will then analyse trends in treatment and trends in outcomes. In a further section we will address the economic implications, before assembling the different pieces of the puzzle in an overall section discussing the implications of the results.

3. EPIDEMIOLOGICAL CONTEXT

91.   Ischaemic heart disease (IHD) is the leading cause of mortality in the world causing an estimated 7.1 million deaths in 1999 (WHO 2000). As a result IHD has received close attention from epidemiologists in a large number of countries. The objective of this chapter is to discuss the main epidemiological trends in the participating countries. The discussion will focus on incidence for AMI and on trends in mortality for IHD. There is also a brief discussion on the comparative role of risk factors across countries.

92.   For readers who are not familiar with some of the problems encountered when measuring prevalence, incidence and mortality of AMI and IHD, these issued are presented in Appendix 1. These persons may wish to read this brief discussion prior to reading this section.

3.1. Variations in incidence with a focus on AMI

93.   As indicated in Appendix 1, difficulties in measuring the incidence of IHD necessitates that most of the analysis will be focussed on AMI, but whenever possible there will be some discussion on IHD. Most countries that supplied information on incidence supplied "hospitalised incidence." This section focuses on total incidence, which includes hospitalised incidence but also non-hospitalised incidence estimated as the number of deaths due to IHD or AMI outside hospital. Hospitalised incidence will be discussed in the section on admissions in the Treatment chapter.

3.1.1. Cross sectional variations by age and gender

Variations by age

94.   Age is considered to be one of the main determinants of ischaemic heart disease, so we should expect a pattern of increasing incidence of IHD and AMI with age, which in fact was the case for all countries for which data on incidence were available. Data on incidence of IHD were available for Denmark for 1996, where it was estimated that for every 100 000 inhabitants aged 35 -64 years, 507 were either admitted to hospital or died from ischaemic heart disease (Table 13). For persons aged 65 – 74, this figure quadrupled to 2 046 per 100 000 while for those aged 75 or greater the figure is 3 701 per 100 000, a greater than sevenfold increase over persons aged less than 64. A similar pattern exists for AMI where the rate per 100 000 was 8.5 times greater for individuals aged 75 and over than for the youngest age group.

Table 13 Incidence of IHD and AMI, Denmark, 1996

95.   It should be noted that incidence in this case was reported as hospital admissions plus the number of deaths outside hospital, meaning there was some underreporting since individuals who did not die or were not admitted to hospital would not have been counted. The exclusion of these underreported individuals is likely to be a greater problem for estimating the incidence of IHD than AMI. Age is another important factor to consider when measuring incidence. These issues are discussed in Appendix 1.

96.　　　The positive age gradient for incidence is also apparent when examining data for other countries. Germany in particular showed a wide gap between the oldest and youngest age groups (Chart 5). It should be noted that these data were taken from the western part of Germany which has a lower incidence of AMI than the eastern part (Wiesner 1999). This pattern does not appear to be restricted to countries with a traditionally higher burden of heart disease. In Okinawa (Japan), the incidence rate for AMI for persons aged 75 or greater was almost six times greater than the incidence rate for individuals aged 45 – 54 (Chart 6). The incidence rate of AMI of Okinawa does not appear to be out-of-line with other regions of Japan (Fukiyama 1993).

Chart 5 Incidence of AMI in Western Germany, by age and gender, 1991

Chart 6 Incidence of AMI in Japan (Okinawa), by age and gender, 1989 – 1991

97.　　　The positive relationship between age and AMI is consistent over time. In Sweden, data on incidence of AMI from 1987 to 1997 show that men aged between 65 and 74 had an incidence rate about three times higher than men aged 40 to 64, while the incidence rate for the oldest group was anywhere between six to eight times greater (Chart 7). The effect is even greater for Swedish women. Similar ratios across time are also evident in Australia (Chart 8) and the Oxford region of the UK (Chart 9).[15]

Chart 7 Incidence of AMI in Sweden, by age and gender, 1987 – 1997

Chart 8 Incidence of AMI in Australia, by age and gender, 1993/94 – 1997/98

Chart 9 Incidence of AMI in the UK (Oxford), by age and gender, 1971 – 1996

Variations by gender

98.　　　Together with increased age, male gender is the other important demographic determinant of heart disease. Figures from Table 13 show that for each age group Danish men are more likely than women to have a reported incident of IHD; the same holds true for AMI. This gender gap diminishes with age, dropping from a rate of incidence of IHD three times greater for men than women in the youngest age category to about 1.5 times in the oldest age group. The same pattern holds for Australia.

99.　　　In Okinawa, the incidence rate of AMI for women aged 65 – 74 was roughly comparable to men aged 45 – 54 (Chart 6). In the western part of Germany, men aged 45 – 54 years suffered more heart attacks per 100 000 persons than women aged 55 – 64, while men from this latter age group had a rate of heart attacks equal to women aged 65 – 74 (Chart 5). These figures not only show a gender gap similar to that found for Denmark, but dividing the youngest age into narrower categories shows more clearly that younger men tend to suffer heart attacks at the rate of older women.

100.　　　These findings confirm well established epidemiological facts, that advanced age and male gender are risk factors for heart disease, in this case ischaemic heart disease and especially acute myocardial infarction. The data show that these incidence patterns are remarkably similar for each country examined, but we need to look further into the data to see the extent to which there exists country specific effects that may determine the rate of incidence of IHD and AMI and how the various patterns vary over time.

15.　　　Sensitivity analysis for using the broad age group 40 - 64 as opposed to smaller age groups will be done using Oxford and Australia data and discussed in a paragraph or two. It is not expected that the trends will change much, if at all.

3.1.2. Variations across countries and trends over time

101.   There are several limitations to the data provided which limit the possibilities of making cross-country comparisons of the incidence of AMI. One limiting factor is that Denmark, Japan and Germany provided data for only one year. Another problem was in the age groupings provided. Data from Germany for instance did not include figures for persons aged 75 or older. Finally, figures for Germany, Japan and the United Kingdom were derived from specific regions of the country and may not reflect the population as a whole. A discussion of these problems can be found in Appendix 1 which deals with specific data issues and problems.

102.   Chart 10a and 10b show incidence rates of AMI in 1991 for persons aged 35-44, 45-54, 55-64 and 65-74 in Germany, United Kingdom and Japan for males and females respectively. For both males and females it is clear that Japan had the lowest rate of AMI per 100 000 persons in 1991 regardless of age. The fact that Germany is represented as having had a higher incidence rate than the UK, whereas in most epidemiological studies it is the UK that has a higher rate of heart attacks, may be due to representation of the UK by the Oxford region, which may have a lower rate of heart disease among its population than the UK as a whole.

103.   Given the serious limitations of these data for purposes of cross-country comparisons, the reader should exercise caution regarding the presentation of the previous paragraph. While making cross-country comparisons with these data are fraught with problems, these data nevertheless are instructive in presenting a picture of the relative burden of AMI across several OECD countries for which this information is difficult to collect.

Chart 10 Incidence of AMI, by age, gender and country, 1991

104.   The incidence of AMI in 1996 for persons aged 40-64, 65-74, 75+ and the overall rate age-standardised to the European population aged 40 and over are shown in Chart 11a for males and Chart 11b for females.[16] The countries in these charts, Australia, Denmark, Sweden and the UK are all countries expected to have a relatively high incidence rate for AMI. Sweden in particular appears to have had a much larger incidence of AMI for both males and females and all age groups than the other countries. It was the only country where the overall rate exceeded 1 000 per 100 000 inhabitants for males and was closest to 500 (485) per 100 000 for females. The next closest country is Australia, where the overall rates were 706 per 100 000 for males and 348 per 100 000 for females. Data to be presented in Section 3.3.2. show that the gap in mortality between Sweden and other countries is not as large as the gap in incidence shown here.[17] The large gap in incidence between Sweden and the other countries is inconsistent with what is generally observed in the literature. Whether this represents a data anomaly, differences in treatment or some other phenomenon is an issue that requires further investigation.

Chart 11 Incidence of AMI, by age, gender and country, 1996

105.   These data show that in certain cases geography may be a better indicator of AMI incidence than gender. For example, in 1991 the incidence rate of AMI for each age group is lower in Japanese men than the comparable rate for women in either Germany or Oxford – if gender is the stronger determining factor than Japanese men would have higher rates of incidence than women from Germany and Oxford. Geography can also be more important than age in predicting AMI incidence. Using the same countries,

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16.   Unless otherwise stated, all standardised figures in this paper were standardised to the European population aged 40 and over.

17.   Mortality data presented in Section 3.3.2. represent deaths due to IHD. Based on data from the OECD Health Data Base AMI mortality figures present a similar picture.

the incidence rate of AMI for Japanese men and women aged 65 – 74 is lower than the corresponding incidence rates for younger men and women from Oxford and Germany aged 45 – 64 – if age is the stronger determining factor than Japanese aged 65 – 74 should have higher rates of incidence than younger men and women from Germany and Oxford.

106.   The figures from Charts 12a and 12b show a decline in the number of recorded cases of acute myocardial infarction between 1987 and 1997 for Australia, Sweden and the United Kingdom (Oxford) age-standardised to the European population 40 and over,[18] but with such a dearth of data on incidence it is difficult to get an accurate picture of the time trends across countries. We computed percentage changes from 1987 to 1997 for Sweden and compared it to data from the Oxford region over the same period. We also calculated the average annual percentage change between 1993 and 1997 for Australia and Sweden.

Chart 12 Age-standardised incidence of AMI, by gender and country, 1987 – 1997

107.   Sweden is the only country for which there were continuous data available from 1987 to 1997, the data show a decline of 23.5% for males and 16.8% for females. The decline in Oxford is even greater, where the incidence rates fall 33.4% for males and 27.2% for females during the same period. The declines in incidence for men and women in Australia from 1993/94 to 1997/98 are similar to the observed declines in Sweden, falling between 16 – 17%; the decline in Sweden during this same period was 15.1% for males and 16.2% for females. Although there is a general decline in AMI incidence observed for all three countries, the decline in Sweden from 1987 to 1997 is not continuous. In between 1990 and 1994 there is a slight increase in the incidence rates for both males and females in Sweden, but we cannot compare this trend with the other countries since there is no data available. Further investigation is required to determine whether this is a general trend observed across many countries during this period.

108.   Thus far we have only commented on trends from the late 1980s to the mid 1990s, a period of about 10 years. Most studies on AMI trends tend to show that declines for most OECD countries began around the 1970s. The only data on incidence available for a longer period were those from the Oxford region, where there were data going back to the 1968-1973 period. It is clear from these data that total identified incidence in the Oxford region was falling as early as the 1970s and continued to fall throughout the 1980s, regardless of sex and age, confirming the trend observed in most of the industrialised world. However, the number of AMIs per 100 000 persons fell much more rapidly for younger persons, those aged 60 and under.

109.   The results of this section support the view that there has been a general decline in the incidence of IHD and AMI for the majority of OECD countries over the past decade.

3.2. Trends in mortality for ischaemic heart disease

3.2.1. Cross sectional variations by age and gender

Variation by age

110.   As noted earlier, advanced age is a risk factor for ischaemic heart disease and acute myocardial infarction. Charts 13 show mortality from IHD for several countries by age. Some problems coding deaths

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18.   Germany is not included in the charts because data were not available for the population aged 75 or over.

due to AMI may make it difficult to have meaningful cross-country comparisons of AMI mortality only (See Appendix 1). For this reason, the focus of this section will be on overall IHD mortality rates.

Chart 13 IHD mortality rates by age and gender, 1981 – 1996

Chart 14 IHD mortality rates by country and age groups, 1996

111.   As expected, each chart shows a positive correlation between increased age and mortality, a pattern that was consistent across time and country. For example, in Norway, a typical high mortality country, in 1981 there were 297 deaths per 100 000 males aged 40 – 64 years due to IHD, 1 683 for men aged 70 – 74 and 4 334 for men aged 85 – 89. In 1996 the figures were 106, 1 021 and 3 685 respectively. In Italy, a low mortality country, in 1981 there were 155 deaths for every 100 000 men aged 40 – 64 828 for men aged 70 – 74 and 2 858 for males 85 – 89. The corresponding figures in 1996 were 88 600 and 2 254. We observe the same pattern for women.

112.   These figures mask a pattern of unequal distribution by age in the reductions in mortality that have occurred over the past twenty years. Specifically, the very elderly in the two low mortality countries for which we have data, Italy and Japan, did not see a continual decrease in mortality.[19] In Italy, there was a significant decrease in mortality for all age groups from 1981 to 1986, but mortality rates for both men and women 80 years or older in 1996 have remained at virtually the same levels as in 1986.

Variation by gender

113.   Male gender has already been identified as a risk factor for IHD. Charts 13 show the relationship as expected, where men generally have more deaths due to IHD than women. However, this pattern does not necessarily extend across countries. For example, in 1996 Italian males aged 85 – 89 have roughly the same mortality rate as Canadian and Norwegian women of the same age. Even more revealing, Japanese men aged 85 – 89 have a lower rate of mortality due to IHD than women aged 80 – 84 in Australia, Canada and Norway (except 1996).

114.   While men have a higher mortality rate than women, the gap has been narrowing over the past twenty years. To illustrate the narrowing gap, gender differences in mortality rates for each country participating in the project were calculated for 1980, 1985, 1990 and 1994 and are shown in Table 14. The countries are arranged in descending order in terms of the decline in the gap between males and females expressed as a percentage change in the gap between 1980 and 1984. With the exception of Korea and Hungary the gap between males and females has decreased over the observed period.

Table 14 Gender gap in mortality, 1980 to 1994

3.2.2. Variations across countries and trends over time

115.   In Section 3.1.2. it was shown that in certain cases geography is a better predictor of AMI incidence than either age or gender. This is also true for mortality, in fact it has been well documented that a north-south gradient exists in Europe where northern countries' populations tend to have higher rates of mortality from IHD. Using the north-south gradient as a rough guide, supplemented with mortality data

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19.   For Japan, there was an increase in mortality from 1990 to 1995 for all age groups, although it is likely this is a spurious increase probably due to a change in standards on how diagnoses are registered in death certificates.

from the OECD Health Data Base, the countries in our survey can be divided into two groups: those with a high rate of mortality – Hungary, Finland, United Kingdom, Denmark, Australia, Sweden, United States, Germany, Norway and Canada; and those with a low rate of mortality – Switzerland, Italy, Greece, Belgium, Spain, Japan and Korea (OECD 2000).

116.   A particularly well-known phenomenon is the so-called "French paradox." It has been observed that French mortality from IHD is about a quarter of that observed in the United Kingdom, even though the level of many of the more important risk factors, smoking, cholesterol level and blood pressure, are similar for both populations. Therefore, there must be some other underlying risk factor(s) which explains the difference in mortality between these two populations. With respect to OECD countries at large this risk factor(s) may also explain the geographic differences, although differences in IHD treatments are equally plausible explanations which must be considered, something that will be explored in more detailed in subsequent sections.

117.   The discussion thus far on trends in mortality and incidence has demonstrated a general trend towards declining mortality and incidence in IHD for most, but not all, OECD countries but with more variation across countries on the magnitudes of the decreases. These data referred to the past decade in the case of incidence of AMI and to the past twenty years for mortality due to IHD. Routinely collected statistics show declines in mortality from ischaemic heart disease starting in the 1960s for the United States and Australia, soon followed by other industrialised nations (Kuulasmaa 2000). Charts 15 and 16 show the long-term trends in IHD mortality using data from 1970.

Chart 15 Age-standardised mortality rates for Ischaemic Heart Disease, Males, 1970 – 1996

Chart 16 Age-standardised mortality rates for Ischaemic Heart Disease, Females, 1970 – 1996

118.   The data for the United States show a continual decline in IHD mortality for both men and women at least since 1970. In fact, non-reported figures from the OECD Health Database show that the declining trend for these data in the US began somewhat earlier, about the late 1960s, confirming the same trend observed in the Framingham study. The decline in mortality for Australia and Canada also appears to have begun sometime in the late 1960s, but for most countries the decline did not begin until sometime in the 1970s.[20] Mortality rates did not decline in all countries during the 1970s. The greatest declines occurred for the countries with the highest mortality rates, except Germany and Hungary, which saw an increase in mortality during this period. In Spain, the early 1970s were characterised by an increase in mortality until the mid-70s when mortality began to fall. In Greece there was a gradual but steady increase in mortality during the 1970s that continued into the mid-1980s.

119.   Since the 1980s, with few exceptions, there has been an almost unabated continuous decline in the mortality of IHD. In Hungary, mortality rates for both men and women remained fairly stable during the 1980s, but around the same time as the former communist regimes of Eastern Europe began to fall, the number of deaths due to IHD began to rise, a pattern that has been observed elsewhere. There was also a slight increase in the level of the mortality rate from 1990 to 1991 in Germany when data for the two former separate countries of East and West Germany were collected together for the first time. Mortality rates have continued to decline in the 1990s for both sexes.

120.   In order to get a more precise picture of the trends in mortality, linear regression slopes were calculated for the standardised IHD mortality rates (standardised to the European population age 40 and

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20.   It should be noted that there was a considerable one-time drop in the mortality rates of several countries in the late 1960s or 1970s which is probably attributable to some data anamolies, although this does not fundamentally change the subsequent underlying trends.

over) for both men and women and are reported in Table 15. Observing data for two distinct periods, 1970 to 1995 and 1980 to 1995, we see slightly different trends across the countries in our survey. As mentioned earlier, the United States was one of the first countries to have witnessed dramatic declines in IHD mortality. Table 15 also compares declines in mortality between the data as reported from the country survey and from the OECD Health Database. The discrepancies between the two sources were small to negligible, which reinforces the integrity of the data. However, the data for Greece and Korea may require some further investigation.

Table 15 A comparison of trends in mortality from IHD for Males and Females: 1970-80 and 1980-95

121.   Data from Table 15 confirm the trends from the graphs for the decade of the 1970s that Australia, Canada and the United States saw the largest declines in IHD mortality rates. Norwegian women also saw similar declines in mortality as these countries. Belgium, Finland, Japan and Swedish women would be classified in the following group that saw declines in mortality but these weren't as dramatic as for the first group of countries. There was a substantial increase in mortality rates for Spain of about 5% per annum for both males and females, while German women and Greek and Swiss men had lower but still significant increases. The mortality rates in the remaining countries were more or less stable during this period.

122.   With the exception of a few countries, from 1970 to 1995, trends in mortality rates for males and females followed the same pattern, which were more likely to be declining. During the 1970s, declines in mortality rates for IHD were greater for females than males, with the exception of Japan, albeit with a practically negligible difference of 0.2 percentage points. However, during the period 1980 to 1995, the declines were generally greater for men than women.

123.   The period from 1980 to 1995 is of particular interest because it is the period that coincides with most of the data we have collected. In terms of the magnitude of average annual percentage changes, the countries can be roughly grouped into three categories. In Table 16, the countries have been grouped according to these three categories and whether they are considered high or low incidence/mortality countries as explained earlier. This is a rough approximation but it does provide a sense of how the countries fare relative to each other in terms of the levels of IHD mortality and the declines in mortality over the 1980s and early 1990s.

Table 16: Mortality trends of high vs. low mortality countries (1980 to 1995)

Average annual percentage decrease	High (about 4% men; 3.5% women)	Medium (about 1 – 4% men; 1 – 3% women)	Low (less than 1% for both men and women)
High incidence/mortality countries	AUS, CAN, DEN, SWE, USA	FIN, NOR, UK	GER, HUN
Low incidence/mortality countries	BEL	ITA, JPN, SPA, SWI	GRE

124.   With an average annual increase in IHD mortality of about 13% between 1980 and 1995 the Korean experience was considered to be too much of an outlier and therefore these data were not included in Table 16. While this may reflect the increased 'westernisation' of Korea during this period and the move from a developing country to a developed country, and all the specific health problems associated with that move, this trend may also involve some underlying data anomaly that has not been taken into account.

125.   All of the countries that saw the greatest decline in the average annual percentage change in IHD mortality, with the exception of Belgium, could be classified as "high mortality" countries.[21] This is probably the only clustering that can be seen in terms of these assigned categories. Countries that saw more modest declines in mortality rates were evenly divided between the high and low mortality countries. Both Germany and Hungary, two high mortality countries, did not see any large declines in mortality. For Hungary, this may be partly attributable to the collapse of the former communist regime and ensuing socioeconomic problems as it made the difficult transition to a market economy. This is not the case however for Germany where the trend for both sexes between 1980 and 1989, prior to reunification, was virtually the same as the trend between 1990 and 1995.

126.   Another trend over this period was the differences between the two sexes where the declines in mortality for men on the whole were larger than for women (Table 15). In particular, the differences in declines between the genders was greatest in Australia, Finland, Norway, Switzerland, the UK and the United States. For example, in Finland the average annual percentage decrease in IHD mortality from 1980 to 1995 was 2.5% for men but only 1.2% for women. Had mortality declined at the same rate for women as it did for men then there would have been about 65 fewer IHD related deaths per 100 000 women in 1995.

127.   In general, mortality rates for men in the remaining countries declined slightly more than for women. The exception was Italy where the decline in IHD mortality was greater for women than men.

3.2.3. The contribution of survival to declining mortality

128.   The link between trends in survival after an acute event, where most patients are admitted to hospital, and overall trends in mortality, where a large proportion of patients die outside hospital, is not straightforward. The 'outcome' for incident cases of AMI fall into three groups:

  - persons who died outside hospital,
  - those who died in hospital (hospital case fatality),
  - those who did not die, that is survivors.

129.   Not all survivors may be identified in the incidence estimates based on routine hospital data collection statistics because some will not make formal contact with the health care system. Therefore the number of non-fatal hospital separations needs to be seen only as a proxy measure of this component of the incidence measure. Using data provided from Greece and Australia, we were able to decompose incidence figures into the three elements mentioned above. Charts 17 and 18 show the results for Australia (population aged 40 and over) and Greece respectively. Table 17 shows similar figures for Denmark in 1996.

130.   The figures indicate that for all three countries, a higher proportion of women die following a myocardial infarction compared with men, but this may be due to women tending to be older than males (DIKE 1999). However, when AMI fatality is decomposed into deaths that occur outside hospitals and deaths that occur inhospital, there is virtually no difference between the two sexes in Australia and Greece. In both of these countries out-of-hospital deaths account for about 80% of all deaths from AMI, for both males and females. In Denmark on the other hand, out-of-hospital deaths accounted for 72.3% of all AMI deaths for males and 57.6% for females.

Chart 17 Contribution of deaths and non-fatal separations to total identified incidence, Australia

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21.   In general terms, these usually refer to what are often called the "Anglo-saxon" countries and the Nordic countries.

Chart 18 Contribution of deaths and non-fatal separations to total identified incidence, Greece

Table 17: Contribution of deaths and non-fatal separations to total identified incidence, Denmark 1996

131.   There may be a temptation to state that men in Australia and Denmark are getting more effective acute care treatments for AMI than women since fewer male identified AMI cases die inhospital. Since these data are not adjusted for age, severity or case mix this would be a misleading statement for at least two reasons; it assumes that the cases of both men and women are of equal severity and does not account for the overrepresentation of women in older populations. An equally plausible explanation, given the above observation that a greater proportion of female than male AMI cases are dying out-of-hospital, may be that women are presenting at hospital with more severe cases than men, perhaps because they are older as a group, and therefore are more predisposed to a fatal event. Since the data we have collected do not measure intensity of the event upon admission, we cannot rule this possibility out.

132.   As discussed earlier, there has been an observed decline in both the incidence and mortality of AMI. If the decline in the incidence of AMI was the sole contributing factor to the decline in mortality, then we should expect to see a parallel decline between both mortality and incidence since the case-fatality rate remains constant and thus the same proportion of new cases result in death. The data from Charts 18 for Greece tell a different story. Since the percentage share of incidence for both components of mortality is decreasing (that is the case fatality rate is falling), then it must be that AMI mortality in Greece is falling at a faster rate than AMI incidence, suggesting that other factors such as improvements in AMI treatments may have led to a decrease in case fatality, also contributing to the decline in AMI mortality.

133.   These data demonstrate that a large proportion of individuals that suffer a heart attack die before ever being admitted to hospital. The implication for health policy analysis when using mortality as an outcome measure for AMI treatment is to consider 'overall mortality', inhospital deaths recorded in hospital administrative data bases and out-of-hospital deaths recorded in death registers. Thus, when assessing the effectiveness of health care for AMI, one must look beyond acute care treatments to other health care interventions including preventive care, treatments aimed at reducing risk factors and ambulatory care treatments, mainly drugs. These aspects will be discussed in the following chapter on treatments.

3.3. A cross national appraisal of the main risk factors

3.3.1. Modifiable versus non modifiable risk factors

134.   There are several non-modifiable risk factors associated with the development of IHD such as family history, male gender, and older age. "Modifiable" risk factors include smoking, diet and physical inactivity which can lead to high blood cholesterol, obesity and elevated blood pressure and eventually to atherosclerosis, which at a later stage will influence the development of ischaemic heart disease. All of these modifiable risk factors themselves result from a complex interaction of individual behavioural factors, socioeconomic status and genetic sensitivity which influences the modifiability of these risk factors among individuals. Many consider reduction of these risk factors as a cost-effective means of reducing heart disease.[22] In order to assess the effectiveness of prevention in treating heart disease it is

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22.   This argument assumes all individuals would prefer to change their behaviour in order to reduce their risk of heart disease, but it may be the case that some individuals' preferences would be to maintain their current behaviour and be treated medically once heart disease has manifested itself. Thus, an economics "utility-based" perspective would produce different results from a standard public health perspective

important to examine as much as possible the role of these risk factors prior to examining how countries treat IHD once it has developed.

135.   Smoking is the number one risk factor targeted by public health policies and data exist for many countries. Body mass index is another measure that is available for some countries. Data on hypertension and elevated cholesterol are somewhat less available since they need to be measured by medically trained personnel. In assessing the role of risk factors in the older age groups, one should be reminded that many of these individuals are survivors in the sense that they have not suffered a premature death despite the presence of behavioural risk factors that were probably started when they were much younger. This phenomenon should be kept in mind when assessing the role of behavioural risk factors in some countries, since many of these such as tobacco and nutrition habits may have already had an impact on younger age groups but have not yet manifested themselves in the form of ischaemic heart disease.

3.3.1.1 Tobacco consumption

136.   With respect to the main risk factors smoking is probably the most obvious modifiable behavioural factor, at least at the population level. However, it needs to be remembered that smoking is an addictive habit with strong psychological implications. Several measurements exist for estimating the prevalence of smoking. Smoking prevalence can be estimated with a simple aggregate number such as the percentage of the population that smokes. However, this lumps together occasional smokers with daily smokers where the latter are at far greater risk of developing IHD. Furthermore, this method does not take into account the latent effects of smoking on health for individuals who once smoked but have quit. Most surveys will indicate at least the percentage of smokers who smoke on a daily basis. More detailed breakdowns could involve analysing data describing levels of consumption and separating light smokers from heavy smokers.

137.   This report makes use of data on the percentage of men and women aged 15 and above who reported they were smokers at the time of the survey since these data are available for several countries (Charts 19). There were no comparable cross national data on the proportion of people who were smokers for significant time periods available. Another difficulty is that the effect of tobacco consumption has a lag effect which usually does not begin until 10 to 15 years later making it difficult to make the link between population levels of cigarette consumption and heart disease.

138.   Perhaps the most noticeable trait found in these charts is the difference in the evolution of smoking between men and women over the past 20 to 30 years. There is a group of countries (Australia, Canada, Denmark, UK and US) that 30 years ago had relatively high levels of tobacco consumption but since then have managed to drastically reduce the percentage of their population that smoke. The decline in smoking for women in these countries has not been as dramatic as it has for men. For Denmark and the UK this is particularly true where women in these countries are still among the highest consumers of tobacco. With the exception of Korea, smoking levels have more or less fallen for men in all countries. However, there is a significant number of countries where tobacco consumption among females has either increased or at least remained stable. Among these countries, Finnish, Hungarian, Norwegian and Spanish women have fared the worse.

Chart 19 Percentage of the population who are daily smokers

139.   With respect to cross-country comparisons, many of the high mortality countries like Australia, Canada and the United States now find themselves at or near the bottom of tobacco consumers for both sexes. Others such as the United Kingdom and Sweden are better for men than women. On the other hand, Spain and Greece, two low mortality countries, are among the heaviest smokers. The north-south gradient

is not as evident for tobacco consumption as it is for IHD indicators, suggesting other risk factors such as nutrition play a significant role conducive to higher incidence in Northern European countries: However, it also remains to be seen what will be the result of recent trends in smoking twenty years from now. Some of the countries where smoking has increased, or remained stable, might have to confront the health implications in a few decades. Conversely, the significant reduction in ischaemic heart disease mortality and incidence observed in Australia, Canada and the United States may have already benefited from the declines in smoking in the past 20 to 30 years.

3.3.1.2. Body Mass

140.   Body mass is another risk factor that is modifiable to a significant extent through changes in eating habits and/or physical activity levels. It can be quantified using the body mass index (BMI) indicator. This indicator involves dividing mass in kilograms by the square of height, measured in metres. There are some limitations in using such data since body mass index levels might have different implications for different populations with different morphogeneses. This is particularly true when comparing Western Caucasian populations with Asians. In addition, surveys that rely on self-reported weight and height measurements tend to underestimate BMI levels. Using trained professionals to obtain height and weight measurements for a survey is vastly more expensive than using self-reported data, which is why most surveys use self-reported data.

141.   Chart 20 below shows the share of the population with a body mass index over 30 kg/m²: Australia,[23] the United States, the United Kingdom and Canada are the countries with the highest proportion of individuals with a BMI greater than the threshold level of 30kg/m^2. Generally, the available data suggest that North Americans and Australians tend to have larger body masses than Europeans with Asians having the lowest BMIs (even if the indicator would need to be corrected for Asians). Body mass is generally increasing in countries where this information is available for several years, a phenomenon observed by the MONICA study and in the research literature in general. However, the results of these trends are difficult to link with current trends in ischaemic heart disease, since they do not allow for a sufficient time lag that corresponds with our knowledge of the correlation between body mass and IHD.

Chart 20 Percentage of the population with a Body Mass Index >30 kg/m²

3.3.1.3. Cholesterol

142.   Data on the proportion of the population with high cholesterol levels were available only for a limited number of countries (see Chart 21 for definition of high cholesterol level). The data show only a mild gradient by age groups for males. There is a much steeper gradient by age groups for females in Germany, Italy and Australia, with levels higher than those observed for men. In the oldest age groups above 70, the proportion above the threshold level tends to plateau in Germany. The country with the highest proportion above the threshold level is Germany, followed in order by Australia, Japan, Italy and Korea. An estimated 42 % of women and 48 % of men aged 40-79 in Germany have high cholesterol levels. By comparison, 48.6 % of men and 43.3 % of women have high cholesterol levels in the United States, defined as a rate above 130 mg/dl, but for individuals aged 20 and older.

Chart 21 Percentage of the population with high cholesterol level, by age and gender, 1998

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23.   Data in Australia were measured by trained professionals; for the other countries data are self-reported.

3.3.1.4. Hypertension

143.   As with cholesterol, data on hypertension are only available for a limited number of countries. The only two age groups for which data are available for all five countries with data are 50 – 59 and 60 – 69 years. Finnish men and women had the highest proportion of individuals above the threshold limit (systolic blood pressure ≥ 140mmHg; diastolic blood pressure < 90mmHg) for the 60 – 69 year age group. For the 50 – 59 year age group, Finland and Korea had the highest proportions. The differences among the younger age groups are less significant. The Japanese male and female populations have the lowest proportions of individuals with high cholesterol levels, irrespective of age group. Data for the United States are available but for different age groups (Heart and Stroke, Statistical update 2000, CDC, NCHS, NHANES III). Aggregated results for the population aged greater than 45 for the United States are similar or 10 % above the results for Australia in similar years, which places the US at the higher end of the countries observed in this reduced sample.

Chart 22 Percentage of the population with hypertension, by age and gender, 1998

3.3.2. Prevention through interventions aimed at modifiable behavioural risk factors

144.   It has been estimated that 25% of the decline in mortality in the United States due to ischaemic heart disease during the 1980s was due to primary prevention, 29% due to secondary prevention and 43% due to improvements in treatment (Hunink 1997). However, a number of issues confound this finding. While it has been shown that secondary prevention through health promotion programmes can be effective for patients with coronary heart disease (Campbell 1998; Cupples 1994), there is little evidence that the effect is long lasting (NHS 1998). Furthermore, the correlation between concerted prevention measures and the decline in ischaemic heart disease is far easier to establish then the causal relationship between them.

145.   As mentioned previously smoking is probably the risk factor with the greatest potential impact for reducing the burden of IHD which makes it a likely target of prevention programs, making smoking cessation programs comparably easier to monitor than other programs. The flood of information on the health hazards of smoking that has been available since the 1960s has had a significant impact on primary prevention of IHD through declines in the proportion of populations smoking. Smoking cessation is also aided through interventions from physicians and nurses, and by behavioural and psychological interventions such as counselling. In a recent clinical review analysing information from the Cochrane Tobacco Addiction Review, Lancaster et. al. (Lancaster 2000) showed that these methods were effective interventions in helping people to stop smoking, but nicotine replacement therapies were equally as effective, which can confound any generalisation of these results to the general population.

146.   Another confounding element in demonstrating the effectiveness of prevention programs is the presence of two or more risk factors. Public health programs usually concentrate on one specific risk factor and are seldom designed for tackling two or more risk factors together. Yet, it is common that people exhibit more than one risk factor. It has been estimated that about 40 to 50% of adult males and 30 to 40% of adult females in Australia and Canada may have two or more of the major risk factors for heart disease (AIHW 2001 – based on AIHW analysis of the ABS/DHAC 1995 National Nutrition Survey; Joffres 1997). Diabetes is often associated with several IHD risk factors and is itself a risk factor for IHD. Furthermore, many behavioural risk factors such as smoking and obesity are negatively correlated with income suggesting socioeconomic status is a potential risk factor for IHD. Therefore, while there is ample circumstantial evidence to suggest that focusing on risk factors has the potential to be an effective means in reducing the overall burden of IHD for OECD countries, demonstrating the effectiveness of these strategies is less straightforward and falls beyond the scope of the current study.

3.3.3. A summary of the MONICA results

147.   The most extensive international project studying trends in cardiovascular disease is the MONICA project[24] sponsored by the WHO. This project represents the first major attempt at examining long-term trends in coronary heart disease and associated influences across several countries. A major drawback of the MONICA study, especially for the purpose of this paper, is the inclusion of individuals aged 35 – 64 years only. Although the long-term trends observed in the MONICA study may not have differed much from the trends for persons aged greater than 65, this fact must be taken into account when using the MONICA results for illustrative purposes in this paper.

148.   When the MONICA project started twenty years ago one of the fundamental questions to be investigated was if the decline in coronary heart disease observed since the 1960s was real or spurious. If it was real than what factors contributed to this decline? After studying data spanning a period of about a decade, from the mid-1980s to the mid-1990s, the investigators came to the conclusion that the decline in IHD mortality, where this phenomenon existed, was in fact real and that the decline in the incidence rate of coronary events contributed two thirds and the decline in case fatality one third (Tunstall-Pedoe 1999). The MONICA results confirm the observation made earlier, that declining incidence of IHD was not the sole contributing factor to the decline in mortality.[25]

149.   The MONICA results shown in Charts 23 and 24 are shown only for centres from countries that participated in the ARD study. The period of coronary-event registration was continuous over a period of about 10 years. Table 18 lists for each corresponding MONICA centre, the periods of acute-coronary care monitoring linked to records of individual coronary events. These data were analysed in a *Lancet* article by Tunstall-Pedoe et. al. in February 2000 (Tunstall-Pedoe 2000).[26]

Table 18 MONICA data

150.   Trends in coronary event rates and case fatality for the MONICA centres are shown in Chart 23. For most centres there was a decline in both coronary event rates and case fatality over the observed period, although less so for the latter. In Spain there was an increase in coronary event rates for both sexes as well as an increase in case fatality for women. Centres in Denmark, Finland, Germany and Sweden also recorded increases or relatively no changes in case fatality, although the centres in Finland had some of the largest reductions in coronary event rates.

Chart 23 Trends in event rates and case fatalities, by gender (MONICA)

151.   Data on 28-day case fatality, standardised to the world population, as a percentage of coronary event rates are ranked in descending order in Chart 24 for the MONICA centres. The MONICA results confirm the observation made earlier that case fatality for women, mean of 48.5% for MONICA centres

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24.   Information on the MONICA project, including publications and the manual outlining the objectives and the protocol, can be found on the internet at www.ktl.fi/monica. See also Kuulasmaa *et al.* (2000) and Tunstall Pedoe *et al.* (2000).

25.   The measures of case fatality between the MONICA project and what was described in Section 3.3.3. as case fatality are not strictly comparable. The case fatality from Section 3.3.3. refers only to deaths due to acute myocardial infarction whereas MONICA case fatality includes a broader range of coronary deaths.

26.   For a more complete description of the coronary-event registration for MONICA see Tunstall-Pedoe 1999. Additional information on the collection of data for the MONICA project can also be found at www.ktl.fi/monica.

included in Chart 24, was higher than for men, mean of 44.2% for MONICA centres included in Chart 24.[27]

Chart 24 28-day case fatality, by gender (MONICA)

152.   If the decline in coronary-event rates was the main contributor to the decline in IHD mortality then what factors led to the decline in coronary-event rates? This was the subject of one of the two main hypotheses the MONICA team investigated: what is the relationship between 10-year trends in the major cardiovascular risk factors of serum cholesterol, blood pressure and cigarette consumption and 10-year trends in incidence rate (fatal plus non-fatal attack rates) of coronary heart disease (MONICA 1997).

153.   In one of two papers publishing the final results of the MONICA project, Kuulasmaa et. al. estimated the contribution of risk factors to trends in incidence rates (Kuulasmaa 2000). They found that smoking rates had decreased, but this was more evident for men than women; mean blood pressures and cholesterol decreased; but obesity, as measured by body mass index increased. However, they found that the decline in these risk factors only partly explained variations in trends in coronary heart disease, a result that supports public health policies aimed at reducing these risk factors, but suggest that other factors are also having an impact. Their conclusions do not go as far as Hunink *et al.* (Hunink 1997) who demonstrated that primary and secondary prevention via lifestyle modification has played an instrumental role in decreasing CHD mortality, although both studies agree that other factors such as medication have also had a non-significant contributing role (Hunink 1997). These will be investigated in greater detail in the next chapter.

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27.   The two Swiss centres did not collect information for women.

4. RECENT TRENDS IN TREATMENT PATTERNS

4.1. Ambulatory care treatment and preventive care

154.   Preventive care for IHD includes both medical and public health (non-medical) interventions aimed at reducing risk factors. The non-medical aspects of prevention include a number of public health programmes that were discussed as part of the epidemiological section. This section will focus on preventive medical care as part of general medical care in ambulatory settings. However, the discussion will be there is little data available to describe ambulatory care medical treatment in most countries. Readers should refer to Appendix 2 on the medical background and recent treatment trends of ischaemic heart disease for a brief summary of the key aspects involved in the prevention and treatment of IHD, which is intended for a non-medical audience.

4.1.1 Trends in ambulatory care treatment

155.   General practitioners play the most active role among physicians in the prevention of ischaemic heart disease, but ambulatory care treatment is not limited to prevention. The role of ambulatory care physicians in the diagnosis and treatment of IHD is a vital component of the continuum of care provided to persons with IHD, a role not limited to cardiac care specialists. For most patients, the first diagnosis of heart disease is made by a general practitioner and quite often the GP is also the one who confirms this diagnosis. Apart from a medical history and physical examination, physicians have available to them several diagnostic procedures, such as electrocardiography and exercise tolerance testing. In addition to these non-invasive diagnostic techniques there exists an invasive diagnostic technology, cardiac catheterisation, that is performed mostly in acute care settings. With increasing frequency this procedure is being performed as an outpatient or ambulatory care treatment (Appendix 2).

156.   In Section 3.3.3. we observed that the majority of AMI deaths occur prior to hospitalisation. It is well understood that AMI patients should receive medical care as quickly as possible prior to hospitalisation, especially during the first hour following a myocardial infarction (Braunwald 1998). However, we acknowledge the limitations of the current study in this specific dimension. Although this dimension is quite relevant from a clinical perspective, obtaining empirical data to study this issue is beyond the scope of this paper.

157.   The mix of GPs and cardiologists in providing ambulatory care treatments depends on their relative availability in a given country. Broad aggregate statistics on physician supply, specifically various cardiac care specialists, have been discussed in Part I as a proxy for the general availability of health care resources, but the discussion focused more on their roles as acute care physicians. The discussion in the following section pertains to the preventive aspects of physicians' roles in ambulatory care.

4.1.2. Trends in the use of ambulatory care preventive drugs

158.   The key to preventive medicine in treating IHD is to prevent atherosclerosis and hypertension for which there exist a number of drugs that are available for this purpose. Ideally, we would have wished to

gather data on prescriptions by type of indications, however, these data are not available at an aggregate level and we were not in a position to gather data on prescriptions from individual files. As a result we have used data on consumption at an aggregate level, data that are not broken down by relevant factors such as age, gender, medical condition and risk factors. Therefore, caution must be exercised when examining the information on drug consumption in this section. We have been able to supplement some of these data with published results from MONICA on the use of certain drugs before an acute event (Tunstall-Pedoe 2000).

159.   Making use of aggregate data prevents us from making the distinction between regular drug use for chronic conditions versus drug use in a hospital during an acute episode. However, since the majority of these drugs are used to treat chronic conditions and risk factors, we have made the assumption that the bulk of consumption for the drugs considered in this section occurs in ambulatory care settings. This assumption allows us to use these indicators as a reasonable proxy for ambulatory care drug treatment of IHD shedding additional light on aggregate levels of treatment patterns for this condition across OECD countries.

160.   In the following section, trends in the consumption of drugs will be used to compare aggregate levels of treatment patterns. Consumption will be discussed in terms of volume, measured by defined daily dosages (DDD), divided by the overall population, so the key indicator to be considered will be DDDs per 1000 inhabitants per day. Consumption figures for each drug will be shown by their Anatomical Therapeutic Chemical (ATC) classification, as defined by the WHO Collaborating Centre for Drug Statistics Methodology (ATC Index with DDDs 2000). All the drugs considered below were chosen because they are mainly used in the prevention and treatment of ischaemic heart disease, but some of them, such as aspirin, are used for treating other conditions which limits the ability to attribute their use in IHD separately from other conditions.

4.1.2.1. Lipid lowering drugs (ATC C10A)

161.   When used in individuals with a history of cardiovascular disease, lipid lowering drugs, or cholesterol and triglyceride reducers, are an accepted and effective means of secondary prevention of IHD. They are not nearly as effective for patients with no history of cardiovascular disease. Data on the consumption of these drugs in the 1990s were available for 10 countries (Chart 25a). Since information on the type of indication is unavailable, it is not possible to estimate the consumption of these drugs used in persons with no history versus those with a history of cardiovascular disease. The use of the broader ATC category (C10A) also limits the discussion from including fairly recent and more expensive drugs, such as statins. The diffusion of statins may be influenced by financial barriers and cost-effectiveness considerations in some health care systems.

Chart 25a Consumption of cholesterol and triglyceride reducers (ATC C10A)

162.   Two countries in particular, Australia and Norway, saw a huge increase in the use of these drugs since 1993, especially after 1994, both experiencing a five-fold increase in consumption by 1999. The consumption of lipid lowering drugs increased in all countries, although the magnitudes of the increases varied. Unlike the consumption of diuretics (see below), there was no clear delineation between countries based on their burden of IHD. Denmark's use was well below Norway even though the countries have similar risk factor profiles, but Italy's use was above Denmark despite the higher burden of IHD for the latter.

4.1.2.2 Diuretics (ATC C03)

163.   Diuretics are often the first drug of choice for treating hypertension. These include fairly old and established drugs that are available at modest prices. They help lower blood pressure by aiding the kidneys in eliminating salt and water, decreasing fluid volume throughout the body. They also help blood vessels to dilate and can be useful in the treatment of IHD as well. Diuretics are often used in combination with other drugs, usually ACE inhibitors where they fall under ATC category C09B A, when treating IHD. The diuretics included in the broad ATC C03 category include both diuretics plain and used in combination with other drugs, usually potassium.

164.   Consumption figures for diuretics are shown in Chart 25b. There has been relatively no change in the consumption of diuretics for the countries displayed in the chart over the past 10 years, with the exception of Australia, where the consumption of diuretics fell about 40% during this period. The countries that typically experience the highest burden from hypertension and IHD are also the ones that consumed the most diuretics, Denmark in particular where consumption was about 20% higher than the next highest country. Finland, Sweden and Germany also had relatively high consumption levels, while Italy, Belgium and Greece were comparatively lower.

Chart 25b Consumption of diuretics (ATC B03)

4.1.2.3. ACE Inhibitors(ATC C09A)

165.   Since the development of oral Angiotensin Converting Enzyme (ACE) inhibitors in the 1970s hypertension has become a major target of this drug. ACE inhibitors such as ramipril are also used in treating heart failure following a heart attack. Consumption of ACE inhibitors has increased steadily during the 1990s (Chart 25c). They are particularly popular in Australia and Greece, the latter being a country characterised by a low burden of IHD. The consumption of ACE inhibitors is lower in Korea than in the other countries despite a relatively high prevalence of hypertension.

Chart 25c Consumption of ACE inhibitors (ATC C09)

4.1.2.4. Beta blocking agents (ATC C07)

166.   Beta blocking agents, or betablockers, treat hypertension by blocking the effects of the sympathetic nervous system, which reacts to stress by raising blood pressure. They are also used in treating myocardial infarction where their efficacy in treating patients following MI has been known for about twenty years. Temporal trends in the consumption of beta-blocking agents differ across OECD countries (Chart 25d). The use of betablockers has steadily increased for most of the countries depicted in the chart. Finland in particular saw a two-thirds increase in the consumption of betablockers during the 1990s, while Norway, Greece and Denmark experienced less pronounced increases. On the other hand, Australia was the only country where consumption of betablockers decreased. By 1999 the consumption of betablockers in Australia was at or near the same level as the low IHD countries Greece, Italy and Korea.

Chart 25d Consumption of beta-blocking agents (ATC C07)

4.1.2.5. Calcium Channel Blockers (ATC C08)

167.   Calcium channel blockers, or calcium antagonists, also cause blood vessels to dilate and therefore are used in treating hypertension. They have also been used to treat cardiovascular disease since the 1960s

and are an effective treatment for angina pectoris (Stone 1980). Chart 25e shows consumption data for calcium antagonists. There has been a steady increase in the use of calcium antagonists throughout the 1990s in all countries, except Germany for which only two years of data were available. In Sweden there was a sudden drop in consumption from 1996 to 1997 which may reflect more a data issue than a true pattern of consumption. The same drop occurred for Germany, although with only two years of data it is even more difficult to determine the cause of this decline. The use of calcium channel blockers was highest in Italy and Hungary whereas it was lowest in Korea. With the exception of Korea, these countries vary little with respect to their consumption levels of calcium antagonists which does not reflect the relative burdens of IHD.

Chart 25e Consumption of calcium channel blockers (ATC C08)

4.1.2.6. Antihypertensives (ATC C02)

168.   The use of antihypertensives for treating hypertension is well established for most people, although there is not much evidence to support their use in people 80 years and older. The data to be discussed here refer to the older class of antihypertensives such as veratrum alkaloids, which tend to have more side-effects than the other drugs used to treat hypertension (Diuretics, ACE inhibitors, Beta blocking agents and calcium channel blockers). There is no discernible pattern of consumption for antihypertensives that can represent the situation for these countries in general (Chart 25f). Some countries have seen a decline in antihypertensive consumption, especially Australia which went from the highest consuming nation in 1990 to middle of the pack by 1998. Other countries like Korea have seen a gradual increase during the decade. A U-shaped pattern characterises the trend in consumption for several of the countries that saw an increase in consumption, especially in the last half of the decade. Hungary, Norway, Greece and Denmark all saw consumption of antihypertensives decrease initially, but eventually there was an increase in for these countries with the timing of the increases differing among them. The increase started first in Norway in 1994 and was the most dramatic, but by 1996 the other three countries also saw consumption increase. A general impression is that many of these older drugs saw their relative use declining until the beginning of the 1990s, but since then several countries have seen increasing consumption of antihypertensives which could be due in part to cost saving measures which emphasise the use of cheaper drugs such as antihypertensives to some of the more expensive ones for treating hypertension.

Chart 25f Consumption of antihypertensives (ATC C02)

169.   We acknowledge the difference between the consumption of drugs used to treat hypertension versus the consumption of antihypertensives themselves. As mentioned earlier, the consumption of antihypertensives in Chart 25f refer to alkaloids and other sub-categorisations of ATC category C02. The main drug types that are used to treat hypertension include peripheral vasodilators (C04) in addition to ACE inhibitors, calcium channel blockers, beta-blocking agents, diuretics and antihypertensives. If one is restricted to studying consumption patterns of drugs at a broad ATC category level, a broader picture of treating hypertension would be to combine consumption figures of all these drugs into one broad indicator. Chart 26 demonstrates this method for consumption of antihypertension drugs in Norway. As the chart indicates, drug consumption for fighting hypertension has been steadily rising during the 1990s, which is in line with most patterns of increasing hypertension among most OECD countries.

Chart 26 Consumption of drugs used to treat hypertension in Norway

170.   There are numerous difficulties in ascribing these consumption patterns to substitution between different types of drugs used for treating hypertension for the reasons mentioned at the beginning of the

section. Not only can these drugs all be used for treating hypertension, but their utilisation will differ. Some of them can be used monotherapeutically while others are generally used in combination with other drugs, even with some of the other drugs discussed here.[28] Furthermore, many of these drugs are also used in treating ischaemic heart disease in addition to their therapeutic values in treating hypertension, all of which makes it nearly impossible to interpret these data more accurately without knowing the indications for which they were prescribed.

4.1.3. Insights from the MONICA project on the use of drugs prior to onset of coronary event

171.   The MONICA project was in a unique position to monitor the use of coronary care services during a span of time that saw considerable changes in treatments for coronary heart disease. Table 19 shows a chronology of the most important evidence-based coronary care treatments that correspond roughly to the MONICA monitoring period. The MONICA project was designed to study epidemiological trends, the monitoring of coronary care treatments was secondary to this purpose, as a result the investigators were not in a position to properly evaluate the efficiencies of various treatments. Nevertheless, the MONICA investigators did collect valuable information on the utilisation of several coronary care treatments that provide a picture of the evolution of coronary care during the 1980s and early 90s. Even if the sample population was restricted to the under 65 population, the data on treatment use provides an interesting proxy for the diffusion of treatment patterns and technologies across countries.

Table 19 Chronology of evidence-based coronary care

Treatment	First observation or trials	Major trials	Meta-analysis or overview of trials
Beta-blockers			
After AMI	1974	1979-81	1982, 85
During AMI	1981-85	1986	1989
Antiplatelet drugs			
During AMI	1979	1988	1994
Subacute CHD	1973	1979-81	1988
Thrombolysis			
During AMI	1970s	1986, 88	1994
ACE inhibitor			
After AMI	1986	1988-93	1994
CABG (vs. medical)			
Chronic CHD	1968	1977-88	1994
PTCA (vs. CABG)			
Chronic CHD		1988-95	1995

Source: (Tunstall-Pedoe 2000)

172.   The MONICA investigators collected information on the use of three drug therapies prior to onset of a coronary event; beta-blockers, antiplatelet drugs and ACE inhibitors. They also collected information on the use of four drug therapies during the event, that is from onset to discharge or death and following discharge for survivors; thrombolytics, beta-blockers, antiplatelet drugs and ACE inhibitors (drug use during the event will be discussed in the following section on trends in acute care). Treatments

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28.   Some of these combination products include one of the antihypertensives (C02). If these "new antihypertensives" were disaggregated and the pieces assigned to separate drug categories it would make it appear that the particulate classes are increasing when in fact it is the combination product, further confounding the analysis.

used prior to onset are shown in Charts 27 a, b, c. These charts show the proportion of patients receiving each of the drugs prior to onset of the acute event for two time-periods corresponding to the base coronary-event monitoring period and the final period. The figures will necessarily be higher during the event since only those patients at high risk would have been receiving treatment prior to onset.

Chart 27 a, b, c Treatment prior to onset of coronary-event (MONICA)

173.   The most significant increases in utilisation during the study period were observed for antiplatelets and ACE inhibitors. Patient populations from only four centres were recorded as having used ACE inhibitors during the first monitoring period, but by the second period the average percentage of patients receiving ACE inhibitors prior to onset had risen from 0% to 8%. Similarly, the average among the MONICA centres from Chart 27a for the use of antiplatelets increased from 6% to 20%. It is possible that a substantial portion of this increase could be attributable to uptake by physicians of the results from the ISIS-2 meta-analysis of 1988 which demonstrated the positive influence of antiplatelet therapy for high risk patients (ISIS-2 1988*a*; ISIS-2 1988*b*). This shows the impact of the diffusion of medical knowledge on the use of certain treatments.

174.   The average use of beta-blockers did not change remaining at 18% for both periods, although consumption patterns varied greater for women than men. For example, there was a much larger decline in consumption for women than for men in the Brianza (Italy) and Gothenburg (Sweden) centres. There was a decline in consumption for both men and women in the two Australian centres and the three Finnish centres. However, the only statistically significant change in the use of beta-blockers was for men in Ghent/Charleroi (Belgium), where consumption of beta-blockers before onset of the coronary event increased from 9% of men during the first period to 21% in the second period.

4.2. Trends in acute care for AMI

175.   The two most common conditions of ischaemic heart disease are angina pectoris and acute myocardial infarction, the former being milder than AMI. Patients admitted for angina are more likely to be admitted on an elective or non-urgent basis, while AMI is more likely to be fatal or lead to emergency admission. For studying acute care treatment we will mainly focus on AMI, following closely the initial insight of the TECH Research Network (TECH 2001); using patients with AMI will remove some of the heterogeneity across countries (See Appendix 3 for a definition of the cohort and treatment variables). For the purposes of this study we do not limit the analysis to the acute care treatment of AMI, but extend it to subacute forms of IHD. However, there are several problems that need to be dealt with when analysing data on subacute forms of IHD, including a lack of available data. Section 4.3 will examine acute care treatment trends for the subacute forms of IHD, with particular focus on angina.

176.   For many suspected cases of AMI cardiac catheterisation (CATH) will be used to diagnose the condition. Following diagnosis there are several treatment options available, these include drug therapy, mainly thrombolytics and revascularisation procedures, percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass graft surgery (CABG). PTCA is a minimally invasive surgical technique that involves dilating the artery with a small balloon attached to a catheter. It is a procedure that does not always require a surgeon and quite often is done immediately following a CATH. CABG is a very costly intensive surgical procedure which has limited use as a first line treatment for AMI. When CABG is used to treat AMI the general clinical practice is to stabilise the patient in a first stage and then perform the operation when the patient is stabilised. The efficacy of PTCA has greatly improved in recent years, especially with the introduction of intracoronary stents (STENT) which prevent the reobstruction of the treated artery. A more complete discussion of the medical background for these procedures can be found in the medical appendix of the report (Appendix 2).

177.   This section will begin by examining trends in admission for AMI. Following that discussion will be an examination of utilisation trends for cardiac catheterisation and PTCA. [The discussion on CABG will be kept minimal and will be developed more at length in the Angina section (see 4.3)]. The discussion for each procedure will examine aggregate trends in utilisation, followed by trends based on treatment during the initial admission for AMI and finish by examining treatment trends based on all treatments provided within 90 days from the initial AMI admission, for those countries where admission data linked by a patient identification number were available.

4.2.1. Summary of the TECH Research Network

178.   The TECH research network is an international collaboration of investigators that is developing new evidence on international differences in trends in treatment, resource costs, and health outcomes for similar health problems, starting with heart attack. To date, the research network consists of national experts in clinical medicine, economics, and epidemiology from 16 countries, who have developed new methods for conducting quantitative research on large administrative and clinical databases from each country.[29]

179.   Using standardised methods of data collection and analysis, TECH has worked to reduce barriers to comparative international research by moving the analysis of medical treatment and outcome trends to the "micro", or patient, level. Focusing initially on the treatment of heart attacks has allowed the TECH network to identify important differences in treatment and especially changes in treatment, and their consequences for patient health outcomes and the quality of care. Work up to this point assesses whether, and how, changes in the economic and regulatory incentives underlying health care systems influence technological diffusion.

180.   Extensive TECH databases contain longitudinal data from patient discharge records from each participating country.[30] Unlike data from the MONICA project mentioned earlier in this report, data collected by the TECH research network incorporate 1) at least a one year follow-up when linked, longitudinal data are available, 2) patients over 65 as well as patients under 65, and 3) large geographic areas, in many cases the entire country. These datasets were constructed according to a uniform research protocol that specified the inclusion and exclusion criteria for the AMI patient cohort and the International Classification of Diseases (ICD) codes for every procedure and diagnosis (see Table 20 for more details regarding the TECH data).

181.   These data allow TECH to complete an ongoing, thorough evaluation of differences in technological change and associated outcomes across all 16 TECH countries. Through a close collaboration with the TECH research network, we have augmented our findings on AMI for several OECD countries.

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29.   Ongoing work reviews the effects of technology change on outcomes and costs broadly and by gender, age, and socio-economic status. In addition, efforts are underway to expand the analysis of medical technology change to other acute conditions and procedures, as well as to non-acute and chronic conditions and treatments. See the TECH website (http://healthpolicy.stanford.edu/intro_tech/) for details.

30.   The TECH Research Network prefers the term longitudinal data for describing linked patient data, that is data which include a patient identification variable which is used to link data from more than one hospital study for patients with multiple hospital stays stemming from an initial admission, whereas the ARD team has prefered the term "patient-based." In this paper we use longitudinal when refering to linked patient data only when describing the work of the TECH Research Network.

182.   In an article for the May/June 2001 edition of Health Affairs, the network found three broad patterns of technology diffusion for catheterisation, PTCA and CABG. In countries that tended to have weaker 'supply' side restrictions to the adoption of technology, such as the provision of additional reimbursement to hospitals based on the treatments they provide and limited regulation of hospitals' choice to adopt new and costly technology, intensive procedures were quickly adopted and rapidly diffused into medical practice, leading to the highest procedure rates among countries. In a second group of countries, intensive technologies diffused rapidly once adopted as common medical practice, but the time of adoption occurred later than that of the first group. This leads to similar trends of procedure use compared with the first group, but lower absolute procedure rates for any given year. The final group of countries generally were slower to adopt new technologies than the other two groups and took longer to diffuse the technologies throughout their medical establishments. This may be due to the strong 'supply' side incentives to control costs within these countries: for example, hospitals are often reimbursed by global budget, or restrictions may be placed on the number of cardiac care facilities (TECH 2001).

4.2.2. Trends in admissions

4.2.2.1. Aggregate trends

183.   Statistics on hospital admissions reflect a number of inter-related factors that determine the demand and supply interactions for acute care services. Admissions for acute myocardial infarction reflect the demand for acute health care services for AMI in as far as they are a function of the burden of this disease, but admissions also reflect supply conditions since they are inextricably linked to capacity and provider incentives. The purpose of this section is to describe aggregate health care system activities referring to commonly used indicators.

184.   The more commonly used term of admissions is used in this section even though we refer to separations or discharges. In the strictest sense, admissions refer to the formal admission of a patient in a hospital whereas separations or discharges refer to the patient's release following treatment. Where data refer to admissions and not separations will be noted.

185.   A couple of caveats need to be borne in mind when interpreting the results to be presented here. As much as possible, the data presented here exclude false AMIs, that is patients who are admitted for a short stay but are released from hospital, not transferred to another institution and did not die since in all probability these patients did not suffer a heart attack (See Appendix 3 in this paper for a definition of the cohort). However, only a few countries were able to exclude false AMIs and these have been noted. Another reason for caution is that some of the data are "event-based" as opposed to "patient-based": this means that some countries provided information based on data where they were not able to keep track of individual patients following discharge. With patient-based data patients can be tracked as they move through the hospital system, including between admissions. This poses a problem for counting individuals who are admitted for AMI, receive treatment during their initial stay and are scheduled for follow-up treatment. In practice this should be considered a single episode of care, but with event-based data it would be seen as two separate cases of AMI. As a result these data should be considered as a first stage approximation for the volume of activity. Table 20 lists each country with information regarding the admissions data they provided (See Appendix 3 on Data sources and data quality). The TECH Research Network separated their data and analysis into non-longitudinal (event-based) and longitudinal (patient-based) cohorts.

Table 20 Data sources based on country reports

186.   The key result for most countries is that the number of admissions for acute myocardial infarction has remained relatively level during the 1990s, using raw data or data age-standardised to the European population aged 40 and over (Charts 28). This is important to note for later on, for if the analysis were constrained only to this indicator this would lead to an impression of stability in the treatment of AMI, whereas the further sections will reveal very strong dynamics in terms of diffusions of specific treatment patterns.[31] The largest declines in admissions were in the Nordic countries and Australia, with a greater decline for men than women, although in the latter data were only available from 1993/94. Both Denmark and Sweden saw a decrease in AMI admissions for men of about 20% from 1990 to 1996 which may reflect the declines in incidence that have been witnessed for these countries (Dozet 2000; DIKE 1999).[32] The countries with the lowest levels of admissions, Japan, Switzerland, Italy and Belgium, are also the countries with the lowest burden of IHD among the countries depicted in these charts. As mentioned before interpreting cross-country comparison will be difficult since both event-based and patient-based admissions are included and the magnitude of the difference between the two is not known. For example, admission rates for AMI in Ontario appear to be lower than Belgium, despite a much higher burden of AMI in Canada than Belgium.[33] The data for Ontario are based on patient-based data whereas the data for Belgium are not, meaning that the figures shown for Belgium are likely higher than the true admission rates due to double counting of patients admitted at least twice within the same year for AMI.

Chart 28a,b Overall admission rates for acute myocardial infarction (raw and standardised).

4.2.2.2. Trends by age and gender

187.   Since men are more predisposed than women to suffer a heart attack, they are more likely to be admitted to hospital for AMI, a fact evident from Charts 29 which show admission rates by age and sex for several countries. These charts also show that age and admissions are positively correlated not a surprising finding given the positive correlation between age and AMI incidence. However some interesting patterns do emerge: in Norway, admission rates for individuals aged 80 or less decreased between 1990 and 1998 for both genders, while admission rates for men and women greater than 85 increased. The same situation prevailed in Canada, including Ontario. With the exception of persons aged 85 and over in Norway, admissions in the Nordic countries have been declining during the 1990s. The decline for men has been steeper in Denmark and Sweden than for women, while the decline for both genders in Finland has not been as steep as for these two countries. In the United States there has been a sharp increase in admission rates for persons aged 80 and older, but curiously enough, sharp decreases for persons aged 75-79 and smaller decreases for persons aged 70-74. In Japan, the 1990s were characterised by an initial increase in admissions for men from 1990 to 1993 followed by a decrease in admission rates in 1996. For Japanese women, this period was marked by a decrease in admission rates for women aged 75 or greater. Admission rates in 1996 for Japanese men aged 85 or older were about the same as women aged 65-69 in Canada, Norway and the United States.

Chart 29 Admission rates for acute myocardial infarction, by age and gender (ARD and TECH)

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31.   The diffusion of technology is a subject that is central to the TECH Research Network's work. They have shown that technological change in medical care is a global phenomenon, one that differs substantially around the world (see Section 4.2.1. and TECH 2001).

32.   Refer to Table 3.8a and 3.8b of the report *Heart Statistics 1999* for incidence trends for Denmark.

33.   Assuming of course that Ontario as well has a lower burden of AMI than Belgium.

4.2.3. Trends in the use of drugs in acute care settings

4.2.3.1. The use of anti-thrombotic drugs based on aggregate data

188.   Perhaps the largest obstacle to overcome when analysing drug consumption at an aggregate level is the separation between drugs used for treating inhospital patients and those drugs that are more commonly used in ambulatory care settings. With some drug classes this is fairly straightforward. Cholesterol and triglyceride reducers for example are mainly used as ambulatory drugs. Antithrombotic agents are a prime example of a drug class where it is next to impossible to distinguish between drugs that are used inhospital and drugs used primarily in ambulatory care, at least not without examining consumption at a more detailed ATC level. Included in the ATC drug class of antithrombotics agents (B01A) are drugs that are used primarily in acute care settings such as streptokinase (B01A D01) and drugs used primarily in ambulatory settings like aspirin (B01A C06).

189.   Many of the drugs examined in Section 4.1.2. are also issued to AMI patients during the course of inhospital treatment, however, since the bulk of these medicines are used in ambulatory care settings the analysis was not compromised much by including them in the section examining ambulatory care treatments. The issue of anti-platelets is a prime example of a drug class fraught with complications for analysis of consumption trends. This class of drugs includes aspirin and more expensive drugs like ticlopodine and clopidogrel, all of which have been shown to be effective treatments for AMI during the event. Further complicating matters is that aspirin is also used as an analgesic. For these reasons it was felt that including an analysis on utilisation patterns for these drugs would be unnecessarily confounding. Appendix 2 includes a discussion on the medical merits of these treatments.

190.   Data on the consumption of anti-thrombotics show a steady increase during the 1990s for all countries (Chart 30).

Chart 30 Consumption of antithrombotic agents(ATC B01A)

191.   A cross country comparison of consumption of anti-thrombotics reveals a pattern that is roughly the inverse of the hierarchy that will be shown below regarding the use of invasive procedures. Finland stands out as the country consuming the most anti-thrombotics with 80.5 DDDs/1000 inhabitants/day consumed in 1998. Next are Denmark, Norway and Sweden with between 40 and 55 DDDs/1000 inhabitants/day consumed. The final group consists of Australia, Korea, Belgium (6.2 in 1996), Germany (14.5 in 1997) and Italy (18.7 in 1998). Australia, Belgium and Germany are among the group that consumes the least anti-thrombotics but have a high rate of use of invasive procedures. Since the use of PTCA can be seen as a substitute for thrombolytic therapy this may reflect the influence of economic and medical factors in the treatment for AMI. Italy and Korea also have a lower level of consumption of these drugs,[34] but this may be because they are both countries with low rates of cardiovascular disease.

4.2.3.2. Insights from the MONICA project on the use of drugs during acute coronary event

192.   As mentioned previously, the MONICA project collected valuable information on the use of drugs both prior to and during onset of infarction. Drug use prior to onset was already discussed in the

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34.   As mentioned above, it may be that Koreans face high copayments which may affect consumption patterns. High copayments also affect inhospital drugs (see Section 3) which may explain the low relative consumption of anti-thrombotics. The other possibility is that there is a consistent bias of under-utilisation in the drug consumption data for Korea.

section on ambulatory care practice. The following discussion will focus on the MONICA findings on the use of drugs during a coronary event. Information was collected on the use of the following drugs: thrombolytic drugs, antiplatelet drugs, beta-blockers and ACE inhibitors.

4.2.3.2.1. Thrombolytic drugs

193.   Charts 31 show the use of drugs during the acute coronary event. The MONICA investigators collected information on the use of thrombolytics (Chart 31a). The use of thrombolytics saw a substantial increase between the two observation periods with wide variation across countries. For some countries the use of thrombolytics may have already been standard practice for treating AMI at the beginning of the monitoring. There was a decrease in the reliance on thrombolytic therapy in the former eastern German Länders, but it is uncertain what effect the changing political climate may have had on this outcome. AMI patients for three centres, Canada, USA-Stanford and Australia-Newcastle did not receive any thrombolytics during the first observation period but showed significant usage during the second period. Two major studies were released either during the first monitoring period (GISSI 1986) or shortly thereafter (ISIS-2 1988*a*; ISIS-2 1988*b*) which probably helped to increase thrombolytic use.

Chart 31a Treatment during acute coronary-event, thrombolytics (MONICA)

4.2.3.2.2. Antiplatelets

194.   An even stronger case for the influence of a major study can be made for the use of anti-platelets during infarction. The data from Chart 31b clearly show a dramatic increase in anti-platelet use for all MONICA centres, from an average of about 35% of male and female patients during the first period to about 90% in the second period. Differences across MONICA centres and between gender were almost non-existent. The ISIS-2 study demonstrated the benefits of aspirin during infarction and was released shortly after the first observation period of acute-coronary-care and most certainly was a major factor in the increased use of anti-platelets. The almost universal acceptance of the results was probably a major factor as well in the small observed differences in anti-platelet use across both countries and genders.

Chart 31b Treatment during acute coronary-event, antiplatelets (MONICA)

4.2.3.2.3. ACE Inhibitors

195.   There was a dramatic increase in the use of ACE inhibitors during the acute coronary event (Chart 31c). During the first period very few centres registered any use of ACE inhibitors during infarction, but by the second period this had increased for all centres to an average of approximately 30% for both men and women. As with anti-platelets, the use of ACE inhibitors during infarction did not differ significantly across gender, with the exception of Finland where over 30% of women were given ACE inhibitors during the second monitoring period but only 20% of men were given this treatment. There were also small differences across countries in the second period with the exception of the Danish and the Swedish-Gothenburg centre where usage for both men and women were less than 15% whereas the other centres recorded usage of at least 20% for both men and women

Chart 31c Treatment during acute coronary-event, ACE inhibitors (MONICA)

4.2.3.2.4. Beta-blockers

196.   Fifty percent of male patients were given beta-blockers during both periods observed for about nine of the 18 MONICA centres (Chart 31d), the same was true for women for seven of the 17 centres. During the second observed period, an additional 5 centres for men and seven centres for women saw half of AMI patients given beta-blockers. In the two Italian centres, only 20% of patients were being given beta-blockers during the first period, but this number swelled to about 60% during the second observation period. There were almost no differences between the proportion of men and of women given beta-blockers.

Chart 31d Treatment during acute coronary-event, betablockers (MONICA)

197.   What is interesting is to compare the changes in consumption between the first observed period and the second period for beta-blockage use prior to onset and during the attack. Prior to onset, there was very little change, in fact usage dropped for several centres (Chart 27c), a different pattern than that observed for usage during the coronary event. One factor which may have contributed to an increase in the use of beta-blockers during AMI is the publication of meta-analyses, released between the first monitoring period and the second monitoring period of coronary care (see Table 18), which showed there to be a benefit to using beta-blockers during AMI (Held 1989; Yusuf 1988).

4.2.4. Trends in acute care invasive procedures following AMI

4.2.4.1.On the use of micro data and administrative hospital discharge databases

198.   The most important phase of the current study was to collect data from administrative hospital discharge databases with a view to providing detailed information on the diffusion of treatment patterns and linking these to trends in outcomes more directly than with what can be observed from aggregate data. These data were collected and each country was asked to produce two cohorts, one based on common definitions for admissions for acute myocardial infarction and another for angina which will be discussed in the following section (See definition of cohort and procedures in Appendix 3 on data sources). Data were also collected from the TECH Research Network project for Australia (Perth), Belgium, Canada (Ontario), Denmark, Finland, Norway, Sweden, Switzerland, UK (Oxford) and the US (see Section 4.2.1., Appendix 2 and TECH 2001 for a further discussion regarding data sources).

199.   The reader should bear in mind three caveats regarding these data. First, for some countries, these data sources represent an almost universal coverage of hospital activity, and therefore can be considered as truly "representative". In certain cases, there is full coverage, but for one given geographical area, such as Ontario, Oxford or the Perth area. In some cases, the area is even more focused, as is the case for the Switzerland and Korea micro-treatment data, as they refer to one hospital, which is likely to be a major treatment centre. In this case, treatment patterns may be more intensive than for the overall country. In the case of Japan, the data come from a set of highly specialised tertiary care hospitals, which again may present patterns of care not representative of all hospitals in this country. In Belgium, certain data come from a sample of hospitals, which is however diversified and seems to be broadly in line with results for the overall country. Therefore, the different care patterns described in this report can only be considered as a "first best" approximation. While the larger picture described by these results is likely to be reflective of the activity and performance of health care systems, the reader should interpret the results with caution.

200.   Second, since treatment for AMI will often involve more than one hospital admission, ideally it would be most informative to follow patients for all of their hospital stays related to the initial AMI admission. Unfortunately, this was only possible for a limited number of countries, therefore countries that had access to non-linked data provided information based on all hospital stays for AMI. In addition, those that had access to patient-based data provided treatment information based on the 90 day episode of care.

Third, in the interests of time and comparability, we did not use all the information, such as clinical status or the number of comorbidities, available in these large administrative databases.

201.　　The following analyses on treatment trends is organised by procedure. The first two procedures to be discussed are cardiac catheterisation and percutaneous transluminal coronary angioplasty since these are the two most relevant to the AMI cohort. The final procedure to be examined will be coronary artery bypass graft, although it is less directly relevant for AMI as an acute event. The discussion on CABG will be developed more at length in the section on angina. Each treatment section will begin with a discussion on the broad aggregate trends in utilisation. This will be followed by discussion based on hospital admissions data, starting with treatment during the initial stay and then treatment based on the 90-day episode of care.

4.2.4.2. Cardiac catheterisation

202.　　As mentioned previously, many AMI patients will be diagnosed by cardiac catheterisation (CATH), a minimally invasive diagnostic procedure that involves insertion of a catheter into an artery to reach the left side of the heart (see Appendix 2 on the medical background for a more complete discussion on the various procedures). Since it is an invasive technology requiring special skills, cardiac catheterisation is usually performed in an acute care setting, but not all hospitals are equipped to perform this procedure. In Ontario for example, of 193 acute care hospitals, only 14 were equipped with at least one catheterisation lab (Tu 2000). As evidenced from Chart 3, countries clearly differ with respect to their capacity to perform cardiac catheterisation which will have a direct impact on utilisation.

203.　　Many patients will often not require an overnight stay following a catheterisation and will only stay if their condition is serious enough. It is becoming increasingly common for cardiac catheterisation to be performed in ambulatory settings or as an outpatient procedure, thus not requiring an overnight stay. For example, in Belgium in 1995, 7.7% of cardiac catheterisations were performed in an ambulatory care setting, by 1997 this figure had risen to 11.3% (Moens *et al.* 2000). For some countries, the figures below on the utilisation of cardiac catheterisation may underestimate the true magnitude since they are based on acute care hospital data, which do not include data on patients receiving the procedure on an outpatient basis or in an ambulatory setting.

4.2.4.2.1. Aggregate trends in the use of cardiac catheterisation

204.　　Chart 32 shows the use of cardiac catheterisation during the 1990s based on aggregate data. This shows the number of cardiac catheterisation procedures divided by an aggregate population denominator. Differences across countries are a result of both the relative prevalence of the disease and intensity of use conditional on the disease. The use of cardiac catheterisation has been increasing from year to year for every country with available data except Canada, although Ontario has seen utilisation grow albeit at a lesser pace than most countries. The increase has been most dramatic in Denmark, Germany and Sweden where utilisation has more than doubled.

Chart 32 Utilisation rates for cardiac catheterisation procedures

205.　　The three countries with the highest utilisation levels of cardiac catheterisation procedures were Germany, Australia and Belgium, while utilisation was lowest in Greece, Canada (including Ontario) and Italy. By 1997, Germany, Australia and Belgium were performing about 1 000 catheterisations per 100 000 inhabitants aged 40 and over. These three countries performed roughly 5 times the number of cardiac catheterisations as did Greece, Canada and Italy; in fact, the German rate in 1997 was greater than the combined rates of these countries. Germany and Australia experience a relatively high burden of disease,

but their rate of use is much greater than Denmark Sweden or Norway. Belgium is an intermediate position in terms of burden of disease, but their utilisation rate for this procedure is high. The comparatively lower rates of Greece and Italy should also be considered in light of the lower prevalence of IHD in Mediterranean countries, which means that conditional on the disease, these countries may actually experience a relatively high use of this technology. However, microdata on treatment based on individual patients was available for only a smaller set of countries, and therefore aggregate data is a useful first step in order to approximate the diffusion of technologies.

206.   These data likely underestimate the true number of cardiac catheterisations in certain countries. For most countries the data were derived exclusively from hospital discharge records databases, therefore they will not capture cardiac catheterisations performed outside of hospitals. For some countries, such as Sweden and the UK which perform few catheterisations outside the hospital setting, the problem is small. For others, such as Canada (Ontario) and Australia, there can be a serious underestimation.[35] Therefore, caution should be exercised when interpreting the results. Of the three procedures examined in this section (coronary), cardiac catheterisation is the most likely to be performed outside of hospitals.

4.2.4.2.2. Trends from in-hospital data

207.   From the AMI cohort, 13 countries were able to provide information on the use of cardiac catheterisation, when combining data from the OECD and TECH Research Network study groups. The aggregate data on the utilisation of catheterisation provide a long-term view of the trends in the use of this procedure, but this information is not sufficient if the goal is to study some of the underlying factors that influence its use. By focusing on one specific set of patients, those admitted to hospital for AMI, differences in utilisation based on type of disease are eliminated providing more focus on the underlying influential factors. The drawback is that some of these data are derived from specific subsets of the health care system, that are often more technologically advanced, resulting in some potential bias.

208.   The data in Charts 33 show the use of catheterisation for several countries following initial admission for AMI. Data for Australia (Perth), Belgium, Canada (Ontario), Switzerland, the UK (England) and the US were provided by the TECH Research Network. As already observed with the aggregate data, some countries tend to use catheterisation more than others. For the initial hospital stay for AMI, Switzerland and Japan were far above other countries regarding the use of this diagnostic procedure. In Japan, the data come from tertiary teaching and private hospitals participating in the VHJ Quality Indicator Project that are more likely to use invasive procedures than other hospitals. For Switzerland, these data represent only one hospital, the Fribourg Canton hospital. In VHJ hospitals in Japan, at least 70% of male and female AMI patients less than 75 years old were given a catheterisation during their initial hospital stay in 1996. It was the same for Switzerland except for women aged 65 – 74 where only about 40% received catheterisation. Caution must be exercised when interpreting these results since they are probably not representative of their respective countries as a whole.

Chart 33 Proportion of AMI patients receiving cardiac cath. during the initial admission and 30 days

209.   Among the next group of countries the United States was the highest user of catheterisations, where half of men and women AMI patients aged 40-64 were given a catheterisation in 1996. In addition to the United States, this group of countries includes Australia, Belgium and Canada (Ontario). Less than 10% of AMI patients in the last group of countries, Italy, Norway and the United Kingdom had received

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35.   In fact, utilisation of catheterisation in Canada and Ontario has been increasing during the 1990s suggesting a substitution of treatment settings away from hospitals towards ambulatory care (Jack Tu comment).

catheterisation; one plausible explanation is that patients transferred to hospitals with more sophisticated facilities were not captured in the data.

210.   For some countries, it is interesting to try to reconcile the aggregate data and the micro data. Chart 32 shows that both Ontario and Canada were among the regions that had a lower use of cardiac catheterisation at an aggregate level (regardless of patients' medical conditions), certainly much lower than Australia, Belgium and the United States, countries with which they have similar usage levels with respect to the proportion of AMI patients receiving a CATH (Chart 33). It is possible that in Ontario at least, cardiac catheterisation may be used more for AMI patients (Chart 33) than other patients with ischaemic heart disease (Chart 32). Within Australia, patients in the 40-64 year group in Perth were much more likely to be diagnosed by cardiac catheterisation than the country as a whole. In fact the proportion of patients in Perth diagnosed by cardiac catheterisation was roughly the same as for the US.

211.   The use of catheterisation decreases with advanced age, independent of the intensity of catheterisation use. However, the steepness of this gradient differs across countries. In the Oxford region of the UK, about 4% of female AMI patients aged 65-69 were given a cardiac catheterisation compared to about 1% for those aged 85-90. For the US, the figures were 50% and 10% respectively, which also denotes a significant gradient by age. For Australia the age gradient was even greater. The data from the VHJ QIP project in Japan show a different pattern. For both sexes, there was virtually no difference among AMI patients aged 40- 64, 65-69 and 70-74, although patients aged 85-90 were less likely to be given a catheter. As stated earlier, these figures should be interpreted with caution since these are all high intensive technology hospitals and are more predisposed to using CATH.

212.   Finally, for those countries that were able to provide data for several years, the use of catheterisation for AMI patients appears to be increasing, although this needs to be nuanced. For example, in Oxford utilisation is about 1% of AMI patients for most age groups and only for patients aged 65-69 does it reach 5%. In the US catheterisation use increased between 1990 and 1996 for AMI patients aged 65 or older, but a threshold level of about 50% for use of cardiac catheterisation for AMI patients appears to be emerging.[36] It may be that the technological diffusion of cardiac catheterisation may have reached a threshold point for the younger age groups. With a relatively lower utilisation rate but increasing over time, this technology may be spreading to older patients; the diffusion process may be working with a lag for older patients.

4.2.4.2.3. Trends from patient-based in-hospital data

213.   Data on catheterisation use for the 90-day episode of care were available for five countries; Finland, Spain (2 Northern regions) and data from the TECH Research Network for Australia (Perth), Canada (Ontario) and the United States (California for under 65 years and nation-wide for 65 or older). Since these figures include catheterisations during the initial admission, the figures for the 90-day episode of care will be greater than for the initial stay. In general these results are very similar to the results for the initial stay, albeit with much higher levels.

Chart 34 Proportion of AMI patients receiving cardiac cath. within 90 days of initial admission

214.   Even after 90 days from the original admission the age gradient for the utilisation of CATH persists. In Finland, the use of cardiac catheterisation after 90 days for diagnosing elderly AMI patients is rarely used. Even for young men and women aged 40-64 cardiac catheterisation is still used for diagnosing

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36.   The VHJ QIP data show that utilisation of catheterisation did not change much between 1996 and 1999 except for the elderly and appears to be levelling off at around 80% for all age groups.

AMI patients in Finland and Spain (Catalonia and Pais Vasco) far less than Perth, Ontario or California. On the other hand, cardiac catheterisation is used extensively in Perth and the US. For the youngest patients, the levels of utilisation between California and Perth are similar, but only for the most recent year and this similarity disappears for patients aged 65 years or older.

4.2.4.3. Trends in the use of percutaneous transluminal coronary angioplasty

215.   Percutaneous transluminal coronary angioplasty (PTCA) is similar to cardiac catheterisation in that both procedures require the insertion of a catheter through an artery to reach the left-side of the heart. The main difference is that a balloon is attached to the tip of the catheter during a PTCA which is used to dilate the blocked artery. This makes PTCA more expensive procedure than CATH. PTCA is used to treat mild forms of IHD and is increasingly being used to treat AMI. Until recently, PTCA as a first-line treatment for AMI (primary PTCA) has not been the treatment of choice for most countries. However, since the early 1990s, a number of studies have been released demonstrating potential advantages for this treatment over the most common alternative of thrombolytic therapy (see Appendix 2 on the medical background for a more complete discussion on the various procedures). The issue of primary PTCA will be discussed in a separate section.

216.   As mentioned previously, the most common substitute treatment for PTCA is thrombolytic. There is more limited substitution with CABG, although it is decidedly more expensive due to its intensity. The discussion of the MONICA treatment results highlights the patterns of use of thrombolytics drugs during the acute coronary event. The other three drugs can be seen as either complementary to PTCA, such as platelet glycoprotein IIb/IIIa receptor inhibitors, or in most cases as adjunctive substitutes used in combination with other drugs. The substitution with CABG will be discussed at the end of the CABG section.

217.   As with cardiac catheterisation, the capacity to perform PTCA will directly depend on the number of catheterisation laboratories available. However, the problem of undercounting procedures because not all cath-labs are located in acute care hospitals is not as significant a problem for the following discussion as it is for the discussion on catheterisation use. Individuals treated for AMI will be admitted directly into an acute care hospital for the initial admission.[37]

4.2.4.3.1 Aggregate trends in the use of PTCA

218.   Charts 35 show aggregate trends in the use of PTCA for 15 countries. At the beginning of the 1990s, the United States was far ahead of all other countries in terms of use of PTCA. In 1990 there were almost 284 PTCAs being performed in the US per 100 000 inhabitants aged 40 and over, the next highest country was Canada with 98 per 100 000. There was a cluster of three countries at the time, Germany and Australia in addition to Canada, that were performing about 100 PTCAs per 100 000 inhabitants. From 1990 onward these three countries differ dramatically with respect to their growth rates in the use of PTCA. Germany narrowed the gap with the US so that by 1997 there were 343 PTCAs performed per 100 000 compared to 396 in the US. The growth rate in Australia was not as dramatic: in 1997 there were about 208 PTCAs per 100 000. There was little change in the gap between the US and Canada where the number of PTCAs performed had increased to 141 per 100 000 in 1997. Most European countries experienced rapid growth rates in the use of PTCA. Levels of use in Greece and Finland are broadly

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37.   There is the possibility that patients referred for follow-up PTCA may be treated as outpatients or ambulatory patients. The number of patients thus referred is likely to be small, except perhaps in countries that are much more inclined to perform PTCA.

similar, even if the burden of disease is much higher in Finland. The causes for these trends are likely to differ. Some of these cause will include planning efforts by medical authorities, reimbursement arrangements, case mix and age..

Chart 35 Utilisation rates for PTCA procedures

219.   The rapid growth in PTCA use has created a divide among the countries in terms of levels of PTCA use per 100 000 inhabitants. At the top are the United States, Germany and Belgium,[38] all with similar levels of use with Belgium having the lowest level at 279 PTCAs per 100 000 in 1997. The next group consists of countries with levels between 100 and 200 PTCAs performed per 100 000 inhabitants aged 40 and over in 1997. This group includes Australia, Norway, Canada, Denmark, Sweden and Greece. The final group includes Finland, Italy, UK and Hungary.

4.2.4.3.2. Trends in the use of PTCA from in-hospital data

220.   Charts 36 provide information on the proportion of AMI patients who received a PTCA during a hospital admission. Data for Belgium, Switzerland and the UK (England) were provided by the TECH Research Network. Different chart categories separate countries with patient-based data from those with event-based data. The use of event-based data will produce lower rates than if patient-based data are used. The numerator, the number of AMI patients receiving a PTCA, in both cases will be equal. However, the denominator, number of AMI admissions, will be higher using event-based data, producing a lower rate with event-based data. These charts confirm the trend shown with the aggregate data that PTCA use has been increasing during the 1990s for all countries with data available over time. The countries also fall more or less in line with the previous observation of level of use. Based on these figures patients admitted to the tertiary care hospitals involved in the VHJ project in Japan would be considered among the group that resorted to PTCA use the most; for example in 1996 more than 50% of male and female AMI patients aged 40 and over admitted to one of these hospitals received a PTCA, a level similar to Switzerland in 1995 where about 50% of males and 60% of females aged 40-64 were given a PTCA.

Chart 36 Proportion of AMI patients receiving PTCA during initial admission and 30 days

221.   These charts show that PTCA use declines with the age of the patient, not surprising since procedure use for most treatments declines with advanced age because of increased comorbidities and the greater likelihood of post-operative complications. In Australia in 1993-94 and Sweden in 1991, no women AMI patients aged 85 to 90 years were given a PTCA. The data from the Japanese VHJ project show that age was likely to be less of a factor in determining use of PTCA than other countries where, in 1999 more than 50% of all males aged less than 85 years had received a PTCA. The ratio of the proportion of individuals aged 65-69 receiving a PTCA to those aged 85-90 ranged from about 5 to 1, for Belgium and American males and Italian and Swedish females, up to 9 to 1 for Belgium women. The gap between the youngest age group and the next youngest was especially large in Switzerland where 60% of female AMI patients aged 40-64 received a PTCA in 1995 but only 7% of those aged 65-74 had received one.

222.   Generally, there were no major differences between males and females regarding the proportion of patients who had received a PTCA. For example, in 1998 in Italy 6% of male AMI patients aged 65-69 had received a PTCA compared to 5% for women the same age, 1% of both males and females aged 80-90

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38.   In Switzerland there were 101 PTCAs performed per 100 000 inhabitants aged 40 and over in 1992 and 141 in 1993, the only two years for which data were available. If data for subsequent years were available there is a strong possibility that the level of use in Switzerland would have been similar to these countries by the late 1990s.

had received PTCA. Therefore, aggregate differences by gender are more likely the result of different age distributions. Gender differences were significant in Korea, at least until 1999. For all age groups males were far more likely to have received a PTCA than females between from 1990 until 1996. In 1999, with the exception of AMI patients aged 75-79, females aged 65 or greater were more likely than males to have received a PTCA.

4.2.4.3.3. Trends in the use of PTCA from patient-based hospital data

223.   Patient-based data for PTCA use were provided by Spain, Australia (Perth), Canada (Ontario), Sweden and the US, data for the latter four countries were provided by the TECH Research Network. The proportion of AMI patients who had received a PTCA within 90 days from the initial admission are shown in Charts 37. There was an increase in the proportion of patients who had received a PTCA when compared to the figures for PTCA use during the initial admission. This is normal since these data include not only PTCAs received during the initial admission, but for subsequent admissions within a 90 day period following the initial admission. For patients aged 85-90 there is no difference in the proportion of AMI patients receiving PTCA during the initial admission and up to 90 days, except in Perth where there is an increase from 0 to 2% for males in 1995. This might be due to the fact that the very elderly have a low probability of undergoing this procedure.

Chart 37 Proportion of AMI patients receiving PTCA within 90 days from initial admission

224.   AMI patients were far more likely to undergo PTCA in the United States than any of the other four countries. In 1996, 15% of males and 12% of females aged 80-84 underwent a PTCA within 90 days of the initial admission. In no other country did more than 5% of AMI patients receive a PTCA. Although AMI patients in the US underwent PTCA more often than in the other countries for all age groups, it is with the elderly that the largest differences occur

4.2.4.3.4. Trends in the use of stents in conjunction with PTCA

225.   Figures on AMI patients receiving intracoronary stents as a proportion of all AMI patients receiving a PTCA are shown in Chart 38. The use of stents increases very rapidly in most countries between the mid-1990s and 1998. This trend is likely to continue given the number of studies that continue to be published regarding the efficacy of this procedure.[39] Note that some countries with relatively low use of PTCA, such as Ontario and Finland, still have a proportionally high use of stents. On the other hand, some countries with higher utilisation rates for PTCA, such as Japan and the US, have a proportionally lower use of stents.

Chart 38 Proportion of PTCAs using an intracoronary stent

226.   Trends in the use of stents provide an opportunity to witness the diffusion of technological knowledge. Studies demonstrating the efficacy of this procedure really began to appear in the medical literature around 1994-95. Chart 38 shows that the greatest increase in stent use occurred between 1994 and 1996 in countries where this information was available. In fact, this data was not available in 1994 for some countries because stent use was almost negligible (personal communication with several researchers). The use of stents with PTCA is considerably costlier than PTCA alone. However, it appears the additional

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39.   There is evidence of this from the data we received for some countries. For example, in 1999 the proportion of AMI PTCA patients receiving stents increased to 53% in Japan and 71% in Greece.

costs of using stents has not dampened the enthusiasm for their use. Medical clinical factors may be playing a leading role in the decision process of stent use, trumping institutional or economic factors.

4.2.4.3.5. The case of primary angioplasty

227.   Primary angioplasty corresponds to the use of PTCA as a first-line treatment for AMI in emergency cases. Data from the TECH Research Network show that the use of this type of treatment is even more contrasted across countries. The US leads the way in the use of a highly intensive treatment for AMI patients with 12% of patients being treated with PTCA within one day of admission and its use has been on the rise since the early 1990s. While the use of primary PTCA in Sweden is three times lower than the US (Dozet 2000), it is used on a greater proportion of AMI patients than in Australia, a country with a much higher rate of PTCA use (Chart 35). In 1994 about 1% of AMI patients in Sweden were given an angioplasty within one day of being admitted to hospital, but by 1996 this had risen to 3% and has been increasing since. This increase coincides with the increase in stent use observed in Sweden; although somewhat speculative, a possible explanation may be that as physicians began to see the benefits of stent use they became more confident in performing primary PTCAs.

4.2.4.4. A brief overview of trends in the use of CABG

228.   CABG is generally not an accepted means of revascularisation for AMI, PTCA being used much more often. Data for Australia (Perth), Canada (Ontario) and the US were provided by the TECH Research Network. In Belgium, Canada, Italy, Sweden and Spain the use of CABG in treating AMI is no more than 3-5% of AMI patients for most age groups. The proportion of AMI patients receiving CABG is slightly higher in Perth, but only for women. Korea and the United States have much higher levels of use, although the data for Korea come from a single teaching hospital and cannot be considered as representative of the entire country. The figures based on the VHJ project in Japan are also high but do not reflect the situation of the entire country since they are based on data obtained from a sample of tertiary care hospitals as discussed earlier. The remaining countries use CABG in less than 2% of their AMI patients. An important factor to consider is time to admission, since CABG is a very intensive procedure that requires significant preparation. The importance of planning for CABG can be seen using data that show the proportion of AMI patients receiving CABG within 90 days. In 1996 in the US, CABG was used within 90 days following the initial admission in at least 20% of male AMI patients under 80.The proportion is closer to 10% during the initial admission. The proportion of AMI patients treated with CABG also increase significantly in Perth, Ontario and Sweden. Only in Spain, the only other country which had available data, was there no difference between CABG use during the initial admission and 90 days after (Chart 39).

Chart 39 Proportion of AMI patients receiving CABG during initial admission

Chart 40 Proportion of AMI patients receiving CABG within 90 day from initial admission

229.   It is more relevant to have a detailed discussion of trends in the use of CABG in the following section on angina since CABG is used far more extensively for treating less acute forms of IHD, such as angina, than AMI. This will facilitate a final discussion on the relative roles of CABG and PTCA as means for revascularisation across countries.

4.2.5. Trends in the acute care component of angina treatment

230.   Health care providers have more discretion when treating a less acute form of IHD such as angina than when treating AMI. Data collected on angina treatments provide an opportunity to observe the effects

of incentives on treatments. In the following section we present data collected on the acute care component of treatment for angina. We will not discuss ambulatory treatments, including drugs, since these were generally covered in Section 4.1. as part of the general treatment of IHD.

4.2.5.1. Trends in admissions for angina

231.   We begin this section with a look at data on hospital admissions for angina, for which a number of countries were able to collect data. All data collected on angina used the ICD-9 codes 411 and 413 to identify admissions.

232.   There are two issues concerning coding problems for angina which may have an effect on the interpretation of the results. The first issue concerns the interpretation of the ICD-9 code for angina.[40] According to the ICD-9 coding manual (NCHS 1997), the code 413 refers to angina pectoris. However, it has been noted by several of the experts participating in the OECD study that a problem of transference of codes between ICD-9 413 and ICD-9 411 (other acute and subacute forms of ischaemic heart disease) may exist in hospital admissions databases for several countries. Following their advice, it was decided to collect data on angina admissions by using both ICD-9 411 and 413. To what extent this reduces the homogeneity of patients in the data is unclear, but for each hospital admissions database it will be related to the proportion of patients with angina whose records indicate a primary diagnosis code of ICD-9 411.

233.   The other coding issue with angina concerns the use of the main or primary diagnosis field. Following the data collection protocol for this study, the experts searched the main (or primary) diagnosis field in their respective hospital admissions databases for the ICD-9 codes 411 and 413. However, as noted by several experts in the OECD study, many angina patients admitted for elective revascularisaton procedures are coded in the main diagnosis field as ICD-9 414, other forms of chronic IHD, with the code for angina ICD-9 413 appearing in one of the secondary diagnosis fields. These patients will not be counted using the algorithm of searching only the primary diagnosis field. In order to get a glimpse of the extent of this problem, one of the experts participating in the OECD study, Dr. M. Hobbs, collected data for the Perth region of Australia searching all diagnosis fields for ICD-9 413. In this particular case, in 1989 and the years 1996 through 1998, the number of records with ICD-9 413 appearing in a diagnosis field other than the primary diagnosis field was never more than 1.7% of the total recorded cases with ICD-9 413 appearing in the primary diagnosis field. However, between 1990 and 1995, angina cases based on the secondary diagnosis fields averaged 29% the number of cases recorded using the primary field only.

234.   In both cases, the issue of coding problems for angina will lead to undercounting the actual number of angina cases. This presents more of a problem for analysing the admissions data than the data on treatments since we are making relative comparisons across countries on admissions rates (data from Perth are not included in the admissions rates comparisons). However, the main purpose of collecting information on angina is to more clearly observe the effects of health care system incentives in the provision of care for a less acute, thus less emergent, form of IHD than AMI, assuming of course that incentives exert more influence on health care providers' decisions for non-emergency conditions. While these problems may not be as problematic for comparing treatment rates, we did not feel confident enough with the data to make any meaningful comparisons of outcomes, and therefore, we did not collect any data on outcomes.

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40.   Some countries have adopted ICD-10, but did not have sufficient experience to say whether or not this latest version of ICD presents similar coding problems for angina as the previous version. For admissions data, only Australia used ICD-10 and only for data from 1998-99.

235.   Figures for angina admissions (ICD-9 411 and 413) are shown in Chart 41. Data are available for four countries, Australia, Canada, including Ontario, Italy and Japan. With the exception of Ontario, these data are event-based, meaning they will overstate the number of angina admissions relative to Ontario. There is a considerable range across countries. From 1993 onwards, Australia has more admissions per 100 000 inhabitants, regardless of age group or gender, than any of the other four regions. This difference is larger for males. For example, in 1998-99 there were 3 155 admissions per 100 000 male inhabitants aged 85 – 90 in Australia. In Ontario, the next highest region, there were 899 angina admissions per 100 000 inhabitants for the same age and gender group. Admissions were lowest for Japan, although the difference is not as great for the oldest age group, which may be due in part to the inclusion of all individuals aged 85 or older in the Japanese data.

Charts 41 Admission rates for angina

236.   There is generally an upward trend in admissions from 1990 to 1998 based on the figures from the charts. This observation does not include Italy for which data were only available for one year. The trend towards increasing admissions rates becomes more pronounced for successively older age groups. As an example, in Japan, in 1987 there were 85 admissions per 100 000 females aged 45 – 54, by 1996 this figure had increased 14.1% to 97 admissions per 100 000. The corresponding figures for females aged 80 – 84 were 374 admissions for angina per 100 000 inhabitants in 1987 and 706 per 100 000 in 1996, an increase of 88.8%. The data for Australia show a large jump in admissions from 1994-95 to 1995-96 (data not shown on Chart 41a and Chart 41b), coincidentally the same period that saw a large increase in admissions in Perth, meaning the increase in Australia may be due to a problem with the data.

237.   Admissions rates for males are greater than females, with the gap decreasing for successively older age groups, a situation similar to the pattern observed for AMI (Section 4.2.2). For example, in 1998 in Italy, the number of angina admissions per 100 000 inhabitants for males aged 40 – 64 is almost 3.5 times greater than the corresponding number for females. The corresponding figure for the 85 – 89 years age group shows admissions for males are only 1.5 times greater than admissions for females.

4.2.5.2. Trends in the use of acute care interventions

238.   Event-based data on the use of cardiac catheterisation, PTCA and CABG are available for Australia, Italy and Japan (VHJ hospitals), while patient-based data are available for only two regions, Perth in Australia and Ontario in Canada.

239.   The data on the use of cardiac catheterisation for angina patients are shown in Charts 42. Catheterisation rates for the event-based data show the proportion of angina patients in the VHJ hospitals in Japan diagnosed with a CATH is double the rates in either Australia or Italy (Charts 42a – 42f). Charts 42g – 42j show CATH rates using patient-based angina admissions. These data show angina patients in Perth are more likely to be diagnosed using cardiac catheterisation than angina patients in Ontario.

Chart 42 Proportion of angina patients receiving cardiac cath. during the initial admission

240.   The trend in Perth and Ontario is towards increasing use of cardiac catheterisation throughout the 1990s. In Australia there is a substantial increase in the proportion of angina patients receiving a CATH between 1993-94 and 1996-97, but during this same period there is an increase in the denominator, the number of admissions (Chart 41a & 41b). Further investigation would be required to determine if the increase in angina admissions is as a result of transference of codes and the resulting effect this would have on the increased likelihood of angina patients, as defined by ICD-9 411 and 413, receiving a CATH. The VHJ data show an increase in the use of CATH from 1996 to 1999, with a greater increase for women than men, except women aged 75 – 84.

241.　　The proportion of angina patients receiving cardiac catheterisation up to 90 days following the initial admission are shown in Chart 43. Apart from the higher proportion of angina patients receiving a CATH in both Ontario and Perth, the patterns of utilisation do not differ from those observed from Chart 42g – 42j.

Chart 43 Proportion of angina patients receiving cardiac cath. during the 90 day episode of care

242.　　Charts 44 show the proportion of angina patients receiving a PTCA during the initial admission. There is no significant difference in the proportion of angina patients receiving PTCA in Australia and the proportion in Italy, across all age groups and gender. As with the other acute care interventions, angina patients admitted to one of the VHJ hospitals in Japan are more likely to undergo a PTCA than patients in either Australia or Italy. Comparisons by gender and age do not reveal any patterns in utilisation that differ from the patterns observed for cardiac catheterisation, which should not be surprising since PTCA is most often performed following a CATH during the same admission.

Chart 44 Proportion of angina patients receiving PTCA during the initial admission

243.　　Utilisation patterns for PTCA based on the patient-based data are somewhat different than the patterns observed for CATH. The patterns are the same for Ontario in the sense that there is a steady increase over time in the proportion of angina patients receiving PTCA, older patients are less likely to receive a PTCA and the proportion of male angina patients receiving a PTCA is slightly higher than the corresponding proportion of females. In Perth, the patterns are more erratic than what was observed for CATH use. The proportion of angina patients undergoing PTCA in 1993 is more than double the proportion from 1990 and by 1998 the proportion is half the level of 1990. This pattern does not parallel the steady increase in CATH use observed during the same period for Perth. This makes it difficult to make a direct comparison with Ontario.

244.　　It is difficult to say with certainty what problems there are with the data from Perth. Indications are that there was some transference of codes for data representing the years 1995, 1996 and 1997. Angina admissions in Perth based on ICD-9 411 and 413 show a stable number of admissions between 1989 and 1994, a big jump in admissions for 1995, gradually increasing from that point until 1997 then a sudden drop in admission in 1998 (Chart 45). The sudden drop in admissions in 1998 is explained by the fact there was a sudden drop in recorded admissions for both ICD-9 411 and 413, so any problem with transference of codes would have had to occur in the years 1995 to 1997. Prior to 1995, admissions based on ICD-9 413 (angina) were steadily decreasing (Chart 44b). During the same period admissions based on ICD-9 411 (other acute and subacute IHD) were steadily increasing and this pattern continued until 1997 (Chart 44c). On the other hand, there was a dramatic increase in admissions for ICD-9 413 in 1995 and again in 1996. Further investigation into coding practices during this period would be required to fully identify the problem, but the graphs appear to indicate that there was no transference between ICD-9 411 and 413. If there had been then there would have been a corresponding drop in 411 admissions at the same time there was an increase in admissions for 413. To what extent this creates a problem for interpreting the data on PTCA use for Perth will depend on which code(s) the transference came from since it is unlikely the sudden increase is a result of a natural course of events.

Chart 45 Total number of admissions in Perth based on ICD-9 411, 413 and 411 combined with 413

245.　　Figures on the proportion of angina patients in Perth and Ontario receiving PTCA within 90 days from the initial admission do not show any patterns of utilisation that differ from what would be expected and are shown in Chart 45.

Chart 46 Proportion of angina patients receiving PTCA during the 90 day episode of care

246.   The final acute care intervention we examine are coronary artery bypass grafts (CABG). We examined CABG treatments earlier within the context of AMI, however, we felt it more appropriate to look at aggregate levels of use of this procedure when discussing angina since CABG is generally performed for less acute cases of IHD than AMI.

247.   Chart 47 shows aggregate utilisation rates for CABG from 1990 to 1998 for the population aged 40 and over. Not displayed on the charts are the data for the US. The rate of CABG use in the US is the largest of the countries in our survey. In 1997 there were 541 CABG procedures per population aged 40 and over in the US, more than double the next highest country, Australia with 227 CABGs per 100 000 inhabitants. Generally speaking, the countries that had the highest aggregate rates of utilisation for PTCA (Chart 35) were the highest users of CABG. Finland and Sweden on the other hand are included among the countries with the highest utilisation rates of CABG, actually having more CABG per 100 000, 186 and 181 per 100 000 respectively, in 1997 than Germany (176). This is a reflection of the preference in the Nordic countries for CABG over PTCA.

Chart 47 Aggregate utilisation rates for CABG, 1990 – 1998

248.   What is also evident from Chart 47 is that the utilisation of CABG is on the rise during the 1990s.The increase in Spain and the UK were not nearly as large as for the other countries in the graph. There are not enough data points to establish any time trends for Hungary, Norway and Switzerland.

249.   Charts 48 show data on the proportion of angina patients receiving a CABG. With its sample of hospitals based on tertiary care teaching hospitals, the proportions of angina patients undergoing CABG are the largest by far for the VHJ sample of hospitals in Japan (Chart 48e & 48f). As many as 33.3% of male angina patients underwent a CABG in 1998. For their part, angina patients in Australia were less likely than angina patients admitted to one of the VHJ hospitals to have undergone a CABG but more likely than patients in Italy.

Chart 48 Proportion of angina patients undergoing CABG during the initial admission

250.   For the two regions for which patient-based data were available, angina patients in Perth were generally more likely than those in Ontario to undergo CABG. The data for Perth do not display the same erratic pattern as do the data for PTCA so perhaps the issue of transference of codes is not as problematic.

251.   In Australia and Ontario, the proportion of angina patients undergoing CABG increased during the 1990s, although for women in Ontario the increase is not that significant since only about 1% of female angina patients undergo PTCA. For the VHJ hospitals in Japan, data were available from 1996 to 1999, but there is no apparent trend. In Perth, the proportion of angina patients receiving CABG is greater in 1996 than 1990, but in 1998 the proportion drops for males aged less than 75 years and females aged 75 – 84 years. By and large males were more likely than females to have received a CABG. Finally, CABG use seems to be used more for angina patients in the 65 – 74 years old range, with the exception of Perth males. In 1990, angina patients aged 40 – 64 were more likely to receive a CABG than older patients. In 1993 and again in 1996, angina patients aged 75 – 84 were less likely than younger patients to have undergone a CABG, but by 1998 there is no discernible age gradient in the use of CABG.

252.   Charts 49 show CABG use for angina patients within 90 days of the initial admission. These charts clearly demonstrate the importance of using patient-based data. Since CABG is typically an elective surgical procedure, there should be a large difference between CABG performed during the initial admission and those performed 90 days or even one year after. In Ontario, the proportion of angina patients undergoing CABG 90 days following the initial admission is about 4 – 6 times greater than the number undergoing CABG during the initial admission. In Perth the corresponding rate is generally about double.

Chart 49 Proportion of angina patients receiving CABG during the 90 day episode of care

5. OUTCOMES OF INTERVENTIONS FOR IHD

5.1 Methodology and choice of health outcomes indicators

253.   Health outcomes are often used to measure health care system performance. However, ideal outcome measures are difficult to measure and often need to be approximated. Mortality is an indicator that is used frequently since it is relatively easy to measure, but it has the disadvantage of being too broad to measure health care system performance directly. When data on mortality can be obtained for given time intervals following an acute event (case-fatality), they can be reasonable proxies for measuring performance. Ideally, a mortality-related performance measure would include an account of the deaths which occur before reaching hospital, reflecting how quickly treatment is initiated. However, these data are not readily available, as demonstrated in Section 3.3.3. where only three countries had data available for deaths occurring out-of-hospital. Therefore, one has to focus on health care interventions occurring after hospitalisation. In the case of a high fatality disease such as AMI, case fatality is well adapted as an outcome indicator since a significant proportion of individuals who suffer a heart attack will die shortly afterward making interventions that reduce case fatality easy to identify.

254.   Outcome indicators for the present project were collected from hospital discharge data. The analysis will focus on AMI patients (only persons admitted in a hospital); angina is not well-defined in comparison to AMI so information for the angina cohort would not ensure that average severity and casemix would be comparable across countries (since providers will differ across countries in the discretion they have in admitting these patients). In focusing on the AMI cohort we make the assumption that the severity of this disease is such that providers have little discretion in whether or not they admit these patients. This will minimise selection bias, making case mix and severity broadly comparable across countries.[41] However, the methodological caveats introduced for treatments in the previous section (See 4.2.3.1 on the use of micro-data) are even more important for outcomes. Data on case-fatality during the initial hospital admission were collected for all countries able to provide hospital discharge data. However, this should be considered very cautiously as differences in length of stay (analysed in Section 6) may also account for some differences in fatality. Therefore, those countries with patient-based data also collected information on 30-day, 90-day and one year case fatality, which can be considered as an outcome measure less sensitive to differing admissions practices.

255.   Case fatality is an important outcome measure but it does not provide a complete picture of the effectiveness of health care interventions. For example, one of the advantages cited by proponents of CABG versus PTCA in treating IHD is not that the former leads to lower rates of mortality but that CABG reduces the likelihood of readmissions for other forms of IHD such as angina. In order to collect information on readmissions hospital discharge databases must be able to follow patients so that those readmitted following health care interventions for AMI can be isolated from those admitted for reasons unrelated to previous AMI treatments. Therefore, only countries with patient-based data collected information on readmissions for this study. The indicators calculated were for readmissions for AMI, angina, other forms of IHD, congestive heart failure and all causes within one year from the initial admission for AMI.

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41.   A further analysis of comorbidities was performed by the TECH Research Network.

256.   From a clinical and policy perspective long-term survival is very relevant. The information collected on case fatality for one year is the closest approximation for long-term survival. It would be desirable in the future to push the data collection further, which may require specific register data collection. Finally, the ARD study is not a medical study, as such no attempt has been made to analyse outcomes for the purpose of determining the efficacy of specific interventions.

5.2 Case fatality for AMI

257.   It is estimated that about 40% of persons who experience an AMI in the US will die within one year (AHA 2000). Similarly, in Australia around 40% of people who have a heart attack will be dead within a year, but over half of these deaths will occur before the person reaches hospital. (AIHW 2001). Therefore, a significant portion of deaths due to AMI will occur prior to admission, but these are not of interest when measuring the outcomes of acute care interventions for myocardial infarction.[42] Ten countries were able to provide us with information on case fatality following admission for AMI; four countries using event-based data and seven using patient-based data.

5.2.1.Case fatality during the initial admission

5.2.1.1. Case fatality using event-based admissions

258.   Australia, Italy, Spain and Belgium all provided admissions data using event-based data, data for the Belgium were provided by the TECH Research Network. These figures will be lower than case fatality rates using patient-based data since the denominator, the number of AMI admissions, will be larger due to double counting of individuals readmitted for AMI but the numerator, inhospital fatality, will be the same. Charts 50a show case fatality for these four countries.

Charts 50a In-hospital case fatality rates (event-based admissions)

259.   The figures for Australia and Belgium show a general decline over time in case fatality, for all age groups during the observed period. In Australia, the decline is evident except for the oldest persons, those aged 85 years or older and males aged 70 – 74. Case fatality rates in Belgium for men and women aged 80-84 in 1996 were 28.6% and 34.3% respectively, not much of a difference from the 1993 rates of 28.1% and 34.7%. Rates were not available for individuals aged 65 or less. In Oxford, there was more temporal variation for both sexes. In 1993 there was a considerable decline in case fatality from the 1990 rates for individuals aged 80-84 for both sexes. There was a similar decline for women aged 75-79. There was also a large increase in the case fatality rate for men aged 85-90 from 22.2% in 1990 to 41.2% in 1993.

260.   Case fatality information for Italy (1998) and Spain (1997/98) were only available for one year. In both countries, fatality rates were slightly greater for all age and sex groups for females than males. For example, in Italy the largest gap was for patients aged 75-79 where 16.9% of females died in-hospital compared to 13.8% of male patients.

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42.   However, differences across countries in whether patients who are 'dead-on-arrival' or who die in the emergency department are coded as inhospital deaths or out-of-hospital deaths can affect the cross-country comparisons of in- hospital case fatality rates. This is extremely difficult to standardize, and since we do not have the information on what standard each country used, we cannot comment on the estimated differences across countries in this respect. See Section 1 (Prevalence versus Incidence) of Annex 1 for a more detailed discussion on place of death.

257.   Differences in length of stay and coverage render comparisons across these countries difficult to interpret. The use of broad age groups by Spain introduces another confounding element seriously reducing comparability with the other countries.

5.2.1.2. Case fatality using patient-based admissions

258.   Charts 50b show case fatality during the initial admission for Australia (Perth), Finland, Switzerland (canton Vaud), Canada (Ontario), Denmark, Sweden and the United States using patient-based admissions; data for the latter four countries were provided by the TECH Research Network. Patient-based data is certainly more appropriate but is more difficult to collect in many countries, which restrict the coverage of the analysis. Case fatality was calculated as the proportion of admitted AMI patients that died during the initial admission. For various reasons the individual researchers were not able to collect these data across a uniform set of age groups, therefore caution should be exercised when examining these data.

Chart 50b Inhospital case fatality rates (patient-based admissions)

259.   Data for Perth were available for three age groups (40-64, 65-74 and 75+). There is a decline in Perth in case fatality between 1990 and 1996 except for women aged 40 – 64. The largest decline is observed for persons aged 75 – 84 years. For all three age groups men generally tend to fare better than women. A similar age grouping was used for Switzerland (canton Vaud), without the cut-off of 84 years for the oldest group. Data were available only for 1998. The one observation that stands out from these figures is the substantial advantage in lower case fatality rates for women aged 75 or older. The case fatality rate for women in this age groups is almost half the male rate.

260.   Denmark, Finland and Sweden were able to provide more detailed age groupings. Figures for Denmark and Sweden show a decline in case fatality between 1990 and 1996 for all age groups and both sexes. In Finland, there is a larger decline in case fatality for men than women between 1990 and 1993, except for men aged 70 – 74 where there was a slight increase. In Denmark, for most age groups men have slightly lower case fatality rates than women in 1990, while in Finland case fatality is slightly higher for men, except persons aged 40 – 64 and in Sweden there is no difference between the two sexes. However, by 1996 there is no longer a gap between the two sexes in both Denmark and Sweden, the same for Finland except persons aged 85 – 90 where the case fatality among women is slightly higher.

261.   Canada (Ontario) and the US also provided data using the same age groups as Denmark, Finland and Sweden. In Ontario, data were only available for two years, 1993 and 1996. The figures show a smaller decline in case fatality rates than declines in Denmark and Sweden from 1993 to 1996, although there is a small increase for Canadian women in the 75 – 79 age group. In 1993 case fatality rates for men aged less than 70 are lower than women, three years later there is almost no discernible difference between the two sexes. In the US, national level data were available for persons aged 65 or older. Data for persons less than 65 were obtained from a sample of California hospitals. It is unknown to what extent these data represent the situation in the country as a whole. The US figures show a similar decline in case fatality rates observed for the other countries with similar data. Case fatality rates are slightly lower for men, especially for persons less than 65.

262.   Reasonable comparisons on case fatality rates can be made for Ontario, Denmark, Finland, Sweden and the United States using figures from 1996, the most recent year available for most regions. The reader is reminded of the caveats mentioned earlier regarding differences in lengths of stay and coverage across these countries. The differences in case fatality rates for persons aged less than 65 years is small, with Denmark and Finland having slightly higher rates than Ontario, Sweden and California. A divergence in rates begins to emerge from the data when looking at figures for persons aged 65 and older.

Case fatality rates in Ontario, Sweden and the US are at similar levels for the 65 – 69 and 70 – 74 year age groups. However, for persons aged 75 and older case fatality rates in Ontario and Sweden increase more rapidly than in the US. In the oldest age group, persons aged 85 – 90, the US case fatality rates are noticeably lower than the rates in the other three countries. It is too difficult at this point to state whether the more favourable US data for the very elderly are a direct result of Medicare coverage for these persons or due to the differences in the data.

263.   Any simplistic explanation of differences in hospital case-fatality rates needs to be avoided given some of the confounding factors that may influence the interpretation of these data. It may also be the case that the more favourable case fatality rates in the US elderly compared to other countries may be due to patients being admitted to hospital with less severe cases of AMI and fewer comorbidities, as the US health care system is not facing capacity constraints to the same extent as some European countries. In addition, the patterns of death outside hospitals remain unknown across countries.

5.2.2. Case fatality within 30 days from initial admission

264.   Case fatality during the 30 day episode of care, that is 30 days from the initial admission, is considered a more accurate indicator of acute care treatment outcomes than in-hospital fatality, since it controls for length of stay and includes deaths occurring outside hospitals. First, it measures outcomes for treatments provided to patients upon readmission, whether it is a scheduled readmission or due to complications from the initial admission. Second and most important, it records those deaths that occur outside hospital within a month. Properly constructed episode of care indicators will identify patients who have died outside hospital through the use of death registers, although they will not capture pre-hospital case fatality.[43] This is an outcome that would not be captured using inhospital case fatality only.

265.   Eight countries/regions were able to provide information on 30 day case fatality. Data for Canada (Ontario), Denmark, Finland, Sweden and the US were provided by the TECH Research Network (Chart 51b). Data for the other countries, Australia (Perth), England (Oxford) and Italy are in Chart 51a. Italy used data from the MONICA-Area Friuli, while data from. Case fatality was calculated using the standard MONICA definition reported in the MONICA protocol (all deaths within 28 days including those who died prior to admission at hospital, divided by all events – see TUNSTALL-PEDOE 1994).

Chart 51. 30-day case fatality rates (ARD and TECH)

266.   Australia (Perth) provided data for the same three broad age groups as in the previous section. There was a decline in case fatality in 1996 from the rates observed in 1990. The drop in case fatality rates is particularly strong for women aged 75 – 84 where the drop is over one-third. Case fatality rates for men aged less than 75 in Perth are slightly lower than women for similar age groups, but the lower rate for men aged 75 – 84 in 1990 vanishes by 1996 so that men and women in that age group have similar case fatality rates.

267.   In Italy, data were collected from 1983-1993 in the MONICA-Area Friuli and are presented in Chart 51a for the population aged 40 – 64 years, for 1990 and 1993. These data show that the case fatality rate for men is lower than for women in both 1990 and 1993, but in both cases are significantly higher than any of the other countries presented in Chart 51. These relatively high case fatality rates underscore a problem of comparability, even when a rigorous data collection protocol is followed. Even when compared to similar data taken from another MONICA collaborating centre, the Vaud and Fribourg cantons in Switzerland, the Italian case fatality rates are still higher (28-day case fatality rate in Vaud and Fribourg of

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43.   For a more detailed discussion about this issue see Moïse 2001.

3.5% for men aged 40 – 64; data for women not available). In this case, differences in the definition of case fatality, which coronary cases deceased prior to admission to include, produced higher case fatality rates for Italy, reducing the comparability of these data (TUNSTALL-PEDOE 1994).

268.   Data for Canada (Ontario), Denmark, Finland, Sweden and the United States were available for similar time periods and age groups as in the previous section. Case fatality rates in Ontario remain almost the same in 1996 as their 1993 levels, although there a significant decline is seen for men aged 85 – 90 and the case fatality rate for women aged 75 – 79 increases. The pattern is similar in Finland, with the exception of men aged 80 -90 and women aged 85 – 90 where there is a noticeable decline in case fatality. There are larger declines in case fatality rates in Denmark, Sweden and the US between 1993 and 1996. The declines in the last three countries is a continuation of the trend observed between 1990 and 1993. The decline appears to be the greatest in Denmark, which also had the highest case fatality rates in 1990.

269.   Using data from 1996, in Ontario, Sweden and Denmark, there is almost no difference between the two genders in terms of case fatality rates, with men having slightly lower rates for some age groups in Ontario. Based on 1993 data, there is also no difference between the two genders in Finland. The difference between the two genders is more noticeable in the US where men enjoy lower case fatality rates across all age groups.

270.   The pattern of cross country case fatality rates for Ontario, Denmark, Sweden and the US is slightly different for 30-day case fatality than that observed for inhospital fatality. For persons aged less than 65, rates are lowest in Ontario. It is for persons over 65 years of age where differences in the patterns of case fatality begin to emerge. For persons aged 65 – 69, there is not much difference between Ontario and the US, with slightly higher rates in Sweden. For the 70 years and above age groups, case fatality rates are more similar in Sweden and Ontario than they are with the US. For all age groups and genders, case fatality rates are highest in Denmark.

271.   We have examined 30-day case fatality rates for several countries and have provided some rationale for why it is preferable to study 30-day case fatality rates as opposed to in-hospital rates. As mentioned previously, 30-day rates are better for measuring the effectiveness of health care interventions and they capture individuals who die outside hospital. We will continue the analysis with case fatality within 90 days and one year.

5.2.3. Case fatality within 90 days from initial admission

272.   A significant share of scheduled readmissions for AMI are likely to take place more than 30 days following the initial admission. For example, one of the treatment options for treating AMI is to stabilise the patient with thrombolytics, keep the patient in hospital for several days and schedule a follow-up invasive procedure, usually PTCA but also CABG if necessary, when the patient is stronger. Therefore, case-fatality within 90 day is in a sense necessary to capture a more complete picture. Charts 52 a, b show case fatality rates for AMI patients up to 90 days from the initial admission. Data for Canada (Ontario), Denmark, Finland, Sweden and the US were provided by the TECH Research Network.

Chart 52. 90-day case fatality rates (ARD and TECH)

273.   Even after 90 days case fatality for men is generally lower than women of the same age group in Perth, although the differences are negligible for persons aged 75 or older. Case fatality rates show a decline during the 1990s similar to the trends observed in the previous sections.

274.   Data for Italy using the MONICA data from Friuli were available only for persons aged 40 – 64. We can use these data to make limited comparison of case fatality rates with persons in Perth aged 40 – 64.

As is the case for 30-day case fatality, rates in Friuli are considerably higher than in Perth. Again, differences in the definition of case fatality are likely to have contributed significantly to the higher case fatality rates in Italy.

275.   There is a slight decline in case fatality rates from 1993 to 1996 for Ontario, Denmark, Sweden and the US. The largest decline is in case fatality rates for men in Finland in the 80 – 84 and 85 – 90 age groups. From 1990 to 1996 the decline in case fatality for Denmark is the largest, although the fall in rates from 1990 to 1993 is similar in magnitude to the fall from 1993 to 1996.

276.   Regarding differences between the two genders, case fatality rates for men and women in Ontario, Denmark, Sweden and the US are very similar. In Ontario, this is a slight change from 30-day case fatality rates where rates are slightly lower for men. The situation is also slightly different in the US. For 30-day case fatality, men had lower rates than women. The data for 90-day case fatality suggest that rates are slightly lower for men in the younger age groups, persons aged less than 70 years, but that case fatality rates for persons aged 70 or greater are the same for men and women.

277.   As observed for inhospital and 30-day case fatality, rates in Denmark tend to be the highest, at least for persons aged 65 or greater. Case fatality rates for persons aged less than 65 years, especially women, are much more similar in all the TECH countries/regions. The pattern for case fatality between Ontario and the US for 90-day case fatality is similar to the pattern observed for 30-day case fatality. Case fatality rates by age group and gender are similar across both countries.

5.2.4. Case fatality within one year from initial admission

278.   Case fatality after one year from admission for AMI is also important as a measure of intermediate-term survival. From a health policy perspective, certain interventions may only have short-term benefits, which would put into question their cost-effectiveness when compared with interventions that have more long-term benefits. Therefore, it is crucial to assess health benefit on as long a time horizon as possible. Charts 53 a, b show cumulative case fatality rates for seven countries/regions, Australia (Perth), Italy (Friuli), Canada (Ontario), Denmark, Finland, Sweden and the US; data for the latter five countries were provided from the TECH Research Network.

279.   Data for Perth are only available for three age groups, 40-64, 65-74 and 75 or older. They show similar trends across age, gender and time as the data for inhospital, 30-day and 90-day case fatality. Even after one year, less than 10% of male AMI patients aged 40-64 died, yet 13.8% of women patients the same age died. In Friuli, data are only available for persons 40 – 64 years. They show that men have lower case fatality rates than women, even after one year; this result is consistent with the majority of the MONICA project populations where case fatality was higher for women than men in 27 of the 36 populations (Tunstall-Pedoe 1994). The rates are significantly greater than case fatality rates for both men and women in Perth aged 40 – 64 in 1990 and 1993.

Chart 53. One year case fatality rates (ARD and TECH)

280.   The time trends for case fatality after one year for the TECH countries are similar to what is observed for case fatality at 90 days, 30 days and inhospital case fatality; there is a decline between 1990 and 1993, for all age groups and both genders. The differences in case fatality between men and women are also evident when observed at one year following the initial admission for AMI. After one year, case fatality rates are largest for Denmark and Finland, followed by Sweden and Ontario, with the US having the lowest rates.

5.2.5. Overall results by age and cumulative case fatality

281.   From these charts it is difficult to visualise the cumulative difference in case fatality rates between inhospital, 30 day, 90 day and one year. It is also difficult to compare countries. Charts 54 show the different case fatality rates for men and women for various age groups in 1995. The United States, Perth, Ontario and Sweden appear to be the countries with the lowest case fatality rates, regardless of the length observed for case fatality. Denmark and Finland have slightly higher case fatality rates. However, the previous discussion has shown that this is not homogenous across age groups. The United States tends to have lower case fatality for older men and older women above the age of 75. However, for the younger age groups patterns tend to be rather different, with much lower case fatality in Australia (Perth) and also in Canada (Ontario).

Chart 54 Cumulative inhospital, 90-day and one year case fatality, by age groups and gender, (TECH)

282.   Cumulative case fatality is an interesting indicator to examine because the distribution of fatalities may differ from one country to the next: some countries may experience lower inhospital case fatality, while a greater share of the deaths may occur later. Another way of looking at cumulative case fatality is to examine the percentage share of all AMI fatalities that occur within one year, divided among inhospital, 30-day, 90-day and one year case fatality, as shown in Chart 55. These figures are cumulative with a few exceptions.[44] The charts show that Finland had the lowest percentage of deaths occurring between 91 days and one year for males and Perth had the lowest for females. Generally the United States has a low share of in hospital case fatality which may be related to the shorter length of stay in this country. The same would hold for Canada. On the other hand, Finland has generally a higher case fatality during the initial inpatient stay, but it may be the case that Finland is admitting more severe cases of AMI than other countries.

Chart 55 Percentage distribution of case fatalities within one year from initial AMI admission (TECH)

283.   These figures show that there are small differences among these countries in the percentage share of deaths that occur between 91 days and one year. For both males and females, approximately 20% of deaths related to AMI admissions occur within 91 days to one year. Where countries differ greatest is in the percentage share of inhospital deaths, although as previously mentioned, length of stay and case severity will also have an impact. The length of stay bias can be reduced somewhat by using a fixed length of stay. For short term episode of care it would be best to use 30-day case fatality based on the indicators we collected. The percentage share of all fatalities is much more homogenous across the countries for 30-day case fatality than it is for inhospital fatality. Approximately 60% of all fatalities occur within 30 days from the initial admission for AMI.

5.3 Readmissions for AMI patients (TECH)

284.   Prevention of death is the first priority in treating AMI patients, especially for the most severe cases, but it is not the only outcome with which quality of care can be measured. Another important outcome is to prevent complications following treatment, which may be measured by readmission rates. Data has been collected from several participating countries on the proportion of AMI patients readmitted within one year from the initial admission. Only countries with access to patient-based admissions data

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44.   For at least two countries the number of inhospital fatalities was either equal to or greater than the number of fatalities within 30 days. This unusual phenomenon can arise if there are a number of inhospital deaths for patients with lengths of stay greater than 30 days. While it is not expected that there are a significant number of these patients, the reader should be aware of this when interpreting the chart.

were able to provide this information. In interpreting these data it is important to remember that no distinction was made between rescheduled admissions, emergent and urgent admissions. As mentioned previously, one of the treatment options for AMI is to stabilise the patient during the initial admission with drugs and reschedule for elective surgery a few months later. Readmissions indicators measure "negative" outcomes. Readmissions based on patients scheduled for follow-up treatment cannot be considered as negative outcomes, but it was not possible to separate these patients from non-scheduled readmissions. Therefore, a proportion of the readmissions indicators below will include "non-negative" outcomes. The data on readmissions in this section were obtained from the TECH Research Network

5.3.1. Readmissions for AMI

285.   The first priority in treatment after the patient is no longer in the critical stage is to decrease the chances of a reoccurrence of the heart attack. Data on readmission for AMI will be less prone to include elective admissions since AMI is usually regarded as a serious, emergent admission making it an excellent indicator to measure outcomes. Table 21 shows readmissions for each of AMI, IHD, congestive heart failure (CHF) and all causes as a percentage of AMI admissions within one year from the initial admission (the choice of these conditions is based on the work of the TECH Research Network; see Section 4.2.1. and the Appendix 3 on data sources). Charts 56 show readmissions for AMI only, for men and women, by age for the countries included in Table 21 and for Perth.

Table 21 Readmissions one year following initial admission for AMI (TECH)

Chart 56 Readmissions for AMI one year following initial admission for AMI, by age and gender

286.   From Table 21 we see that readmissions for AMI range between 5% and 8%. Women tended to be readmitted more often for AMI than men. Unlike fatality statistics, readmissions for AMI do not follow a positive age gradient. In fact, in some cases readmissions for AMI are lower for older age groups. In Perth women aged 85 – 90 were the least likeliest to be readmitted for AMI. There are several reasons why this could happen; older persons are more likely to die outside hospital and by extension will not be readmitted, they are probably more likely to be readmitted for a wider range of conditions, some of which may not be related to complications from AMI treatment or they may be less likely to be rescheduled for follow-up treatment.

287.   The greatest drop in the percentage of admissions for AMI was for women in Perth, especially for women 70 and older. In 1990, the percentage of readmissions for women aged 85-90 in Perth fell from 10.3% to 1.6% in 1996. Readmissions reached their peak in 1993 in Finland for women aged 75-79 when 12% of patients were readmitted for AMI. The age group that had the largest increase in admission rates between 1990 and 1993 is the 85 – 90 year age group in Finland, where readmissions increased from 3.6% to 7.7% for males and 3.5% to 6.6% for females. The highest readmission rate for men was for men in Sweden in 1996 when 10% were readmitted for AMI. Readmission rates in general were higher for the Nordic countries than for Ontario or the US.

288.   There was no real discernible pattern to readmissions across time. In Perth, women across all age groups saw a decline in readmissions for AMI between 1990 and 1993, but the situation was more mixed for men with some age groups experiencing declines and other increases. With the exception of men in the 75 – 79 year age group, there is no noticeable change in the rate of readmissions for AMI between 1993 and 1996 in Ontario. In Denmark and Sweden, the rate of readmissions declines from 1990 to 1996 for men and women aged 40 – 69, although the declines are larger in Denmark.

5.3.2. Readmissions for other cardiovascular diseases

5.3.2.1. Ischaemic Heart Disease

289.   Collecting information on readmissions for angina is another important outcome measure for AMI treatment. One of the arguments in favour of using PTCA to treat AMI as opposed to thrombolytics is that the former results in less cases of angina following treatment. However, the data collected for the TECH project on readmissions did not isolate the ICD-9 codes we have used for angina, ICD-9 411 and 413, but rather included readmissions due to other forms of chronic IHD (ICD-9 414) together with codes 411 and 413. Thus, data for angina readmissions will be included in Table 21 under the heading "Ischaemic Heart Disease". In the following discussion we will use IHD to denote readmissions based on ICD-9 411 (other acute and subacute forms of IHD), ICD-9 413 (angina pectoris) and ICD-9 414 (other forms of chronic IHD).

290.   The data (Table 21) clearly show that the percentage of patients being readmitted for IHD is lowest in the US. There is no gender difference in the US with 11% of men and women AMI patients being readmitted for IHD in 1996 which is down from 12% in 1990. The country with the highest readmission rates for IHD is Denmark where in 1996 26% of AMI patients were readmitted with IHD. There was also a greater difference between males and females in Denmark than there was in the US with males (28% in 1996) having a greater percentage of readmissions than women (22% in 1996). There was also a marked increase in the percentage of IHD readmissions in Denmark between 1990 and 1996 for both genders, this also happened in Sweden where readmission increased from 15% to 20%.

291.   There may be a temptation to attribute these results to the greater reliance in the US on PTCA. While it is true that US rates of PTCA for the AMI cohort were substantially greater than the other countries shown here, we cannot say with certainty that the lower readmission rates for IHD are due to these patients being treated for PTCA since we did not collect information on outcomes by procedure received. Other factors, such as casemix, admission procedures and especially coding practices may also account for the differential between the US and other countries. However, the circumstantial evidence raises the question of whether the high rate of utilisation of PTCA in the US may have lessened the need for readmissions for angina, which in the present case would translate into lower readmission rates for IHD as denoted by ICD-9 411, 413 and 414.

5.3.2.2. Congestive heart failure

292.   Another common complication following AMI treatment is congestive heart failure (CHF) where the heart fails to pump a sufficient volume of blood to meet the body's normal requirements. Data on readmissions for CHF were available for Ontario, Denmark, Finland (not 1996) and the US. Table 21 shows that the highest readmission rates for CHF are for the US, although the differences are smaller than for angina. For both men and women, the US rates were twice those of Ontario and Denmark. As with angina, coding practices may account for some of the difference between the US and other countries. For example, 1993 data were available for Finland; these data showed that only 1% of patients admitted for AMI were readmitted for CHF, however, coding practices in Finland recommend that CHF admissions be coded as a primary diagnosis of coronary heart disease, with CHF recorded as a secondary diagnosis.

5.3.2.3. Readmissions for any cause

293.   The final readmission indicator to be examined is on readmissions for all causes. There will be some confounding issues here since this indicator is the most likely to include readmissions for adverse

health conditions that have no connection with the initial admission for AMI, for anything from hip fractures to cancer. Table 21 shows that Denmark has the highest readmission rates for all causes but the differences across countries are not substantial. The lowest rates are for Ontario and Sweden.

5.4. Quality of life

294.   The issue of quality of life is an important one for IHD which should not be overlooked, especially for a disease that affects the elderly in such large proportions. However, the data used in the current study are limited in measuring quality of life. Quality of life is analysed in detail in medical studies and clinical trials, but the philosophy, tools and purpose of such studies is rather different.

5.5. Explaining differences in outcomes

295.   Treatment variation may explain some of the differences in outcomes, but it probably goes deeper than that. Underlying treatment preferences are the various incentives and economic characteristics that influence providers and patients alike. Several factors need to be considered when discussing outcomes and should be kept in mind throughout the discussion in the report:

– gender and especially age are important factors to be considered since both have been shown to influence treatment patterns;

– availability of resources can influence what treatments patients are given, this is especially important for AMI where time is the crucial factor in treatment;

– socioeconomic status plays an important role as a risk factor and in determining treatment, even if it has not been addressed in the current study.

– condition of the patient as measured either through severity of illness or by comorbidities, especially diabetes.

296.   Another factor which should not be overlooked is the issue of coding practices. As demonstrated with the Finnish CHF readmissions data, variations in coding practices can affect measures of outcomes. The degree to which this will affect the interpretation of results is proportional to the degree of aggregation of the results. In the previous case, overall readmission rates will not be affected though distortions in readmission rates for CHF are evident.

6. ECONOMIC ASPECTS OF ISCHAEMIC HEART DISEASE TREATMENT

297.   Many of the treatments for IHD discussed in this paper are relatively expensive treatments that involve a significant use of modern and expensive technologies. In addition, heart disease as a whole (cardiovascular disease), kills more people across OECD countries than any other disease, representing a significant proportion of health care expenditures. In this section we will discuss the macroeconomic impact, in the sense of the health care system as a whole, of ischaemic heart disease as well as detailed microeconomic estimates available across countries.

6.1 Global economic impact of ischaemic heart disease

298.   The figures quoted in this section are based on cost of illness studies. These studies aim to identify and measure the direct and indirect costs of a particular disease. Direct costs are costs normally associated with the curative part of the health care system while indirect costs are conceived of as the economic consequences of morbidity and mortality. In the present study only direct costs (measured as health care *expenditures*) have been used, but only as an information tool in conjunction with other sources of information, to compare the share of health care expenditure on IHD and related expenditures as a percentage of total health expenditure. However, their usefulness as tools for policy decision making is a subject of debate among economists (Byford 2000; Rice 1994; Ament 1993; Rice 1985). The primary objection of economists to these studies is that they do not measure the true economic costs of a disease since they do not account for the 'opportunity cost' of the various resources used in treating a particular disease, nor do they show the health effects of extra spending on treatment of the particular disease. We wish to present a picture of the relative economic burden of IHD among OECD countries, a purpose for which cost of illness studies are well-suited. In this paper we present results of available cost of illness studies for Australia, Canada, the United Kingdom and the United States.[45]

299.   Ischaemic heart disease places a heavy economic burden on health care systems. Table 22 shows health care expenditure on IHD for Australia, Canada, the UK and the US, divided among spending on hospitals, physicians and drugs (Mathers 1999; Moore 1997; British Heart Foundation 1999; Hodgson 1999).[46] According to these studies, IHD accounts for 2.7 – 5.1% of total health care expenditure. If we include cardiovascular disease, where IHD accounts for about one-quarter to one-third of the costs, the range increases to 7.1 – 11.3%.

Table 22 Health care expenditure associated with IHD

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45.   Cost of illness studies are also available for the Netherlands and Sweden. However, the Netherlands are not a part of the IHD study and the Swedish study was not available as of the writing of this document.

46.   For ease of comparison, only these three, relatively comparable, categories of spending were used. Other relevant direct costs, such as research, prevention, community services, etc. were not included.

300.   The cost studies for Australia, Canada and the United States used a similar framework for allocating total health expenditures based on the methodology developed by Dorothy Rice (Rice 1966), which has since been improved to allow allocation by diagnosis based on ICD codes.[47]

301.   The breakdown of expenditure by three categories; hospitals, physician services and drug shows that IHD expenditure is primarily concentrated in inpatient settings. In Australia, Canada and the United States, spending in hospitals is about 75% of total spending associated with IHD, while in the United Kingdom it only accounts for 61% of total spending associated with IHD. Spending on drugs represents 35% of overall IHD associated expenditure in the UK, twice the proportion of the next highest country, Australia at 13.7%. However, differences in the components of spending in each category may affect the comparability of the figures.[48]

302.   Ischaemic heart disease, like all debilitating diseases, carries with it an economic impact beyond the direct measurable costs. Direct costs do not fully account for the total economic burden of IHD since they do not measure the economic consequences of mortality and morbidity, known as the *indirect costs*, associated with the health burden of the disease. The purpose of calculating indirect costs is to place a value on the consequences of disease morbidity and mortality, since these consequences are not only felt in the health care system, but in other aspects of life, such as diminished or lost worker productivity or the burden of care placed on family members of disabled persons. Beyond a qualitative statement that indirect costs of IHD are generally estimated to be much larger than the direct costs, comparability of these estimates is very difficult to achieve, therefore we will not include them as part of this study.[49]

6.2 Trends in length of stay

303.   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.[50] However, length of stay, usually presented as an average or median, is an imprecise measure of resource use since it does not provide detailed information on the intensity of resource use during admission. In addition, length of stay will be underestimated if they do not include AMI patients transferred from other hospitals, since the number of days for which these patients received treatment in the hospitals of origin should be included as part of the episode of care.[51] In this section we present data on lengths of stay for AMI patients. These data should be interpreted with care since

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47.   The methodology used for estimating direct costs in the UK did not follow this top down approach of allocating total expenditure by age, sex and diagnosis. Instead the authors estimated the number of services in each category (except for drugs where the methodology employed was more similar to that used in the other three studies), multiplied these by average cost for each service type and arrived at an estimate of total direct costs. This is a simplified version of the methodologies used in each of these studies, so the reader should be cautious when interpreting some of the results, especially in the case of the UK study which differs from the other studies.

48.   For example, Australia is the only country that included nonprescription drugs in the drug category. The figures are also affected by how the health care systems are organized; in the UK, specialists are hospital-based and as a result spending on physician services for IHD, the bulk of which are done by specialists, is included in the hospital category, unlike the other countries where it appears in the physician category.

49.   Moore 1997 provides a concise discussion of the different methodologies and issues for indirect costs.

50.   In a study on predictors of cost and LOS for CABG, Ghali et. al. found cost and LOS to be distinct outcomes and recommended not using LOS as a proxy for costs whenever possible, at least for CABG.

51.   See Annex 3 for more detail on the selection criteria for AMI patients. For the case of length of stay, this is only relevant for Chart 59. The selection criteria are similar to that used by the TECH Research Network.

differences exist across countries in what is measured that may distort the calculated average length of stay.

6.2.1. Aggregate trends

304.   The data on length of stay show a gradual decline in lengths of stay since 1990 for all countries shown. Average length of stay (ALOS) figures for AMI admissions in Chart 57 use the information provided as part of the ARD project, covering most of the 1990s. These figures are supplemented with data from the OECD Health Data Base 2000 for countries that were unable to provide ALOS data at an aggregate level. The sharpest declines are in Sweden, especially in the early 1990s, Germany since 1992 and Finland where length of stay fell by almost 50% during the 1990s.

Chart 57 Average length of stay for AMI, 1985 – 1999

305.   With the exception of a three year period in the United Kingdom during the mid-1980s, more likely an anomaly in the data than actual increases, ALOS for AMI was on the decline during the 1980s.

306.   These figures show the average length of stay for AMI patients in Japan is greater than 30 days (see note to Chart 57), more than double the ALOS of the next highest country Germany. In Japan, there is no distinction between acute care beds and long-term care beds in acute care institutions, therefore, a significant number of bed days used to calculate ALOS for Japan may include patients originally admitted for AMI but who are no longer receiving acute care related to the original AMI, patients who in fact should be considered long-term care patients. A similar problem exists for Finland, though not to the same extent. It is not possible to determine from these data at exactly what point an AMI patient makes the transition from being treated for AMI to a long-term care patient, necessitating a need to estimate the extent of this problem if we are to properly interpret the figures.

307.   The Japanese data draw attention to the potential problem of using *average* length of stay; extreme observations not related to AMI care (like extended lengths of stay for long-term care patients) may inflate the ALOS for AMI. Under these circumstances it is instructive to observe measures of length of stay not as sensitive to extreme observations. In order to get a clearer picture of the distribution of length of stay some countries also provided information on the median and 75th percentile length of stays. These figures are presented in Chart 58 for those countries able to provide this information.

Chart 58 Distribution of length of stay for AMI, 1998

308.   The figures show that the median length of stay for each of the five countries does not differ substantially from the average length of stay; using average length of stay does not appear to be seriously affected by the presence of extreme values. On the other hand, the figures from the chart show that 50% of Japanese AMI patients stayed in hospital a minimum of 28 days in 1998, a length of stay still much greater than the other countries. It is unlikely the majority of these patients were still being treated primarily for AMI. A reasonable inference to draw from these figures is that long-term care patients are being included in length of stay calculations. The figures from Japan for the 75th percentile add support to this inference, showing that one-quarter of AMI patients were hospitalised for at least 40 days. Nevertheless, these data do not dismiss the possibility that treatment for AMI in Japan is associated with longer hospitalization.

6.2.2. Trends in length of stay by age and sex

309.   Age is also an important determinant of length of stay since older patients tend to be sicker thus requiring more care as well as having slower recuperation times. Patient gender is probably not as large a

factor as disease severity or age in determining length of stay. The severity of the disease may be the most important determining factor in how long AMI patients need hospitalization and thus probably has the largest effect on length of stay calculations, but it has a positive correlation with age. Information by severity of disease is beyond the scope of this study, thus no information on this factor was collected.

310.   Chart 59 shows figures on ALOS for Australia, Canada (Ontario), Denmark, Finland, Sweden and the United States for several years, by age (40 – 64, 65 – 74 and 75 or older) and sex. For most countries the decline in ALOS for the 1990s observed in the previous section shows up in the figures from Chart 59. In Australia, ALOS for men aged 75 or older did not change between 1993 and 1996, even though there was a decline for the other two age groups as well as for women. Average length of stay for Finnish women aged 65 – 74 remained unchanged between 1998 and 1996.

Chart 59 Average length of stay, by age and sex

311.   There are some noticeable differences in ALOS by age. Length of stay in Australia and Sweden are positively correlated with age, but the largest age gradient occurs in Finland, especially for women. For example, Chart 59h shows that in 1996 the ALOS in Finland for women aged 40 – 64, 65 – 74 and 75 or older is 10.1%, 11.8% and 15.2% respectively. In the US, the age difference in ALOS is more noticeable between persons aged 40 -64 and those aged 65 – 74 than it is between the latter group and persons aged 75 or older. In fact, Chart 59k shows that in 1990, men aged 40 -64 have a longer ALOS than men aged 65 – 74. As mentioned in previous sections, it is difficult to assess the extent to which Medicare has an influence on this phenomenon and how much of it is due to other factors.

312.   Gender also appears to have a distinctive effect on ALOS in Australia and Finland. In Finland, men aged 65 – 74 experienced a decline in ALOS which was more pronounced than for women of the same age, where ALOS remained unchanged as mentioned previously, so that following 1988 women had a slightly longer ALOS than men. More striking are the differences between the two genders for persons aged 75 or older in Australia and Finland. However, this may be due to the fact that, on average women live longer, thus the average age of women in this age group is likely to be greater than the average age of men. Gender differences in the oldest age group may be more a reflection of differences in average age than gender.

6.3. Micro-economic estimates of expenditure per unit treatment

313.   In this section we analyse the economic incentives that underlie treatment choices by investigating unit costs per acute care treatments, approximated by expenditures per treatments, for six pre-defined "bundles of goods" that are comparable across countries. The objective is to see which countries pay more for their outputs due to higher input prices, which are proxied by unit costs, as opposed to which treatments are the best "value" based on a measure of cost per outcome, which would be a cost-effectiveness approach. The bundles of goods were arrived at using a DRG approach which allows for a certain level of comparability across countries and ensures a proper methodological standardisation.

314.   Unfortunately, there is no international standard DRG, even though in principle countries have based their DRGs on those introduced by the US for MEDICARE in the 1980s (see Section 2.2.1.1.). We have tried to make these data as comparable as possible, however, even within these broadly defined DRGs there was some variation across countries in the inputs that were employed. As a result it will be difficult to distinguish variations in unit costs due to different input prices from variations due to different inputs used. Nevertheless, these data provide a useful glimpse into cross-country variations in the costs of treating IHD

6.3.1 The sources of data for the estimates of unit expenditure

315.   There is a need for caution when interpreting these estimates. First, different methods of financing hospitals mean that reported costs in one country may not necessarily correspond to those of another country. Second, the costs, or *charges*, payers pay for IHD treatments are not equal to, nor are they in some cases necessarily an accurate reflection of the actual cost of the resources consumed; hospital charges will not include physician charges where physicians are not salaried hospital employees, and charges are based on accounting procedures that for various reasons (cross-subsidies between departments, assignation of costs between department; assignation of costs to individual patients within departments) do not accurately reflect actual resources consumed (Finkler 1982).

316.   We have quoted from the medical and economics literature data from cost-effectiveness studies in the UK and the US to supplement the data we received from some of the countries (Ghali 1999; Hlatky 1999; Stone 1997; Sculpher 1994). There are two basic types of cost information used for cost-effectiveness studies. First, some studies make use of hospital accounting data. But these accounting processes were designed to collect information by department, not by patient, which makes it difficult to assess resource consumption (Finkler 1982). In order to correct this data insufficiency, these cost-effectiveness studies use complicated algorithms designed to reallocate accounting data to more accurately reflect resource use (Naglie 1999; Drummond 1987). None of the studies we quoted used this method.

317.   The second type of cost information used is charges. Charges have the advantage of being patient-based, that is they more closely reflect resource use then accounting costs. However, charges are not equal to the opportunity cost of hospital resources (Finkler 1982), therefore data on charges are usually altered in cost-effectiveness studies to reflect the cost to hospitals. The most common method converts charges to costs using cost/charges ratios that have been developed for that purpose. Ghali et. al. and Hlatky et. al. converted charges into costs while Stone et. al. used charges. The Sculpher study estimated annual costs of running an intensive care unit, cardiac care unit and a general ward and divided each by the number of bed-occupancy days over the year to obtain a unit cost.

Table 23 Data sources and characteristics for costs related to IHD treatment

6.3.2. Comparison of costs for selected treatment bundles

318.   We have collected data on costs for six pre-defined "bundles of goods," that is, for six specific groups of resource use for treating IHD. In order to make these bundles as comparable as possible, we used French DRGs (Groupes homogénes de malades) to help us define the resource groups (MASSV 1994). These DRGs are based on the US version, which facilitates the task of comparison since many of the existing DRGs used in various countries are based on the US system. The six groupings are:

uncomplicated AMI (GHM-1),

- – - complicated AMI where PTCA was used (GHM-2),

- – - complicated AMI with no PTCA(GHM-3),

- – - AMI discharged as dead(GHM-4),

- – - elective PTCA excluding AMI patients (GHM-5), and

- – - CABG (GHM-6).

319.   These data were collected for seven countries (Australia, Belgium, Canada (Ontario), Denmark, Finland, Greece and Italy). The cost data collected attempts to balance the competing interests of comparability, by not collecting data on too detailed a level of disease severity and/or comorbidity, and accuracy, by at least defining a broad grouping that is somewhat comparable, such as complicated AMI or AMI deceased.

320.   In order to make the data comparable, we need to control for differences in health care spending that would result from differences in income or overall level of national prices. Ideally, we would adjust the cost figures using health care specific Purchasing Power Parity (PPP), however, dependable health care specific PPPs are difficult to find. The alternative would be to adjust the cost figures using general PPPs, but these reflect price differences across countries which do not necessarily reflect health care price differences. We have chosen instead to express unit costs as a percentage of GDP per capita. Not only does this method control for differences in income and prices (though not health care prices), but it has the added advantage of expressing unit costs as a cost to society since dividing by GDP per capita shows expenditure on these goods as a percentage of the available resources to society.

326.   We will use the term "unit cost" to refer to the average expenditure for each bundle of goods as we have collected them. The data collected are presented in two sets of charts. The first set of charts expresses unit costs as a percentage of GDP per capita:

where: i – a bundle of goods used to treat AMI or IHD as defined earlier

$$\frac{\text{Unit cost}_i}{\text{GDP per capita}}$$

Chart 60 Unit costs for selected treatments as a percentage of GDP per capita

327.   The second set of charts presents data on unit costs per capita as a percentage of GDP per capita weighted by the length of stay for the respective grouping. In a sense this is an approximation of the average per diem cost for a given bundle of goods. Dividing by length of stay helps to visualise the distortion on costs from underlying factors that keep patients in hospital longer in some countries.

Chart 61 Unit costs per day for selected treatments as a percentage of GDP per capita

328.   The data from Chart 60 show that costs in the US are much higher than other countries, even after adjusting by GDP per capita. For AMI without PTCA, the cost data used for the US refer to the use of t-PA (tissue plasminogen activator) for the choice of thrombolytic therapy. The cost of t-PA in the US can be anywhere from 5-9 times greater the cost of streptokinase, a less costly thrombolytic drug (Mark 1995; Lorenzoni 1998).[52] However, since drugs accounted for about 20% of the total cost, we could expect at most a 10% drop in the cost per capita of treatment for AMI without PTCA based on the data from Stone et. al. This would still leave the cost of treating AMI with thrombolytic therapy about 3.5 times higher than the cost in the next highest country.

329.   The difference between the US and other countries was largest for the AMI without PTCA bundle. The information for the US for this group was taken from the Stone study, which used charges

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52.   This illustrates one of the difficulties in adjusting for health care specific input prices. There are two separate issues: the first concerns differences in prices across countries of a specific input, t-PA, the second concerns differences in prices for "bundles" of thrombolytic drugs, the bundles consisting of some weighted average of the thrombolytic drugs used in each country. In either case, using GDP per capita only partially controls for these differences.

instead of costs, unlike the other two US studies which used costs but calculated from charges based on cost-charges ratios. This may account for why the difference from the Stone study was significantly larger than the other studies since charges are usually greater than costs (Finkler 1982; Stone 1997). In other words, the Ghali and Hlatky studies likely underestimate the costs of GHM-3, GHM-5 and GHM-6 that would be considered relevant for the present study.

330.   Data on the cost of uncomplicated AMI and AMI deceased provide the best opportunity to examine cost data for a relatively homogenous set of patients. The costs of treating uncomplicated AMI in Denmark and Italy are the highest (there was no data for the UK or US). After adjusting for length of stay, costs in Italy are the second lowest, since length of stay for uncomplicated AMI was highest in Italy. However, the costs for Italy were calculated for patient stays greater than one day and less than a cut-off point (calculated as a function of the 25th and 75th percentiles of length of stay). Excluding patients with a length of stay less than one day will lower the average cost of uncomplicated AMI if the average cost for this group is less than the overall average cost, which seems a reasonable assumption. On the other hand, how the average cost calculated in Italy will be affected by the upper cut-off point will depend on the formula used.

331.   Data on cost of CABG were available for all eight countries. Cross-country comparability should be greater vis-à-vis the other groupings since these data were collected regardless of admitting diagnosis. The lowest cost ratio for CABG is in Canada (37.1% of GDP per capita), in fact, Canada had the lowest cost for all three groupings that involved either CABG or PTCA. This is likely attributable to the absence of physician charges being included in the costs. Naglie et. al. calculated the costs of CABG by age group and complication in Ontario for 1992 and found a range of $3 970 to $5 750 in Canadian dollars (Naglie 1999). If these physician charges are included in the figures for Ontario then per capita cost as a percentage of per capita income increases anywhere between 46.9% to 53.8%, making the figures comparable to costs in Denmark, Australia and Belgium.

332.   With the exception of Australia, none of the data we collected on costs were adjusted for complications and comorbidities within each bundle of goods. The study by Naglie demonstrated a significant difference in costs between complicated and uncomplicated cases (Naglie 1999), and data provided by Tu et. al for the present study show complicated CABG cases cost about 15% more than uncomplicated ones (Tu 2000). Relative cost differences will likely be affected by differences in case-mix across the eight countries. This is especially important with regards to the data from the UK and US which were taken from studies that selected a group of patients much more homogenous in terms of severity of disease. However, at a cross-country level, and with large underlying administrative datasets, there is less of a likelihood that comorbidities could account for a large variation across countries.

333.   The ratio of costs as a percentage of GDP per capita to LOS show the effect that length of stay has on costs. We have already seen the effect for Italy, where relative costs were much lower for uncomplicated AMI once the length of stay was taken into account. Another case in point is Belgium. For complicated AMI with PTCA, cost in Belgium as a percentage of GDP per capita was the highest, apart from the US. However, once cost is weighted by length of stay, Belgium is observed to have the lowest relative cost-LOS ratio. This also occurs to a lesser extent for GHM-3 and CABG. From Section 2 we know that Belgium hospitals are paid fee-for-service, in this case service being the per diem cost of a hospital stay (Table 8). Thus, there is an incentive for Belgium hospitals, other things being equal, to keep patients longer than in hospitals that are not paid fee-for-service.

7. DISCUSSION OF THE RESULTS AND CONCLUSION

334.   The ARD research network has brought together a wealth of data from numerous sources. This report integrates this information to analyse treatment patterns, outcomes and costs in relation to the regulatory and microeconomic incentives embedded in health care systems. Given the complexities of such a large and diverse set of information it was not possible to collect data for all possible indicators, for all participating countries. Therefore, given the gaps in information and the complex interrelationships that characterise IHD treatment, our discussion will remain suggestive, addressing some of the key issues, while leaving more conclusive remarks for further research.

335.   Health care systems involve a complex interaction of economic and social institutions: from copayments, listing and prescription policies for ambulatory care drugs, to planning and regulating special care facilities, assessing health technologies and paying providers. These are supported by an information infrastructure to assess epidemiological trends, needs and health status, as well as health interventions and their health outcomes. How the various components interact is often intrinsically linked with the structure of a given health care system: on the one hand, there is the "integrated public model," consisting primarily of public hospitals for the delivery of acute care, on the other hand, there is the "insurance" model, be it social or private insurance, which in general imposes less overall regulation on infrastructure and its geographical distribution. When the results of the study are considered as a whole, these categories appear to have a strong influence on the amount of IHD-related care delivered to patients.

336.   One issue we have not addressed in this report is the issue of the relative roles of public and private financing. In our view, what matters most is not the source of financing itself, but how providers are reimbursed and whether or not it is under open-ended arrangements. Another issue we have not addressed is the socio-economic dimension of health care, although we do draw upon published material on this issue in the report when required. Since we have not addressed either of these issues in a significant manner, we have refrained from drawing any conclusions between these two issues and the various areas of our investigation.

337.   First, we discuss the role of demand and supply side factors in shaping treatment patterns. Following this discussion, we review the trends in outcomes in relation to the use of resources to obtain an understanding of how countries may achieve value for money in treating IHD. We finish the report with a few concluding remarks.

7.1 Demand side constraints- greater impact for ambulatory care

338.   We have found little evidence of any constraints on the demand for IHD health care. What evidence exists lies mainly with restrictions in coverage, which have a limited impact in acute care but a more significant impact for ambulatory care.

339.   By and large OECD countries have universal health care coverage. The one exception is the United States for whom 14% of individuals have no health care coverage; these are mainly the working poor and young persons. Although we have not gathered any direct evidence on the uninsured in the US, studies have shown them to have lower access to expensive elective procedures (Wenneker 1990; Hadley 1991). More recent studies that have controlled for patient's insurance status found similar results for

access to emergency intensive cardiac procedures for AMI, but found no differences in outcomes by insurance status (Sada 1998; Canto 2000). However, the impact of restricted coverage in the US for IHD related health care is limited because the bulk of health care for IHD is delivered to older persons, for whom there is near universal coverage through Medicare and Medicaid.

340.   Even where universal coverage exists, this coverage is not without some forms of restrictions. Universal coverage for health care is defined within the parameters of what may be considered as "medically necessary," a definition which varies by country, and it is within this definition where we have found the strongest evidence of demand side constraints. For some countries this definition limits coverage to public providers, thus limiting choice of provider. The option to choose a private provider is thus available to those who can afford this option by paying out-of-pocket, or as is more common, through private or supplemental health insurance. This is a more limited constraint on demand than total lack of health insurance. The potential impact is greatest in countries such as Greece and the United Kingdom where excessive waiting times for invasive interventions in the public sector can be eased by choosing a private provider with shorter waiting times.

341.   The potential for the greatest impact on the demand for IHD health care is with respect to prescription drugs delivered outside the acute care hospital setting, since health insurance generally covers drugs within hospitals. Some health insurance systems, such as Canada and Medicare in the United States, do not provide coverage for drugs outside hospitals, so that beneficiaries have to purchase supplemental health insurance if they are to be reimbursed for ambulatory care drugs. Whether as part of the public health insurance scheme or as supplemental insurance, there are usually restrictions in the form of copayments or limitations on prescriptions. Our analysis of drug consumption refers primarily to the consumption of drugs in the ambulatory care sector: the data we collected on drug consumption concern mainly the consumption of ambulatory drugs related to primary and secondary preventive care of IHD. Data on drug consumption in hospitals is, for most countries, more difficult to attach to individual patients.

342.   We have supplemented the indicators on drug consumption contained in this study with information from a related study (Dickson 2001). Both reports point to the same qualitative results: the consumption of relatively cheap and older drugs, which are proven to be effective in treating hypertension, such as diuretics and betablockers (Charts 25b and 25d), seems to be linked with the relative burden of IHD. Countries with high burdens of IHD such as Denmark, Sweden, Hungary and Finland experience relatively high rates of consumption, while Italy, Belgium and Korea, countries with much lower burdens of IHD, have the lowest rates of consumption. On the other hand, increases in the consumption of cholesterol and triglyceride reducers, starting in the mid-1990s (Chart 25a), are mainly driven by the use of the newer and more expensive statin drugs. For these more expensive drugs, including ACE inhibitors, we found no clear link between patterns of consumption and the relative burden of IHD, as measured through standardised mortality rates. However, we often found a positive association with economic variables, such as relative GDP per capita and the relative propensity to spend on health (share of health expenditure in GDP), independent of the burden of IHD.

343.   It is also interesting to note that the countries with lower levels of drug consumption have universal coverage, while countries with non-universal coverage, or coverage limited through copayments, experience higher rates of consumption. The role of prescription patterns, and possibly the budgeting of physician prescriptions in some countries (Jacobzone 2000), may play a greater role on overall levels of consumption, suggesting variations across countries in patterns of drug consumption may result from a mix of demand and supply-side constraints.

7.2. Supply side constraints – strong impact on utilisation and treatment mix

344.   We have found supply-side constraints exert a strong influence on treatment patterns. Supply-side constraints reflect a complex interaction between payment methods, availability and constraints on technology that determine utilisation levels. Supply-side factors appear to be important in determining utilisation levels for the more resource intensive procedures of PTCA and CABG, relative to drug therapy. The two most important supply-side factors are the methods used for paying hospitals and physicians, and how strictly facilities are regulated.

345.   Utilisation of PTCA and CABG procedures requires that the proper facilities be available. The availability of specialised human resources as well is likely important, but the data we collected do not allow us to draw any meaningful conclusions with respect to utilisation levels of PTCA and CABG. More reliable information is available for the number of catheterisation laboratories and cardiac surgery facilities. We find positive relationships between the availability of cardiac surgery facilities and utilisation of CABGs, and between the number of catheterisation laboratories and utilisation of PTCAs (Chart 62a, b).

Chart 62a Rate of CABG procedures and cardiac surgery units per 100 000 inhabitants

346.   Based on the trendlines in Charts 62a and 62b we can describe a relationship across countries in terms of relative "production" levels of CABGs per facility. For example, those countries that produce relatively more CABGs per facility will be located above the line. Production levels for CABG in Denmark, Italy and Sweden for instance, are relatively less than the level in the United States, or to a lesser extent Canada (Ontario), Germany or Australia. One very important feature separates countries above the line from those below in Chart 62a: in the countries above the line, physicians operating in hospitals are paid fee-for-service, whereas in all the countries at or below the line, physicians operating in hospitals are paid on a salaried basis with hospitals financed with global budgets. In a sense, the health care systems for the countries above the line are organised on an "insurance" model, whereas the health care systems of the countries below the line are more of the "integrated public" model.

Chart 62b Rates of PTCA procedures and catheterisation laboratories per 100 000 inhabitants

347.   The analysis is similar for catheterisation laboratories, with an even stronger link between utilisation levels and the availability of facilities (Chart 62b). The distribution of countries is slightly different with the United States, Canada (Ontario), Norway, Greece and Australia being above the line, Germany and Canada being on the line, and Denmark, Sweden and Finland being clearly below the line. There are some slight differences in the link between physician payment methods and production levels from Chart 62a, Norway for example has a relatively high production level of PTCA. The reader should bear in mind a couple of caveats regarding this analysis. 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, and no 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 ill-equipped to do PTCA to the total number of catheterisation laboratories would vary by country.

348.   While we have shown there to be a strong link between supply-side characteristics and utilisation levels of CABG and PTCA, another factor which should not be overlooked is "demand," as defined through health needs in terms of burden of IHD. Ideally we would use incidence of IHD, but since this information is available for only four countries, we used mortality rates age-standardised to the European

population aged 40 and over as a proxy for the burden of ischaemic heart disease. The relationship between utilisation and demand is depicted in Chart 63a and 63b.

Chart 63a, b Rates of CABG and PTCA procedures and IHD mortality per 100 000 inhabitants

349.   There is a weaker link between utilisation levels of CABGs and the burden of disease. The same relationship holds true for PTCA. In general, the insurance countries are on or above the trend line representing the correlation between the utilisation of PTCA or CABG and IHD mortality, whereas the public integrated countries are generally located below the line. This reflects the relatively strong supply-side constraints that exist in the latter group of countries. However, we cannot disentangle in this analysis the relative roles of the regulation of facilities from payment methods. Charts 63 c and 63d depict the relationship between facilities and IHD mortality. The charts show the relationships between facilities and the burden of disease are weaker than the relationships between revascularization procedures and the burden of disease. From these charts we find that the United States and Germany have a higher number of catheterisation laboratories than expected relative to the burden of IHD, and the United States and Japan have a much higher than expected number of cardiac surgery units (data for facilities were not available for Belgium). This reflects the generally weaker constraints on the availability of facilities in the insurance countries.

Chart 63 c, d Number of catheterisation laboratories and cardiac surgery facilities per 100 000 inhabitants and IHD mortality per 100 000 inhabitants

350.   These data show that supply-side factors, namely provider payment methods and facility regulation, are important determinants of utilisation levels for PTCA and CABG. They also show there to be a weaker relationship between demand, health need, and utilisation of these procedures, and that utilisation levels seem to be linked to the organisation of health care systems. Preliminary empirical analyses on the data we have collected find further evidence of the link between payment methods and utilisation of CABG and PTCA. Furthermore, we also find a strong influence on utilisation levels for relative GDP per capita, capacity constraints and the diffusion of technology, while relative health need, defined as IHD mortality, has a lesser influence.

351.   This discussion is based on cross sectional evidence. However, over the course of several years, the rate of technology diffusion is an additional factor that needs to be taken into account. New technological innovations in health care, including treatments for IHD, diffuse at different rates across countries. Two recent works have shed some light on this subject. In a paper published in the journal Health Affairs, the TECH research network categorised the pattern of technological change for several of the countries included in the OECD-ARD project according to the rate of growth in the use of cardiac catheterisation for treating AMI (TECH 2001). Based on their analysis the countries fall into three groups: early adoption of the procedure and rapid growth in utilisation following adoption (US), late adoption but rapid growth in utilisation following adoption (Australia, Belgium, Canada, Italy and Switzerland) and late adoption and slow growth in utilisation (England (Oxford), Finland and Norway). The growth rate following adoption was rapid in Japan but it was unclear as to how early cardiac catheterisation was adopted relative to the other countries. In another work, Slade and Anderson show that early adoption of medical technologies is positively related to national per capita income, but as the technology diffuses over time the influence of national per capita income diminishes (Slade 2001).

352.   Payment mechanisms can also influence the mix of care, in this case the relative proportion of CABG to the total number of revascularisations. Chart 64 presents the use of CABG as a proportion of total revascularisations. First, the data clearly show that for all countries CABG as a means of revascularization is losing ground to PTCA. Since the rate of CABG use per 100 000 persons has been increasing during this period (Chart 47), PTCA use is growing even faster. In addition, Chart 64 shows the

insurance countries (Belgium, Germany and the US), rely far less on CABG as a means of revascularisation than PTCA. These three countries have in common fee-for-service arrangements for paying hospitals and physicians (in Germany physicians are not paid exclusively fee-for-service). In an environment where both hospitals and physicians are paid fee-for-service, there are several factors that make PTCA more financially attractive: on the cost side, the procedure is not as intensive and requires less fixed capital costs; in terms of financial benefits for physicians, it is fixed fees combined with a lower risk of complications during the production process (the operation itself). It is the combination of these factors that makes PTCA the more attractive alternative for revascularization under a fee-for-service regime for both hospitals and physicians.

Charts 64 Utilisation of CABG as a proportion of total revascularisation procedures

353.   The impact of payment mechanisms can be felt in other ways as well, not just in creating a higher propensity to use more intensive and costly procedures. Open-ended financing of hospitals creates the incentive for keeping patients in hospital longer. This is the case for Belgium and Japan, which have much longer lengths of stay than other countries (Chart 59), even after controlling for patient homogeneity in terms of age groups (although in the case of Japan, this also reflects a substitution of acute care beds for use as long-term care beds).

7.3 Do we get value for money?

354.   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 where 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 would be to determine the relative performances of their health care systems.

355.   The easiest and perhaps best population-based aggregate measure would be the trend in mortality from IHD. Since the 1970s age-standardised (European population aged 40 and over) mortality rates have been on the decline for the majority of OECD countries, but at different rates (Table 15). How much of a role has the health care system played in bringing about these reductions? The three countries that achieved the greatest reductions in IHD mortality, Australia, Canada and the United States, differ from each other in the mix of health care services used to treat IHD. The US has the highest use of intensive procedures among these countries, followed by Australia and then Canada, yet the reductions in IHD mortality were roughly similar. On the other hand, in both Belgium and Germany, two countries with similar utilisation levels for intensive procedures as the US and Australia, the reductions in IHD mortality were not as large. The United Kingdom, which has the lowest utilisation rates of intensive treatments for IHD, also saw mortality from IHD decline. While health care treatments may explain some of the success in reducing IHD mortality rates, there must be other contributing factors.

356.   Evidence from other studies, especially the MONICA study, suggest that the reductions in IHD mortality may not be entirely due to improvements in health care but also to reductions in underlying risk factors which helped to reduce the overall burden of disease. Perhaps the most cited example of this is the changes in smoking patterns since the 1970s. For example, Australia, Canada and the United States not only saw the largest reductions in IHD mortality during this period (Table 18), but they also saw the largest reductions in tobacco consumption (Chart 19). On the other hand, tobacco consumption in the United Kingdom has declined by similar levels but has not been matched by a decline in IHD mortality similar to Australia, Canada and the US. By and large tobacco consumption in most OECD countries has declined since the 1970s and parallel to this there has been a decline in IHD mortality. In both cases, the levels of decline are not equal among the countries surveyed, nor are they similar across gender, especially tobacco

consumption where for some countries, for example Finland, Italy and Norway, tobacco consumption among females has increased (Chart 19B).

357.   Putting aside any causal implications, we find that, at an aggregate level the countries with the highest activity rates, in terms of utilisation of medically intensive procedures, do not necessarily achieve the steepest reductions in IHD mortality. However, it does not necessarily follow that those with the lowest activity rates achieve the greatest reductions in IHD mortality.

358.   In Section 4 we looked at trends in treatment using a defined cohort of patients with AMI and angina respectively, and in Section 5 we provided information from AMI cohort for various indicators of case fatality and readmissions (see data from the TECH research network). In the following charts, we have provided a graphical depiction making the link between treatment trends and outcomes: Charts 65 show the proportion of AMI patients receiving a revascularisation procedure (CABG + PTCA) within 90-days from the initial admission on the x-axis and the proportion of patients who died within one-year from the initial admission on the y-axis.

Charts 65 One-year case fatality rates and utilisation of revascularisation for 90-day episode of care

359.   The most obvious depiction from these charts is that they clearly separate the countries with a higher propensity to use revascularisation as a means of treating AMI, the US and to a lesser extent Australia (Perth), from the countries that rely less on this method, Canada (Ontario), Finland and Sweden. What is also clear is that there was generally an increase in the proportion of patients receiving revascularisation procedures and an accompanying declining case fatality. Modest increases in revascularisation rates in Ontario and Sweden have been accompanied by significant declines in case fatality for the elderly. The United States seems to be on a different "production function", with much higher increases in revascularisation rates but similar declines in mortality. For the younger age groups, the pattern is more mixed, with some declines in case fatality in Finland, Sweden and Ontario, and a mixed picture for the United States.

360.   From these charts we see that persons aged 40 – 64 in the US do not fare as well in terms of case fatality relative to the other countries as their older fellow citizens. Since we have not controlled for case-mix or socioeconomic status, the poorer results for the younger age group in the US likely reflect the inclusion of individuals with no health insurance, which is not a problem for Americans aged 65 and over who enjoy near universal coverage. In a sense, these charts would tend to support the view that Ontario, Perth, Finland and Sweden are more or less on the same production function. The United States would either be on a different production function, or on the part of the same production function exhibiting decreasing returns to health interventions: the US also experiences reductions in case fatality, but these do not seem to be in line with the additional amount of resources invested.

361.   Not only do incentives and regulations affect treatment decisions, they may also have an effect on the time to treatment. Using revascularization as an aggressive treatment of AMI refers not only to if the procedure is performed, but also *when* it is performed: the use of primary angioplasty for treating AMI as a first-line treatment, as opposed to waiting until the patient has stabilised, is a prime example. This may distort somewhat the picture from Chart 65 (as well as Chart 66 below). For the 90 day episode of care, AMI patients that are not revascularised can be divided in two groups: those that are not considered candidates for revascularization and those that are but will be treated *after* 90 days. In Finland for example, the majority of CABGs for AMI patients occur more than 90 days following the initial admission. Therefore, the use of a 90 day threshold may be insufficient to capture the episode of care for readmissions for (elective) revascularizations, especially for CABG.

362.   With respect to the report investigating other measures of outcomes, we also collected data on readmissions. One of the issues surrounding the option of treating AMI with CABG as opposed to PTCA or thrombolytics, is that CABG is more effective in reducing future episodes of angina, thus reducing the need for readmission for IHD. Does the trend towards higher use of CABG translate into a lower proportion of patients readmitted for IHD? Using data from the TECH research network, we plot the proportion of AMI patients readmitted for IHD (ICD9 411, 413 and 414) against the proportion of AMI patients receiving a CABG 90 days following admission. The US does have lower readmission rates for persons aged 40 – 64 and those aged 65 – 69. During the period observed in the charts, readmission rates in the US were stable, while the utilisation of CABG as a proportion of all revascularizations was increasing for all age groups 65 and over. For the older age groups, Sweden and Ontario have similar proportions of readmissions compared with the US, but with much lower levels of CABG use. Thus, it is unclear from these charts whether the use of CABG has led to a reduction in readmissions.

Charts 66 One year readmission rates for IHD and proportion of AMI patients receiving CABG during the 90 day episode of care

363.   Any assessment regarding "value for money" requires we make a link between outcome indicators and some notion of expenditure, keeping in mind that expenditure reflects both volume of activity and prices. The health care expenditure patterns of OECD countries are well documented. The United States stands alone as the largest overall spender on health care, a second group of countries including Australia, Belgium, Canada and Germany tend to spend more than the average of OECD countries, while the lowest spenders include countries such as Finland, Spain and the United Kingdom. In our report we have found there to be a general link between activity levels as reported above and trends in expenditure. In order to forge a stronger link, we examined per unit expenditure on IHD-related care. Our survey mostly shows that the United States spends more than other countries per unit of input. Therefore, the gap in expenditure between the United States and other countries with similar volumes of activity for intensive procedures, such as Belgium and Germany, can be further explained through higher per unit expenditures.

364.   Since the United States is such an outlier, it is difficult to have a discussion on spending on health care among OECD countries without the US experience dominating. Based on the data we collected on overall spending and per unit expenditures, combined with at best marginally better health outcomes, it is hard not to conclude that the marginal returns to spending in the US appear to be relatively small relative to other countries. However, the question remains open whether other technologically intensive countries, such as Germany and Belgium, with cheaper inputs than the US get as much value for their money compared with countries such as Australia and Canada. For the time-being, our ability to examine this issue is restricted by the lack of patient-based data in many countries. At the other end of the health expenditure spectrum lies the UK, for which we do not have information linking interventions, costs and outcomes since we did not have data on case fatality or readmissions. We do know that, based on Chart 35 (Utilisation of PTCA) and Chart 47 (Utilisation of CABG), the UK is among the countries that rely the least on technologically intensive treatments, which is probably attributable to the lower levels of health expenditures in the UK. Furthermore, we know from Table 15 that the long-run decline in IHD mortality in the UK was not as great as in other countries with a similar burden of the disease. Thus, we see an indirect link between the lower levels of spending in the UK, the consequent lower level of utilisation of invasive cardiac procedures and the weaker declines in IHD mortality.

7.4 Concluding remarks

365.   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, despite the many caveats spelt out above, will serve as a convenient reference for understanding patterns of care for ischaemic heart disease.

366.   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 similar utilisation rates for treatments across countries, since OECD countries devote very different levels of resources to health care. However, higher "activity rates" (utilisation of revascularisation procedures) observed in some countries do not necessarily translate into improvements in outcomes for patients that parallel the investment in resources: case fatality rates for the oldest persons in the United States were generally lower than in other countries, yet case fatality rates for persons in the lowest age group (40-64 years) were as low, if not lower, in both Canada and Sweden, two countries that invest far fewer of their resources in health care than the United States.

367.   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. In the future, similar analyses will benefit from improvements in the utility of these information systems, which will require long-term investments, as well as the goodwill and participation of patients and physicians. They will be more likely to participate if we can demonstrate that the information they have to offer can be used to improve health care systems in the long run. This study is a positive step in that direction.

APPENDIX 1. MEASUREMENT AND METHODOLOGICAL ISSUES INVOLVED IN THE EPIDEMIOLOGICAL APPROACH

1. Prevalence versus incidence

368.   Measuring prevalence, the number of cases of IHD existing in a given population at a specific period of time (period prevalence) or at a particular moment in time (point prevalence) is most advantageous from a health policy perspective since this measure represents best the burden of the disease. A first limitation to this indicator is that measuring prevalence is rather difficult on a population basis. The main problem is to track individuals who exhibit the symptoms of IHD but have not been in formal contact with the health care system. Surveys are the only practical means of identifying these individuals, but self-reported data can be difficult to interpret. In addition, differences in survey methodologies across countries provides a further limitation in interpreting this information making it extremely difficult to use prevalence as a reliable picture of the burden of IHD across several countries.

369.   Given these limitations, the analysis focuses on incidence, which is not without some methodological limitations of its own. The acute nature of acute myocardial infarction (AMI) and the greater need for hospitalisation make it easier to use hospital admissions data to measure the incidence of AMI, as opposed to IHD. Countries with readily accessible hospital administrative data can calculate admission rates, but this measure is only a proxy to the true rate of incidence and is dependent on the proportion of heart attack victims who are hospitalised. For example, results from the Oxford Record Linkage Study show that the share of hospitalised incidence has increased to about 70% of total incidence in the area surveyed over the past 15 years, but is still 50% or less for the older age groups (Goldacre 2000). That still leaves a substantial proportion of individuals who suffered a heart attack but were not hospitalised. Discounting those who died due to AMI, some people will not be counted because they were unaware of the seriousness of their condition and did not seek treatment, what are referred to as "silent AMIs". Others may have sought treatment but did so in an ambulatory care setting, and without linkage between ambulatory care and inpatient data they too would not be counted.

370.   What is difficult to say is the extent to which measurement bias of incidence is affected by age. The likelihood of detecting IHD and AMI increases with the number of physician visits, since the number of physician visits also increases with age this will lead to underreporting of IHD and AMI incidence for younger age groups. This will be more problematic for IHD than AMI since IHD cases, excluding the sub-group of AMI, are more likely to be detected during regular physician visits. This is not an issue if there is linkage between hospital discharge data bases and data bases from ambulatory, outpatient and institutional (long-term care facilities, nursing homes) sources. For AMI, the bigger problem lies with underestimating its incidence in older persons. Angina and myocardial infarction symptoms tend to be atypical among the elderly, furthermore, silent AMIs are proportionately higher among the elderly, factors which lead to an underestimation of AMI.

371.   Since hospital admission rates alone are insufficient to calculate incidence, there is a need to supplement these data with estimates of the number of cases that do not reach hospital, the most likely cause being those persons who did not die inhospital. These patients may have died at home, at a nonhospital type of institution or may even have died upon arrival at the hospital in which case they were never formerly admitted and thus not included in the admissions database. The approach used to deal with

this problem is to combine hospital administrative data with cause of death information from death certificates. However, if the inpatient data are not patient-based, that is if patients cannot be tracked in the case of readmissions, then this method is likely to result in some overestimation of true incidence due to double counting.

372. Other issues may arise when using administrative data sets. In some countries, incidence rates may be underestimated if only the primary diagnosis field is available, thus omitting patients admitted with AMI as a comorbidity. The bias is likely to be larger when calculating IHD incidence than AMI because heart attacks are more likely to be coded as the primary diagnosis. Furthermore, incidence may be underestimated if the primary diagnosis field identifies the diagnosis that led to the admission as opposed to the diagnosis most responsible for treatment, as for example with individuals admitted for angina who subsequently suffer a heart attack while being treated, the latter requiring the greater use of hospital resources. Finally, there is also a possibility of coding errors for the International Classification of Diseases Code version 9 (ICD9 410) for AMI which may bias estimates of the true number of AMIs (Boyle 1995).[53] Based on discussions with experts this is more problematic for data derived from death certificates than it is for hospital separation data where coding experts are more used to using the ICD nomenclature.

373. However, many of these difficulties may not be as serious as they appear if one is using data to assess trends over time for two reasons: first, if the processing of data is homogeneous over time, that is the errors are consistently biased in the same direction, then the margins of error will be kept constant and the trend can still be estimated with reliability. Second, and perhaps more important, since we are interested more in the qualitative nature of the trends in variations across countries, over a sufficiently lengthy period of time, cross-country variations will diminish. Nevertheless, changes in biochemical markers of AMI and ICD versions since the 1970s can lead to errors in the trend estimates that need to be taken into consideration when interpreting the results.

2. Mortality

374. The other key epidemiological indicator is mortality, particularly trends over time. The previous paragraphs discussed some of the methodological issues surrounding mortality, but only within the context of measuring the incidence of AMI. Coding problems with ICD9 present a particular difficulty when calculating mortality. To rectify this situation, a broader range of disease codes are used to calculate deaths from AMI. The codes used most often are those for IHD (ICD9 410-414) since it is most likely that deaths coded as ischaemic heart disease are in fact deaths due to AMI (in addition, in many countries IHD deaths are often coded ICD-9 798, "sudden non-violent death"). While it will be possible to compare countries based on mortality due to AMI, comparisons are likely to be more robust when performed with the broader indicator for IHD. After briefly introducing some of the AMI mortality data, this is the reason why we shift to an epidemiological discussion on ischaemic heart disease mortality. The more specific case of AMI case fatality, is discussed in more detail in the section on outcome indicators.

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53. To account for these biases Boyle et. al. developed adjustment factors based on MONICA data which are applied to hospital separation data and mortality data.

APPENDIX 2. RECENT TRENDS IN TREATMENT FOR ISCHAEMIC HEART DISEASE

1. Recent Trends in Treatment

375.   During the period covered by the Ageing-Related Diseases project (ARD) there have been several changes that have altered treatment patterns of ischaemic heart disease in OECD countries. The most noticeable trends in treatment patterns can be placed along a spectrum of technological sophistication, with coronary artery bypass graft as the most sophisticated followed by PTCA then drug therapy. Treatment patterns have followed developments in improved methods of delivering these procedures creating interesting substitution patterns between these three treatment methods.

1.1. Coronary artery bypass graft

376.   Coronary artery bypass grafting – a technique whereby the obstructed area is bypassed by grafting veins or arteries from the aorta to the coronary artery – has been around since the mid 1960s and is the most widely recognised revascularisation technique for treating ischaemic heart disease. Compared with angioplasty, although it is an older procedure, it is highly complicated and requires significantly greater medical resources. Patients with less severe forms of ischaemic heart disease are more likely to undergo angioplasty or drug therapy than CABG, yet in many cases CABG is still the preferred treatment because it has been shown to offer durable long term relief for anginal symptoms.

377.   Although the rate of increase in CABG use has been overtaken by the use of angioplasty in recent years, CABG use is still increasing at a significant rate. (McClellan 1998; Tu 1997) With the increasing evidence of the significant benefits and lower than expected complication rates among the older population, frequency of these procedures among the older populations is likely to continue increasing over the years. The micro data results from the study offer an overview of recent trends.

1.2. Percutaneous transluminal coronary angioplasty

378.   With approximately 1.3 million procedures performed world-wide in 1999, percutaneous transluminal coronary angioplasty (PTCA) – a technique whereby a catheter is threaded through the arterial system until it reaches the obstructed coronary artery where a balloon is inflated to clear the obstructed area – has now overtaken coronary artery bypass surgery, with 700 000 operations, as the most frequently used revascularisation procedure in the world (Reicin 1999). In Western European countries, a steady six-fold increase in the utilisation of angioplasties over the period 1985 to 1992 has been documented since 1985 (Van den Brand 1993).

379.   The popularity of PTCA over CABG is due to its minimally invasive nature but is limited to only certain types of lesions (Reference to be added). Furthermore, the advantage of PTCA in reducing anginal symptoms compared with other treatments decreases with the number of diseased vessels (Hollman 1992; Meier 1991). Decisions between the two revascularisation procedures tend to be related to the patient's age, number of vessels blocked (if there are more lesions more, patients are likely to receive CABG), general health of the patient and availability of facilities and skilled personnel.

380.   Since its introduction in the late 1970s and during the 1980s the number of PTCA procedures performed gradually rose. During this period a number of studies demonstrated the efficacy of PTCA as an important means of revascularisation. PTCA of a non-occluded coronary artery was shown to be successful in about 90% of patients (Detre K 1988; Gruentzig 1987; Hollman 1992; Parisi 1992), although the success rate is lower in chronically occluded arteries (Meier 1991; Bell 1992).

381.   Despite some of the advantages of PTCA, up until the mid-1990s CABG was still the preferred method of revascularisation. In several studies comparing PTCA with bypass surgery both procedures had similar rates of long-term major ischaemic complications (RITA 1993; Pocock 1995; BARI 1996), although CABG appears to provide greater relief from symptoms of angina. The main difference between the two procedures was the higher rates of restenosis, a recurrent narrowing of the artery following successful angioplasty. High rates of restenosis led to the introduction of several new techniques to overcome these difficulties, the most successful of these being the coronary stent, a wire rim used to keep the blood vessel open following angioplasty.

382.   Despite early clinical evidence that stents were effective in reducing restenosis (Serruys 1994; Fischman 1994; Ellis 1995), there was still a reluctance among clinicians to routinely use this technique in practice. Serious complications demonstrated in clinical experience in the use of stents (Serruys 1991; Savage 1994) may have contributed to this reluctance. Furthermore, physicians may have been reluctant to adopt stenting into broad-based practice because the successful results of these studies were demonstrated only in a highly select group of patients (Serruys 1994; Fischman 1994; Lincoff 2000). It wasn't until important developments in deployment techniques and adjunctive pharmacologic therapy that stenting began to develop into the most common technique in angioplasty (Schömig 1996; Lincoff 2000).In fact, a recent article has demonstrated that stents can be successfully used in broad-based clinical practice (Kimmel 2000). As data from the TECH Research Network show, the use of stents as a proportion of all PTCA really began to take off around 1994 (TECH 2001).

383.   While subsequent trials have shown that PTCA with stent leads to lower repeat revascularizations and lower rates of restenosis then PTCA using balloon dilation (Suwaidi 2000; Serruys 1998; Versaci 1997; Macaya 1996), the increased use of stents has not been accompanied by rigorous clinical evidence of its efficacy in reducing the risk of death or myocardial infarction. Furthermore, restenosis within a stent remains a considerable problem to be overcome.

384.   The other major trend with the use of angioplasty has been the advent of primary PTCA, when angioplasty is used to treat AMI as soon as possible rather than thrombolytic therapy. Several studies have demonstrated the advantage of primary PTCA vs. thrombolytic therapy (Weaver 1997; Every 1996; Tiefenbrunn 1998; Grines 1993; Zilstra 1993). Furthermore, there is evidence that primary stenting may be better than angioplasty (Stone 1998; Grines 1999). Two recent articles have shown that primary angioplasty may have better longer term benefits (Zilstra 1999; Berger 1999), possibly reflecting the technological improvements, including the increased use of stents, that PTCA has undergone in the 1990s. If more studies can confirm the benefit of primary stenting than there may be an even bigger increase in the use of both stents and primary angioplasty.

1.3. Recent Trends in Drug Therapy

385.   The utilisation of drugs in treating ischaemic heart disease will depend on the severity of the condition and whether the drugs are being used as preventive measures or as treatment. For patients diagnosed with milder cases of IHD, medical management through drug therapy consists of anti-hypertensives such as beta-blockers or diuretics, calcium antagonists, ACE inhibitor, anti-platelets or lipid-lowering agents.

386.   The use of lipid lowering agents for secondary prevention of cardiovascular disease in patients with lipid disorders and no history of cardiovascular disease is well established, but when used as primary prevention the results are more ambiguous. A recent meta-analysis showed that long-term use of lipid lowering drugs reduces coronary heart disease events but has no significant effect on all cause mortality for people with no known cardiovascular disease (Pignone 2000).

387.   The use of antiplatelets has long been accepted as having an important role in arresting the development of coronary thrombosis. With the publication of the results of the ISIS-2 trial aspirin was shown to be highly effective in reducing mortality following AMI (ISIS-2 1988*a*; ISIS-2 1988*b*), combined with its low cost aspirin may be the most cost-effective treatment in existence. New, and more expensive, types of anti-platelets such as ticlopodine and glycoprotein IIb/IIIa inhibitors have been introduced since the ISIS publication and have the potential to even improve upon the results obtained with aspirin, albeit at a much higher costs. Therefore, their cost-effectiveness deserves to be further analysed.

388.   For acute myocardial infarction the choice of first line treatment is between the immediate administration of thrombolytic therapy or, as seen above, primary PTCA. Thrombolytic therapy breaks down the blood clot responsible for the heart attack and restores blood flow to the affected heart muscle before it dies. This treatment must be given immediately to the patients, within 6 to 12 hours of the heart attack. The traditional drugs of choice have been streptokinase and urokinase. More recently, the introduction of tissue plasminogen activator (tPA) has been used.

389.   In past years, there have been differing opinions and much research to determine which first line treatment leads to better short-term and long-term. Although several studies have demonstrated the efficacy of primary PTCA in treating AMI as noted above, thrombolytic therapy has proven to be equally as efficient in restoring coronary flow (GUSTO 1993; Cannon 1994) and has demonstrated beneficial effects on survival (ISIS-2 1988*a*; ISIS-2 1988*b*; GISSI 1986). Furthermore, there is the possibility that treatment comparisons have been restricted to a highly selective group of patients (Robinson 2000). One article using observational data suggested thrombolytic therapy may be more beneficial than primary angioplasty (Danchin 1999).

390.   As noted above, the introduction of adjunctive pharmacologic therapy helped provide the impetus to the use of stents in PTCA. Schömig showed that ischaemic and haemorrhagic complications of PTCA could be reduced through antiplatelet therapy using aspirin and ticlopodine hydrochlroride (Schömig 1996). Two other trials have shown that concomitant use of platelet glycoprotein IIb/IIIa receptor inhibitors has further reduced the incidence of early complications of stenting (Brener 1998; EPISTENT 1998)

391.   The literature remains ambiguous about the relative merits of thrombolytic therapy vs. primary angioplasty. In the United States especially, primary angioplasty is gaining increasing acceptance as a standard practice for treating AMI. A meta-analysis of trials with over 1 000 patients comparing thrombolysis with placebo found significant benefits in patients treated with thrombolysis (FTT 1994). A meta analysis of trials comparing thrombolytic therapy with primary angioplasty demonstrated primary angioplasty to be superior for short-term mortality and the incidence of recurrent infarction (Weaver 1997). However, the evidence is not conclusive (Every 1996). Observations from an examining utilisation patterns of primary angioplasty may prove to be an excellent bellwether for dividing countries along the intensive technology use spectrum. The main advantages of thrombolytic therapy over primary angioplasty are greater access for patients, shorter treatment times and ease of use for the physician. All of these are likely to be contributing factors to the continued popularity of thrombolytic therapy for most OECD countries.

APPENDIX 3. SOURCES AND DATA QUALITY

392.   The analysis of treatment received during inpatient care relies upon large micro datasets collected in a number of countries. These microdatasets come often from hospital administrative databases and the current study is an attempt at making use of such dataset for a disease-based approach to a cross national study of health care systems. These datasets in general are described in Moise (Moise 2001).

Selection criteria for the analysed cohorts

393.   The treatment described in the current study concerns two major sets of diagnostics. The first is described as: Acute Myocardial Infarction (AMI), the second as Angina.

AMI patients

394.   The AMI patient cohort was constructed using the following criteria. These represent the standard which was proposed for the research. This work draws heavily upon the work of the TECH Research Network.

Inclusion criteria

395.   The patients should have a principal diagnosis of AMI (*ICD-9 410; ICD-10 I21*). Records should be searched to find the first occurrence of an admission for AMI in the case of patient-based data.

Exclusion criteria

- Patients should be excluded if they had an earlier admission for AMI (ICD9 410) in the previous year (within 365 days of their first admission in the current year) (In the case of patient-based data).

- Patients should also be excluded if they were transferred from another hospital and the primary diagnosis from the preceding admission was not AMI or IHD. (In the case of patient-based data).

- Patients admitted for less than 3 days should be excluded if they were not transferred to another facility or did not die in the hospital; 3 days being the minimum duration for a real AMI admission. Participating experts were encouraged to respect this criterion, unless they felt this did not reflect the minimum duration for a real AMI admission in their country. In this case, a minimum duration criterion was used to reflect specific conditions, and this should be mentioned.

For countries with event-based data but able to identify admission and discharge transfers, the third exclusion criterion was still applied, but with some slight amendments to take into account patients transferred from another facility. In this case the third exclusion criterion was:

Patients admitted for less than 3 days who were not transferred from another facility were excluded if they were subsequently transferred to another facility or did not die in the hospital. For patients admitted from another facility with a stay of less than 3 days they were excluded only if they were transferred to another facility (even though it is unlikely that a patient transferred from another facility for treatment for AMI would have a stay of less than 3 days).

Angina Patients

Treatment variables

396.   The following codes describe in more detail the main types of procedures analysed in the report.

CATH: Cardiac Catheterisation – with or without coronary arteriography

- Left heart cardiac catheterisation – *ICD-9CM 37.22* or
- Combined right and left heart cardiac catheterisation – *ICD-9CM 37.23* or
- Left heart angiocardiogram – *ICD-9CM 88.53* or
- Right and left heart angiocardiogram – *ICD-9CM 88.54* or
- Coronary arteriography, single catheter – *ICD-9CM 88.55* or
- Coronary arteriography, two catheters – *ICD-9CM 88.56* or
- Other coronary arteriogram – *ICD-9CM 88.57*.

CABG   Coronary Artery Bypass Graft

- Bypass anastomosis for heart revascularization *ICD-9CM 36.1* or
- Open chest coronary artery angioplasty – *ICD-9CM 36.03*.

PTCA   Percutaneous Transluminal Coronary Angioplasty – with or without stent(s)

- PTCA or coronary atherectomy without mention of thrombolytic agent – *ICD-9CM 36.01* or
- Single vessel PTCA or coronary atherectomy with mention of thrombolytic agent *ICD-9CM 36.02* or
- Multiple vess. PTCA coronary atherect. with or without mention of thromb. agent – *ICD-9CM 36.05*.

STENT

- Insertion of coronary artery stent(s) – *ICD9CM 36.06*.

Data sources

397.   The following table describes the main datasources used in the sections describing admissions, treatments and outcomes of the report. In some countries, several datasets were used. We also mentioned where data were supplied as part of the co-operation with the TECH Research Network.

Table 20 Data sources

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