Quality, costs and the role of primary health care

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ABSTRACT

The general aim of this thesis is to describe and analyse the role of primary care in health care systems in terms of health, health care utilisation and costs, and to study the feasibility of retrieval of data from computerised medical records to monitor medical quality.

The thesis includes five studies, a systematic literature review, a register study of utilisation of hospital and primary care, a study based on data from computerised medical records of individual patients cost for primary care, and two studies of management of respiratory infections in primary care based on data from computerised medical records of twelve health centres.

The general findings of the literature review were that an expansion of the primary care component of the health care system would most likely result in better health, lower hospital care consumption and lower expenses for care. The personal physician and continuity of care were core elements to achieve this, and the significance of the way primary care is organised and funded was evident.

In the register study fifty health centres were compared. Age and rates of outpatient hospital visits were the most important factors explaining the variation of rates of hospitalisations between the health centres’ areas. Hospital district also influenced hospitalisation rates in the different health centres’ areas, indicating that the health care structure in the district per se was an important factor. The rates of visits to general practitioners correlated negatively with rates of hospitalisations.

The study of costs in primary care showed that the variation in the costs of the individual patients was substantial, also within age groups and within the diagnosis-related Adjusted Clinical Groups (ACG). Age and gender explained a smaller part of the variation in costs per patient in primary care. Adding the ACG weight had a major influence on improving the ability to explain the variation in costs at patient level. The ACG system might be of value in the calculation of weighted capitation in Swedish primary care, but appears to be sensitive to the thoroughness with which physicians register diagnoses.

The retrieval of data from computerised medical records comprised a total number of 19 965 encounters for respiratory tract infections i.e. 199 per 1000 inhabitants during the year 2001. Most frequent diagnoses were common cold, acute tonsillitis, and acute bronchitis. The number of antibiotic
prescriptions was 7,961, accounting for 47% of the episodes. The most commonly prescribed antibiotics were phenoxymethylpenicillin (61%), tetracyclines (18%) and macrolides (8%).

A rapid test was performed in 43% of the encounters: for C-reactive protein (CRP) in 31%; for Group A beta-haemolytic streptococci (StrepA) in 22%; and both tests were performed in 10% of the encounters. The findings in the study indicate that StrepA and CRP tests were used too frequently and often with minor contributions to patient management. The frequencies of tests and of antibiotic prescriptions varied greatly between health centres in a way that hardly could be explained by differences in morbidity.

Computerised medical records provided a source of clinical information, which might be a feasible and pragmatic method for studying daily practice, and for follow-up of adherence to guidelines in general practice.
LIST OF PAPERS

This thesis is based on the following original papers, referred to in the text by their Roman numbers

I. Engström S, Foldevi M, Borgquist L.  
   Is general practice effective? A systematic literature review.  

II. Lindström K, Engström S, Bengtsson C, Borgquist L.  
   Determinants of hospitalisation rates: does primary health care play a role?  

    The significance of case-mix in estimating primary health care costs.  
    Submitted in April 2004.

IV. Engström S, Mölstad S, Nilsson G, Lindström K, Borgquist L.  
    Data from electronic patient records are suitable for surveillance of antibiotic prescriptions for respiratory tract infections in primary health care.  
    Scand J Infect Dis 2004;36(2) 139-143.

   Excessive use of rapid tests in respiratory tract infections in Swedish primary health care.  
## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG</td>
<td>Adjusted Diagnostic Group</td>
</tr>
<tr>
<td>ACG</td>
<td>Adjusted Clinical Group</td>
</tr>
<tr>
<td>CNI</td>
<td>Care Need Index</td>
</tr>
<tr>
<td>CPR</td>
<td>Computerised Patient Record</td>
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<tr>
<td>CRP</td>
<td>C-Reactive Protein</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GABHS</td>
<td>Group A Beta Haemolytic Streptococci.</td>
</tr>
<tr>
<td>GP</td>
<td>General Practitioner</td>
</tr>
<tr>
<td>ICD-9</td>
<td>International Classification of Diseases and Related Health Problems 9th version</td>
</tr>
<tr>
<td>ICD-10</td>
<td>International Classification of Diseases and Related Health Problems 10th version</td>
</tr>
<tr>
<td>RTI</td>
<td>Respiratory Tract Infection</td>
</tr>
<tr>
<td>SAMS</td>
<td>Small Area Market Statistics</td>
</tr>
<tr>
<td>StrepA</td>
<td>Rapid test to detect Group A beta-haemolytic streptococci</td>
</tr>
<tr>
<td>UPA</td>
<td>UnderPrivileged Area score</td>
</tr>
</tbody>
</table>
INTRODUCTION

I have worked as a GP since 1980. During many years I have tried to monitor and evaluate my own practice with the help of various sources of information. The medical record has been the most important one. A substantial increase in the possibilities of monitoring my practice occurred in 1994, when the computerised patient record was introduced at the health centre. Subsequently, one of my special spheres of interest has been to make good use of the abundance of data aggregated in the computerised patient record.

I have also been reflecting that, in spite of decades of health authorities highlighting the important role of general practice in the health care system, the bulk of the expansion of resources in the health care systems has been allocated to hospital care. I started to wonder if this process was due to lack of evidence of the efficacy of primary care, and thus a development in line with prevailing knowledge. Or else, was the expansion of hospital care rather than primary care going on, in spite of existing evidence of the benefits of expanding primary care.

Hence, this thesis describes different ways to assess the role and the performance of primary care. The assessment includes quality in practice, distribution of health care resources and qualities of primary care as a part of health care systems.

An analysis of primary care performance can be carried out from different aspects or levels using various kinds of available information:

- **Societal.** Comparisons of health care systems between different countries or regions, concerning the extent and function of primary care, and health status. Indicators of primary care performance might be health indicators and health care costs. The sources of data are most often official statistical data on health, health care utilisation and health care resources.
- **Organisational.** Comparisons are made concerning groups of individuals using either specialist care (organ-related, in or outside hospitals) or primary care as their prime source of care. Primary care performance can be measured by health indicators, health care utilisation/costs or patient outcomes. Sources of data might be statistics on health, health care utilisation/costs, medical records and surveys of patients or physicians.
- **Disease.** Utilisation and costs can be studied using data from claims for reimbursement or data from the general ledger and computerised patient...
records (CPR). Quality of practice can be studied using different methods e.g., medical audit, tracer – condition, register studies etc. (1). Sources of data can be medical records, prospective physician surveys and outcome data from patient surveys or registers on mortality and morbidity.

This structure with the aspects society, organisation and disease has been used in the planning and collection of data.

**The role of primary care in health care systems**

During the 20th century, especially the last 50 years, there has been a substantial escalation of the resources for health care and the increase has by far superseded the growth in total resources. Studying the OECD countries, however, no connection was found between health expenditures per capita and health indicators such as infant mortality, postnatal mortality or life expectancy (2). The perplexing relationships between health care resources and health have caused the international society to put forward suggestions of changes in the health care systems.

Already in 1978 the World Health Organization in the Declaration of Alma Ata (3) stated that primary care was the key to the target “Health for all 2000” i.e., that all peoples of the world by the year 2000 should reach a level of health that permits them to lead a socially and economically productive life. The declaration further defined primary care: “It is the first level of contact of individuals, the family and community with the national health system bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process.” In the Ljubljana charter 1999 (4) the WHO again emphasized that health care systems should be oriented towards primary care in order to ensure that health services at all levels protect and promote health.

In Sweden in the updated Health and Medical Services Act, issued in 1995, the commission for primary care was defined: “Primary care as a part of out-patient care shall, with no restrictions as to illness, age or patient categories, cater to the need of the population for such basic treatment, nursing, preventive work and rehabilitation as do not require the medical and technical resources of hospital or other special competence.” (5)

The goals seen for primary care are hence highly set and comprehensive. To approach these goals, resources, both human and financial, are needed.

There is a dearth of information, about the distribution of resources between primary and hospital care in different countries. Data concerning the
number inhabitants per GP are, however, available for most countries in Europe. The number varied from 2 870 (Sweden) to 588 (Belgium) in 1993. The proportion of GPs who were vocationally trained varied between 99% (Denmark) and 11% (Italy) (6). Thus, between countries, the bases for primary care to attain the goals vary greatly.

The organisation of primary care varies between countries. In Sweden and Finland there are health centres employing many professional categories (physicians, community nurses, physiotherapists, occupational therapists, social workers etc.), and the health authorities run most of the health centres. The most common setting, worldwide, however, is that the general practitioner runs his own business, often working in single-handed practice and most often with a minimum of ancillary staff. Community nurses and midwives are as a rule employed and salaried by the health authorities while physiotherapists are mostly self-employed on a fee-for-service basis. (6)

Primary care physicians in northern Europe are specialists in general practice but in southern Europe most have a short, or no, special education in general practice. In the USA, physicians working in primary care include specialists in general practice, family medicine, general medicine and general paediatrics. These are all considered as generalists. In addition some primary care physicians are organ-related sub-specialists. In Denmark, Great Britain, Ireland, Italy, Spain and The Netherlands primary care physicians act as gatekeepers, thus patients are not normally allowed to see another specialist without having a referral from their primary care physician (2).

It is essential, to attain the highly set goals, that primary care is organised to be efficient. The variation in the organisation of primary care between countries indicates that there is a lack of knowledge concerning the effectiveness of different organisations.

**Primary care in Sweden – a historical view**

In the 17th century, a governmental national organisation of district medical officers was first established. Their number was initially small but gradually increased. At the end of the 19th century there were 250 district medical officers with the task to mediate medical care and monitor the state of health and the sanitary conditions of the population. In the 1950s there was a rapid expansion of hospitals and the influence of the district medical officers declined. In 1963 the County Councils were made accountable for the district medical officers who were renamed as “district GPs”. During the 1970s health centres were created with GPs, district nurses and often also physiotherapists and
occupational therapists. The child and maternity care, which since the 1930s had been carried out in separate organisations, was integrated as part of the health centres. In 1980 there were 2000 positions for GPs but 50% of these were vacant. In the report “Health care facing the 1990s” (7) from the Swedish National board of Health and Welfare, it was stated that, in spite of political rhetorical emphasis on primary care, the expansion of the health care resources had been allocated to hospital care. During the 1980s one thousand new positions for GPs were created compared to 4000 new positions for hospital doctors (8). In the beginning of the year 2003 about 4300 of the vocationally trained physicians were working as GPs in Sweden compared to approximately 12 000 working as consultants in hospitals (9).

Most GPs in Sweden are salaried and working in health centres run by the health authorities. However, in the last 10 years an increasing number of health centres have been privatized. The health centres are remunerated by capitation or by fixed budget systems. There is no official gate-keeping function of the GPs, but in fact, most hospital departments demand referrals for non-emergency matters.

In earlier years, there was no regulation of the qualifications needed for physicians to work as GPs. A GP education including three years work at different hospital clinics was instigated in 1969. In 1981 the speciality of general practice was introduced with requirements of 4.5 years work in different specialities, out of which two years should be general practice (8).

At the end of the 19th century in Sweden there were nurses in towns and the countryside with the task of preventing the spread of contagious diseases. Other nurses were recruited to help the district medical officers with home care of the underprivileged. In 1918 the Community Nurse Reform was introduced with official requirements of training and regulation of the work in home care. In 1935 a new regulation was established with emphasis on preventive care, in particular, concerning children (infants) and pregnant women. In the 1970s the community nurses rapidly increased in numbers and they moved into the health centres. Midwives working with preventive maternity care were in most places also integrated in the health centres. Physiotherapists and occupational therapists became a part of the health centre staff during the 1970s enabling team-work between them and the GPs in the rehabilitation. During the 1990s the importance of psychosocial factors in illness and rehabilitation was acknowledged, and social workers were employed at many health centres (8, 10).
Costs and health care utilisation

The funds for health care may be generated by taxation or by insurance premiums to public or private insurance systems and by user fees. Funding of providers may be done directly or by reimbursing, totally or partially, the patients for their payments to providers. The unit of payment is either the produced service which is charged and paid (fee-for-service), the number of people cared for (capitation system) or the number of hours worked (salary system) (6).

National health services are regulated and distributed by government/local authorities. They apply to the entire population. Public insurance systems involve central coordination and the proportion of excluded citizens is very small. Private insurances may coexist alongside a national health service or public insurance, or may well be the sole alternative. In that case significant numbers of people can be excluded, often those being the worst risk, i.e., the most sick (6). In the European health care systems there is, in contrast to the system in the USA, a universal or near-universal coverage of health insurance (2).

In all industrialised countries, health care costs are escalating in an accelerating way. Especially in the industrialised Western countries, the growth of resources has been substantial. From 1970 to 2001 the total health expenditures per capita (expressed as US$ purchasing power equivalents) in the EU increased 12 times, in the Nordic countries 9 times and in Sweden 7 times (11).

To deal with the increasing costs, health authorities in many countries have changed from a rather passive role of reimbursing costs incurred, to a more active role called strategic purchasing including a change of the remuneration systems for medical care from fee-for-service to prepaid service. The expectations are that by giving the doctors fixed budgets for health services, based on objective criteria, the variation would diminish and health services would be used more appropriately. Active purchasing implies that the distribution of the resources for health care should be done in accordance with the verifiable need for health care. Population needs, however, cannot be measured directly, and thus it is essential to use other available measures as proxies for need, albeit that these often can be difficult to interpret (12).

In countries with national health care systems, such as UK and Sweden, where public authorities are responsible for health care provision in regions and smaller areas, interest has focused on demographic and socioeconomic determinants of health care need. Age, gender and socioeconomic
determinants (most often on an ecological level) have been used to adapt the payments to population need (13).

To compensate GPs in UK areas with greater workload the underprivileged area score (UPA) or Jarman index was developed. In UPA, eight indicators of deprivation (people older than 64 years living alone, children aged under five years, single parents, manual workers, unemployed people, overcrowded apartments, foreign born from non-Western countries and highly mobile people) are weighted according to a national survey of GPs in the UK (14). This index has been adapted to Sweden and named Care Need Index (CNI), initially using the same eight indicators but at the present time seven indicators namely: elderly people (older than 64 years) living alone, children under age five, foreign born from non-Western countries, unemployed, single parent families, moved house during the last year, and low level of education. The weightings are different from the UPA, and the basis for this is the results of a random sample survey to one thousand GPs in Sweden (15).

Small Area Market Statistics (SAMS) refer to the smallest area units in a system of geographical co-ordinates for the whole of Sweden. The system divides the country into 9,667 different SAMS areas. The boundaries are drawn based on similar types of housing in an area. The application of CNI is based on the characteristics of the different SAMS areas concerning the indicators above. The CNI has been found, in ecological studies, to correlate well to psychiatric morbidity, self-reported poor health, cardiovascular risk factors, mortality and obesity (16-19).

Diderichsen et al. have elaborated a model based on individual level data on both actual relative costs of care and socioeconomic data. The model is in use to distribute resources to the nine health authorities in Stockholm county (20).

Costs of care, however, are directly related to health status in a way that demographic measures hardly can predict. At individual patient level, age and gender can predict only 5%-9% of the variation in costs (21).

In countries with a health care system based on individual health insurance, and with no link between providers and a defined local population (e.g., the USA), interest has focused on morbidity measures based on individual patient characteristics, most often diagnoses recorded by the health care providers. Different methods for case-mix or risk adjustment have been created to address predictable differences in the costs of care and to reflect the higher costs for those physicians who care for a higher proportion of iller patients (21).
The Adjusted Clinical Groups (ACG) system is one of the most used of the risk adjustment systems. The ACG system quantifies morbidity by grouping individuals based on the constellation of diagnoses assigned by their health care provider over a defined time period, usually one year. All diagnoses in ICD-9 have, on the basis of their clinical characteristics, been categorised in 32 groups, called Aggregated Diagnostic Groups (ADG). A patient can be assigned to one or several of these groups. The combination of the patient’s ADGs, in some instances supplemented by gender and age group, results in an assignment to one specific ACG, thereby categorising this patient’s expected use of health care resources. Thus a patient may have one or many diagnoses in terms of ICD-codes, but each patient is assigned to only one ACG. The ACG system has been evaluated in the USA (22-24) and also in Canada (21, 25). The ACG performance is dependent on the degree to which diagnoses are registered and captured by the administrative systems, and also on the accuracy of these diagnoses. Another limitation of the ACG morbidity index is that it is systematically related to physician visit rates -- the higher the visit rate, the greater likelihood that conditions which increase the morbidity score will be recorded (21).

Valid methods to measure and predict the burden of morbidity in populations are needed to allocate resources matched to population health need, and to compensate health care organisations for the burden of illness in their patient populations. This is still more important when remunerating health centres or GPs, since, the smaller the population groups: the greater the variation in morbidity between these groups (20).

Computerised patient records

Computerised patient records (CPR) are used by more than 90% of Swedish GPs (26). Compared to paper-based medical records, CPRs can offer faster access to the medical record, which, in addition, could be simultaneously read by several readers. The computer can, adapted to the needs of the reader, organise and present the information in different ways. This enables a more complete and clear picture of the patients’ disease, and holds opportunities to improve care. CPRs can be programmed to generate reminders in predetermined clinical situations (27).

Data from a number of patients may be aggregated and analysed. This enables the clinician to identify subgroups of patients with a certain diagnosis, a certain result of a diagnostic test or a certain medication. The computer
system could generate information enabling investigations of variations in clinical practice and utilisation of medical resources (28-31). In prospective investigations, there is a risk that questionnaires and the study situation *per se* could change the physicians’ practice.

Feedback from CPRs to GPs about their own practice has resulted in favourable change concerning testing of young women with dysuria for Chlamydia, immunisation of risk groups against influenza and the management of diabetes (32). Regular monthly feedback from the CPR on antibiotic prescriptions resulted in a major favourable change that persisted for more than two years after cessation of the feedback (2004, Per Alsén, personal communication). Computer-generated, individualized feedback regarding clinician use of guideline recommendations is an effective way to enhance adherence to guidelines (33). Reuse of information by retrieving data from electronic patient records might be a rational and feasible way to study everyday clinical practice on a large scale.

However, a number of prerequisites have to be fulfilled to enable these potential benefits from the CPR. The information has to be stored in a structured database and the CPR system must contain an, easy-to-use, report generator enabling the clinicians to study their own results. The classification of clinical data has to be proper and uniform i.e., the medical vocabulary has to be controlled. The clinicians have to understand and conform to the medical recording and classification of information used in the computer system (34). This may, however, be difficult to achieve since the criteria for diagnostic labelling used by the different physicians has been shown to be variable (35, 36). Thus, there are grounds to explore quality and feasibility of existing computerised medical record to monitor practice in primary care.

**Respiratory tract infections in primary care**

Bacterial resistance is a growing problem and a subject of international concern (37). The European Union has emphasized the importance of surveillance of both prevalence of resistant bacteria and use of antibiotics (38). Over 400 laboratories participate in EARSS (European Antimicrobial Resistance Surveillance System) and deliver resistance data to the National Institute of Public Health and the Environment in The Netherlands (39). A surveillance system to monitor consumption of antimicrobial agents in EU called ESAC (European Surveillance of Antimicrobial Consumption) has been started (40).
The appearance and spread of bacterial resistance are related to antibiotic consumption by the individual and in the community, as well as to the type of antibiotic consumed (41-44). Treatment for respiratory tract infections (RTIs) constitutes 60%-70% of antibiotic prescriptions in outpatient care in Sweden, and primary care accounts for 90% of these prescriptions (45). Antibiotic treatments of RTIs have, as a rule, only a minor effect on the course of RTIs, because most of them are self-limiting (46). There have been expectations that an increased accuracy in separating bacterial RTIs from viral RTIs would lead to a more appropriate use of antibiotics. Rapid tests have been introduced to detect Group A beta-haemolytic streptococci (GABHS) and to measure C-reactive protein (CRP). Rapid tests for GABHS have been found to be reliable (47, 48) and they may increase the appropriate use of antibiotics (49). The clinical value of the CRP analysis in RTIs is uncertain. Melby et al. (50) and Diederichsen et al. (51) in randomised studies, have found no effects on rates of antibiotic prescribing or patient outcomes, while in cross-sectional studies an association between elevated CRP levels and bacterial infections has been found (52-54).

Intervention strategies are needed to reduce both unsuitable use of tests and inappropriate prescribing of antibiotics. To elaborate these strategies, information about use of rapid tests and prescribing of antibiotics for different indications is essential.

In this thesis the management of respiratory tract infections has been used to study, at disease level, the feasibility of monitoring medical quality by retrieval of data from computerised patient records.
AIMS OF THE STUDY

The general aim of this thesis was to describe and analyse the role of primary care in health care systems in terms of health, health care utilisation and costs, and also to study the feasibility to monitor medical quality, exemplified by the management of respiratory infections, by the retrieval of data from computerised patient records.

Specific aims

Systematically search for and present available evidence of the cost-effectiveness and quality in practice of physicians in primary care with emphasis on general / family practice (I).

Analyse the influence of rates of GP visits on hospitalisation rates, also considering socioeconomic factors as well as the influence of health care structure (II).

To explore, apart from age and gender, the significance of the diagnosis-related ACG morbidity risk adjustment system and the socioeconomic CNI score in estimating individual patients' costs in Swedish primary care (III).

Analyse the yearly number of episodes, encounters, diagnoses and antibiotic treatments related to respiratory tract infections in primary care by using data from computerised patient records (IV).

To analyse management of respiratory tract infections in everyday primary care regarding diagnoses, diagnostic tests and antibiotic treatment, and to evaluate the feasibility of using data from computerised patient records for this objective (V).
MATERIAL AND METHODS

This thesis is based on five papers, using data mainly acquired from a database search of Medline and the Cochrane Library (I) a study of county statistics of health care utilisation (II) a study of utilisation and costs of care at patient level in two health centres (III) a retrieval of data from the computerised patient records of 12 health centres concerning 19 965 encounters for respiratory tract infections (IV and V)

Principal features of the five papers are illustrated in Table 1.

Table 1. Summary of study characteristics

<table>
<thead>
<tr>
<th>Paper</th>
<th>Year of data collection</th>
<th>Study population</th>
<th>Kinds of data</th>
<th>Data sources</th>
<th>Level of assessment</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>1988-2001</td>
<td>Countries, States, Counties, Patients and Health care providers</td>
<td>Scientific articles</td>
<td>Medline, Cochrane</td>
<td>Societal, Organisational Disease</td>
</tr>
<tr>
<td>II</td>
<td>2000</td>
<td>Health centres</td>
<td>Health care utilisation data Demographics</td>
<td>County councils' registers, Data from Statistics Sweden</td>
<td>Organisational</td>
</tr>
<tr>
<td>III</td>
<td>2001</td>
<td>Patients in primary care</td>
<td>Health care costs, Demographics Diagnoses</td>
<td>Computerised patient records, Cost data from general ledgers</td>
<td>Organisational Disease</td>
</tr>
<tr>
<td>IV</td>
<td>2001</td>
<td>Patients with RTI consulting GPs</td>
<td>Encounters, Diagnoses, Prescriptions</td>
<td>Computerised patient records</td>
<td>Disease</td>
</tr>
<tr>
<td>V</td>
<td>2001</td>
<td>Patients with RTI consulting GPs</td>
<td>Diagnoses, Laboratory tests, Prescriptions</td>
<td>Computerised patient records</td>
<td>Disease</td>
</tr>
</tbody>
</table>
Paper I

Medline, using the Ovid search engine, and Cochrane databases were searched for studies comparing primary care with specialist care concerning costs, quality and/or results. The search was restricted to studies in English published in 1988 or later. The search was done strictly by MeSH (Medical Subject Headings) terms, and the terms used in the search were Primary Health Care, Family Practice, Physicians, Family or Specialties, Medical combined with the MeSH terms Health surveys or Health status indicators, Health, Health expenditures, Health care costs or Costs and cost analysis, Fees and charges, Economics and Comparative study, Outcome and process assessment, Quality of health care, Socioeconomic factors, Health resources and Health services. The inclusion criteria, for studies to be included, were comparisons of either of the following:
1. Countries or regions concerning health and primary care supply.
2. Health care utilisation/costs between subjects mainly consulting primary care and subjects mainly consulting specialist care.
3. Quality of care in primary care in relation to specialist care
4. Different ways of organising or reimbursing primary care

All titles produced by the MeSH combinations, and abstracts of all titles that could be of interest were read. If the abstracts indicated that the study would match any of our four criteria, the articles were read (fig 1).

Figure 1. Flow chart of the literature search

Our review was focused on physicians in general practice / family practice working in a community setting. The articles were evaluated for methodological quality, adapted and modified after Sackett (55) and for representativity, concerning our focus of interest. Information concerning this evaluation is given in Table 2. In our reading of the articles, we found a variety of settings. The schedule for rating of representativity was created to categorise this variation.
Table 2. Evaluation of methodological quality and representativity for general practice

A: Design and methodological quality

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Randomised controlled study with adequate description of protocol, material and method.</td>
</tr>
<tr>
<td>Medium</td>
<td>Large consecutive, cross-sectional or database material, with conscientious adjustments for confounders. Systematic review with well-described material, inclusive search criteria and quality analysis.</td>
</tr>
<tr>
<td>Low</td>
<td>Smaller cohort, cross-sectional or database study. Big cohort, cross-sectional or database study without adjustments for confounders. Non-systematic review - material not well described</td>
</tr>
</tbody>
</table>

B. Representativity

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>Medium</td>
<td>Physicians: Family / General Practice, General Medicine, Community based. Patients: Patients representative of part of ordinary general practice.</td>
</tr>
</tbody>
</table>

Paper II

The study objects were 50 health centres in southeast Sweden, 39 centres in the County of Östergötland with three hospital districts and 11 health centres in the district of the Jönköping Hospital, which is a part of the County of Jönköping. The health centres were compared concerning rates of hospitalisations, outpatient visits to hospitals and GP visits during the year 2001. The data used originated from data files sent to the registers of the county councils from the different wards, surgeries and health centres. The
Materials and methods
data used contained information about age and sex of the inhabitants, number of hospitalisations and outpatient visits to hospitals as well as health centres. In addition we used data from Statistics Sweden concerning mean income, percentage living alone of 45-64 year old inhabitants and percentage of foreign-born inhabitants. All data were available entirely as aggregated data on health centre level. We also studied the influence of variations in the number of GPs per 1000 inhabitants, and of the possibility, or not, to consult the GPs without previous agreement by phone.

Paper III

Costs for care in relation to age, sex and medical diagnoses were analysed in two health centres, one rural and one urban, both in southeast Sweden. Costs for patients at the rural health centre were calculated according to the cost per patient method (56). To calculate costs per patient in the urban health centres the following method was used. Data from all patient contacts (i.e., both direct and indirect contacts) during 2001 were extracted from the CPRs, including encrypted identification numbers for each patient, profession of caregiver, and date and type of contact (e.g., face-to-face encounter, telephone, house call and contact through a third party). These contacts were priced, including overhead costs, according to the time and other resources consumed. The yearly cost per patient was subsequently calculated by adding the costs for all contacts of that patient during the year 2001. All costs were calculated in Swedish crowns (SEK) (approximate 2001 exchange rate: 1 Euro = 9.25 SEK).

All patients registered at the urban health centre were, with assistance of Statistics Sweden, assigned by their living place to a specific SAMS neighbourhood. The SAMS codes were then transformed to CNI scores by the method described by Sundquist et al. (57).

The Swedish primary care version of the International Classification of Diseases and Related Health Problems (ICD-10) was used for labelling of health problems (58). All assigned diagnoses during the study period, for each patient, were extracted from the CPRs of both health centres. The patients were categorised into ACGs using Version 6.0 of the ACG instrument, constructed to use the codes from the International Classification of Diseases, Ninth Revision (ICD-9). The classification in use (58) was therefore mapped to ICD-9 codes by use of cross-mapping tables from the WHO. The costs per patient data from the rural health centre then were used to calculate the mean costs for each ACG. In order to obtain more accurate figures, the average cost of both years, 2001 and 2002, was determined. Patients with a cost above mean
plus three standard deviations were excluded in order to prevent a few extremely costly patients producing a “false” high mean cost for some ACGs. Weights were then calculated by dividing the mean cost for each ACG with the total mean. These relative weights of each ACG were then assigned to every single patient in the urban health centre based on their individual ACG assignment.

**Paper IV and Paper V**

Twelve health centres with a total population of 102 050 subjects, in the counties of Östergötland and Kalmar, in southeast Sweden participated in the study. All centres used computerised patient records, and the databases were accessible on line for searches through a statistical module. The Swedish primary care version of the tenth International Classification of Diseases and Related Health Problems was used for labelling of health problems (58). The GPs did classification and coding. Drugs were classified according to the Anatomical Therapeutic Chemical classification system (59). Drugs were automatically coded in the computerised patient records when using the integrated drug-prescribing module.

A retrospective study of all encounters diagnosed as a respiratory tract infection (RTI) was performed during 2001 (January through December). Information from these encounters was retrieved from the computerised patient records concerning data on patient age and gender, date of contact, results of rapid tests for Group A beta-haemolytic streptococci as well as C-reactive protein, diagnostic code, and antibiotic prescriptions. An episode of RTI was defined as all encounters for a patient occurring within 30 days of one another.

In the data retrieval, important facts about the separate encounters may have been concealed. To assess this we examined patient records from two health centres concerning encounters where, in our experience, concealed data could be suspected. We chose pneumonia since the diagnosis implies an antibiotic prescription and since encounters to check on recovery are common. We also studied patient records concerning encounters with C-reactive protein above 60 mg/l and, according to the data-retrieval, no antibiotic prescription.

**Statistics**

The unit of analysis in Paper II was the health centre area. Spearman’s correlation coefficient was used for bivariate correlations. Stepwise multiple
linear regression analysis was used to get adjusted correlations. The four hospital districts were included as dummies. SPSS version 10.0 was used.

In Paper III Spearman’s correlation coefficient was used for bivariate correlations. Stepwise multiple linear regression analysis was used to obtain adjusted correlations between the dependent variable (cost per patient) and the independent variables (age, gender, ACG weight and CNI score). Variance component estimation was made to assess the proportion of variance attributed to the CNI score. SPSS version 11.5 was used.

Pearson’s test were used for bivariate correlations in Paper IV. A direct age standardisation was done following the age distribution for the total population of all 12 health centres. SPSS version 11.5 was used.

In Paper V we used unpaired T-test or, when appropriate, Fisher’s exact test to test the distribution of cross-classified nominal variables. Stat View 5.0.1. was used.

Generally in the thesis a p-value < 0.05 was considered to be statistically significant.

**Ethical aspects**

The studies on utilisation and costs in primary care and management of respiratory tract infections were not sent for approval to an ethical committee since they were judged to be, and used as, quality improvement projects. The management boards of every health centre, of the twelve participating in the studies for paper IV and V, were asked for, and approved, participation.

In paper II no individual patient data were used. In paper III-V we used encrypted patient identification numbers to be able to aggregate data per patient or episode of respiratory tract infection. To assess the completeness and accuracy of data in CPRs a study of patient records was performed in paper IV and V. The encrypted patient identification numbers were sent to GPs working at the two health centres. These GPs could, inside the CPR system at their health centre, decode the identification numbers and hence perform the examination of the patient’s record. Apart from the GPs’ study of their patient records, the encrypted identification numbers were not decoded.

In the database used in paper IV and V the health centres were identified but not the GPs. The participating health centres have been informed of their own results compared to total, besides that, individual health centre results have not been shown.
RESULTS

Paper I

The database search yielded 7223 titles, about 1200 abstracts and about 150 articles were read. Most articles were excluded, because they did not contain comparisons of primary care or specialist care, or of different ways of organising or reimbursing primary care. Finally 45 publications fulfilled our criteria and were included. The result of our evaluation of methodological quality and representativity for general practice is shown in Table 3.

Table 3. Results of the evaluation of the articles.

<table>
<thead>
<tr>
<th>Representativity</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>1</td>
</tr>
<tr>
<td>Medium</td>
<td>1</td>
</tr>
<tr>
<td>Low</td>
<td>3</td>
</tr>
</tbody>
</table>

The majority of the articles were ranked medium for both quality and representativity and only one was ranked as high in both dimensions. Research areas, studies included, study designs and the ratings of quality and representativity are illustrated in table 4.

Some of the main findings in the studies can be summarised as follows. Greater numbers of primary care physicians per inhabitant or a higher ratio of primary care physicians to total physicians were significantly associated with lower mortality rates, lower rate of low birth weight and an increased life expectancy in comparisons of the 51 states in the USA (60-63). A close association was found between the ranking of primary care, and the overall ranking of twelve public health indicators in 10 OECD countries (64).

Higher proportions of primary care physicians were associated with lower payments for both in-hospital and out-of-hospital care (66, 67). Subjects with a primary care physician, rather than another specialist, as their personal physician, had 33 % lower annual health care expenditures (68) and 50% less emergency room visits (69). Ambulatory episodes of care that began with a visit to the primary care physician caused, after adjusting for case-mix 53% lower overall expenditures than those starting elsewhere (70).
### Table 4. Research areas, included studies (numbers allude to list of references), study designs and ratings of method and representativity.

<table>
<thead>
<tr>
<th>Research area</th>
<th>Studies</th>
<th>Design</th>
<th>Method</th>
<th>Representativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary care and its impact on health</td>
<td>(60-65)</td>
<td>5 cross-sectional, 1 case control</td>
<td>5 medium</td>
<td>5 medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 case control</td>
<td>1 low</td>
<td>1 low</td>
</tr>
<tr>
<td>Primary care and costs in the health care systems</td>
<td>(66-72)</td>
<td>3 cross-sectional, 2 cohort, 1 prospective non-randomised, 1 review</td>
<td>7 medium</td>
<td>2 high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 medium</td>
</tr>
<tr>
<td>Reimbursement systems</td>
<td>(73-78)</td>
<td>3 cross-sectional, 2 cohort, 1 retrospective review of medical records</td>
<td>4 medium</td>
<td>3 high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 low</td>
<td>3 medium</td>
</tr>
<tr>
<td>Effects of gatekeeper systems</td>
<td>(2, 79-81)</td>
<td>1 cross-sectional, 1 cross-sectional over time, 2 randomised controlled trials, 1 review</td>
<td>2 high</td>
<td>3 medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 medium</td>
<td>1 low</td>
</tr>
<tr>
<td>Effects of continuity of care</td>
<td>(82-87)</td>
<td>3 cross-sectional, 2 cohort, 1 review</td>
<td>5 medium</td>
<td>2 high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 low</td>
<td>4 medium</td>
</tr>
<tr>
<td>Effects of medical specialities in primary care</td>
<td>(88-93)</td>
<td>3 cross-sectional, 1 cohort, 2 randomised controlled trials</td>
<td>2 high</td>
<td>1 high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 medium</td>
<td>3 medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 low</td>
<td>2 low</td>
</tr>
<tr>
<td>Quality of care in primary and specialist care</td>
<td>(94-103)</td>
<td>1 cross-sectional 15-year retrospective case-note review, 1 prospective intervention study 3 randomised controlled trials, 1 meta-analysis 3 reviews</td>
<td>1 high</td>
<td>2 high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 medium</td>
<td>6 medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 low</td>
<td>2 low</td>
</tr>
</tbody>
</table>
Solo practices had higher hospitalisation rates (77) and lower scores for quality in three out of seven conditions studied while community health centres had the best scores for five out of the seven conditions (73).

Personal continuity increased patient satisfaction and adherence to therapeutic regimens and recognition of psycho-social problems (82, 85), furthermore continuity reduced emergency department visits (87), hospital admissions (84, 86), saved time and tests in primary care (83). The free choice of doctor facilitated the longitudinal patient-doctor relationship (78). Accessibility was central both to prevent hospitalisations (104) and to achieve continuity (91).

Higher numbers of family/general practitioners in primary care per 1000 inhabitants were associated with lower numbers of avoidable hospitalisation, while no such association was found for the numbers of general internists or specialist in primary care (88). Generalists, compared to specialists as primary care physicians, had less access barriers and provided more first contact care (91). Family/general practice physicians in hospital outpatient or emergency departments were associated with lower costs and fewer hospitalisations (89, 90, 98, 100).

For hypertension, diabetes, low back pain and non-urgent emergency department episodes GP care could be of equivalent quality and cheaper (71, 73, 94-96, 98, 100).

Gatekeeper systems tended to reduce costs (2, 79-81). In fee-for-service practices, physicians tended to be more flexible and to order more tests, consultations, elective procedures and their patients had higher rates of hospitalisations compared to those financed by capitation (74, 77). Capitation was associated with fewer solo practices (2), and contained incentives to defer care beyond the prepayment interval and to hesitate before undertaking the care of complex or chronically ill patients (105).

**Paper II**

The yearly numbers per 1000 inhabitants of GP visits varied between 749 and 1517, hospital outpatient visits from 687 to 1232 and hospitalisations from 125 to 194 among the 50 health centres in this study.

Positive bivariate correlations were observed between hospitalisation rates and hospital outpatient visits as well as between hospitalisation rates and percentage of inhabitants foreign-born. Negative correlations were found between hospitalisation rates and distance to hospital as well as to the rate of GP visits. We found no correlations between hospitalisations and the number
of GPs per 1000 inhabitants or of the possibility, or not, to consult the GPs without previous agreement by phone.

A stepwise multiple linear regression analysis with hospitalisations as the dependent variable resulted in a model, with an adjusted \( R^2 = 0.85 \). (Table 5, Model 1). The following significant factors were identified: age, percentage of inhabitants foreign-born, hospital outpatient visits and hospital district.

Table 5. Multiple linear stepwise regression analysis with rates of hospitalisation as dependent variable.

<p>| Model 1 Adjusted ( R^2 = 0.85 ) | ( \beta )-coefficient | 95% CI of ( \beta )-coefficient | P-value |</p>
<table>
<thead>
<tr>
<th>Independent variables</th>
<th>( \beta )</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.72</td>
<td>1.89</td>
<td>3.54</td>
</tr>
<tr>
<td>Hospital outpatient visits</td>
<td>0.08</td>
<td>0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>Foreign-born</td>
<td>0.71</td>
<td>0.15</td>
<td>1.26</td>
</tr>
<tr>
<td>Hospital district</td>
<td>18.06</td>
<td>10.10</td>
<td>26.00</td>
</tr>
</tbody>
</table>

<p>| Model 2(^1) Adjusted ( R^2 = 0.80 ) | ( \beta )-coefficient | 95% CI of ( \beta )-coefficient | P-value |</p>
<table>
<thead>
<tr>
<th>Independent variables</th>
<th>( \beta )</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>4.183</td>
<td>3.46</td>
<td>4.90</td>
</tr>
<tr>
<td>GP visits</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.01</td>
</tr>
<tr>
<td>Foreign-born</td>
<td>1.31</td>
<td>0.75</td>
<td>1.87</td>
</tr>
<tr>
<td>Hospital district</td>
<td>15.09</td>
<td>5.86</td>
<td>24.31</td>
</tr>
</tbody>
</table>

\(^1\)Hospital outpatient visits excluded in the statistical analysis.

In this model the rates of GP visits did not fall out. However, primary care visits and hospital outpatient visits were seen to partially replace each other, thus including the rates of hospital outpatient visits in the model might conceal the effects of GP visits. For this reason an additional stepwise regression analysis, where hospital outpatient visits were excluded, was performed and resulted in a model with an adjusted \( R^2 = 0.80 \) and a significant negative association between GP visits and hospitalisations (Table 5, Model 2).

**Paper III**

The mean of cost per patient for the year 2001 in the rural health centre was 3331 SEK and in the urban 2650 SEK. The relations between the mean costs in the different age groups were similar in the two health centres with the most costly group, 85-89 years, being five times as expensive as the least costly
Results

group, 7-14 years. The mean cost for women in Ryd was 3027 SEK compared to 2239 SEK for men.

The distribution between ACG groups in the two health centres was similar with a correlation of 0.98. The mean cost of the most expensive ACG in the urban health centre was 45 times greater than the mean cost of the cheapest ACG. The variation in costs per patient was large also within age groups and ACGs (Table 6).

Table 6. The most frequent ACGs, distribution of patients, mean and range for cost per patient (SEK) in the urban health centre

<table>
<thead>
<tr>
<th>ACG</th>
<th>ACG Description</th>
<th>N</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>Acute minor age 6+</td>
<td>646</td>
<td>1 048</td>
<td>90 – 15 755</td>
</tr>
<tr>
<td>4100</td>
<td>2-3 other ADG comb age &gt;34</td>
<td>555</td>
<td>3 812</td>
<td>153 – 44 693</td>
</tr>
<tr>
<td>500</td>
<td>Likely to recur without allergy</td>
<td>458</td>
<td>1 048</td>
<td>90 – 12 905</td>
</tr>
<tr>
<td>400</td>
<td>Acute Major</td>
<td>356</td>
<td>1 480</td>
<td>50 – 14 773</td>
</tr>
<tr>
<td>900</td>
<td>Chronic medical, stable</td>
<td>307</td>
<td>1 542</td>
<td>90 – 19 271</td>
</tr>
<tr>
<td>2100</td>
<td>Acute minor &amp; Likely to recur</td>
<td>174</td>
<td>2 120</td>
<td>90 – 13 455</td>
</tr>
<tr>
<td>1800</td>
<td>Acute minor &amp; Acute major</td>
<td>160</td>
<td>2 540</td>
<td>530 – 27 116</td>
</tr>
<tr>
<td>2300</td>
<td>Acute minor &amp; Chronic medical stable</td>
<td>115</td>
<td>2 416</td>
<td>106 – 11 332</td>
</tr>
<tr>
<td>2800</td>
<td>Acute Major &amp; Likely to recur</td>
<td>103</td>
<td>2 613</td>
<td>220 – 34 406</td>
</tr>
<tr>
<td>800</td>
<td>Chronic medical, unstable</td>
<td>102</td>
<td>2 630</td>
<td>90 – 16 034</td>
</tr>
<tr>
<td>1600</td>
<td>Preventive / Administrative</td>
<td>98</td>
<td>978</td>
<td>90 – 4 267</td>
</tr>
<tr>
<td>4420</td>
<td>4-5 ADGs, 1 major, age &gt;44</td>
<td>93</td>
<td>6 523</td>
<td>683 – 33 465</td>
</tr>
</tbody>
</table>

The mean CNI score in the urban health centre was 5.4, compared to the mean of the CNI scores for the SAMS areas of Sweden that is zero with a range from 54 (most affluent) to 78 (most deprived) neighbourhood. The CNI distribution was, however, skewed with 85% of the patients in five large clusters: -27 (544 subjects), -21 (174), -7 (1125), 19 (546) and 32 (1066). A stepwise regression analysis with cost per patient as the dependent variable resulted in an adjusted $R^2 = 0.38$ in (Table 7). The combination of age, gender and CNI resulted in an adjusted $R^2 = 0.12$. A model including only age and gender resulted in an adjusted $R^2 = 0.11$, while including only ACG weight resulted in an adjusted $R^2 = 0.37$. 

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Table 7. Multiple linear stepwise regression analysis with cost per patient as dependent variable.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>β-coefficient</th>
<th>95% CI of β-coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>9.9</td>
<td>7.2 - 12.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Gender</td>
<td>230</td>
<td>121 - 338</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACG weight</td>
<td>1974</td>
<td>1880 - 2069</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CNI score</td>
<td>3.4</td>
<td>0.8 - 5.9</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

3558 patients attended the urban health centre both in 2001 and 2002. The correlation of individual cost per patient between the two years was 0.56 (p<0.01). To study the possibilities to predict the costs of the following year regression analyses were performed. Cost per patient 2001 explained 18% of the variation in cost per patient in 2002, compared to age, sex, CNI-score and the ACG weight for 2001 that explained 16% in a multiple regression analysis.

Paper IV

A total of 19,964 encounters concerning respiratory infections were included. Out of the study population of 102,050 individuals, 15,548 (16%) patients had an encounter for a RTI, their mean age was 33 years, and 58% were women. The total number of episodes was 16,964, equivalent to 166/1000 inhabitants/year. Children (0-6.9 years of age) were the most frequent visitors: 480 encounters/1000 children/year. Inhabitants older than 75 years had, on average, 110 visits/1000/year.

Common cold was the most frequent diagnosis (40%), followed by acute tonsillitis (18%), and acute bronchitis (15%). The total number of antibiotic prescriptions was 7961, accounting for 78/1000 inhabitants/year. An antibiotic was prescribed in 47% of the episodes, with a range of 34%-63% between the different health centres. The most frequently used antibiotics were phenoxybenzylpenicillin (penicillin V) (61%), tetracyclines (18%) and macrolides (8%). Antibiotic prescriptions distributed to different diagnoses are illustrated in table 8.
Table 8. Prescriptions for episodes of respiratory tract infections during a one-year period at twelve health centres

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of Prescriptions</th>
<th>Prescriptions per episode</th>
<th>Prescriptions per 1000 inhabitants</th>
<th>PenicillinV % of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute tonsillitis</td>
<td>2 709</td>
<td>0.89</td>
<td>27.1</td>
<td>81.0</td>
</tr>
<tr>
<td>Acute sinusitis</td>
<td>1 432</td>
<td>0.89</td>
<td>14.3</td>
<td>70.8</td>
</tr>
<tr>
<td>Acute bronchitis</td>
<td>1 312</td>
<td>0.53</td>
<td>13.1</td>
<td>28.8</td>
</tr>
<tr>
<td>Common Cold</td>
<td>1 279</td>
<td>0.18</td>
<td>12.8</td>
<td>54.3</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>886</td>
<td>0.67</td>
<td>8.9</td>
<td>43.7</td>
</tr>
<tr>
<td>Acute pharyngitis</td>
<td>275</td>
<td>0.29</td>
<td>2.8</td>
<td>65.5</td>
</tr>
<tr>
<td>Acute laryngitis and tracheitis</td>
<td>33</td>
<td>0.23</td>
<td>0.3</td>
<td>39.4</td>
</tr>
<tr>
<td>Peritonsillar abscess</td>
<td>16</td>
<td>0.29</td>
<td>0.2</td>
<td>75.0</td>
</tr>
<tr>
<td>Influenza</td>
<td>15</td>
<td>0.05</td>
<td>0.2</td>
<td>80.0</td>
</tr>
<tr>
<td>Acute obstructive laryngitis</td>
<td>4</td>
<td>0.05</td>
<td>0.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Total</td>
<td>7961</td>
<td>0.47</td>
<td>79.6</td>
<td>61.4</td>
</tr>
</tbody>
</table>

When comparing the health centres no significant correlation was found between prescription rates per consultation and the number of encounters / 1000 inhabitants / year.

**Paper V**

The encounters studied were the same as in paper IV. A rapid test was performed in 43 % of the encounters. A CRP test was done in 31 %, a StrepA test in 22 %, and both tests in 10 % of the encounters.

In encounters, where a sore throat could be a major symptom we studied the use of the StrepA test. A total of 12 684 encounters diagnosed as acute tonsillitis (n=3524), acute pharyngitis (n=1114) or common cold (n=8046) were analysed. In 4100 (32%) of these encounters a StrepA test was performed and 1110 (27%) showed GABHS. Figure 2 illustrates the relations between StrepA tests diagnoses and prescriptions.
Results

Figure 2. Encounters diagnosed as tonsillitis, acute pharyngitis or common cold. Results of StrepA analyses, diagnoses and proportion of antibiotic prescriptions in percent.

In 433 cases diagnosed as acute tonsillitis and 202 cases diagnosed as acute pharyngitis, both StrepA and CRP had been analysed. The mean CRP value was 37.6 mg/l for the group with a StrepA test showing GABHS and 37.4 mg/l for those with a test not showing GABHS.

An antibiotic prescription was associated with a CRP test in 37% of encounters as compared to 41% of encounters without the test \((p<0.01)\). Antibiotics were prescribed in 21% when the CRP value was below 25 mg/l, in 61% when CRP was 25-50 mg/l, in 83% when CRP was 51-100 mg/l and in 80% of encounters when the CRP value was above 100 mg/l. The proportion of antibiotic prescriptions preceded by CRP tests varied from 16% to 43% between the different health centres. CRP tests were most common (about 40%) in encounters finally diagnosed as common cold, influenza, acute bronchitis or pneumonia. The distribution of encounters on diagnoses and numbers tested for GABHS and C-reactive protein is illustrated in table 9.
Table 9. Distribution of diagnoses, antibiotic prescriptions, tests for GABHS (StrepA) and C-reactive protein (CRP).

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Encounters</th>
<th>Antibiotic prescriptions</th>
<th>StrepA tested</th>
<th>GABHS positive</th>
<th>CRP tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common cold</td>
<td>8046</td>
<td>16</td>
<td>1893</td>
<td>1</td>
<td>3070</td>
</tr>
<tr>
<td>Acute tonsillitis</td>
<td>3524</td>
<td>77</td>
<td>1567</td>
<td>67</td>
<td>520</td>
</tr>
<tr>
<td>Acute pharyngitis</td>
<td>1114</td>
<td>25</td>
<td>640</td>
<td>5</td>
<td>254</td>
</tr>
<tr>
<td>Acute sinusitis</td>
<td>2072</td>
<td>77</td>
<td>49</td>
<td>2</td>
<td>276</td>
</tr>
<tr>
<td>Other diagnosis ¹</td>
<td>358</td>
<td>15</td>
<td>40</td>
<td>8</td>
<td>61</td>
</tr>
<tr>
<td>All upper RTIs</td>
<td>15114</td>
<td>39</td>
<td>4189</td>
<td>27</td>
<td>1481</td>
</tr>
<tr>
<td>Acute bronchitis</td>
<td>3008</td>
<td>43</td>
<td>167</td>
<td>2</td>
<td>1240</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1503</td>
<td>48</td>
<td>40</td>
<td>5</td>
<td>575</td>
</tr>
<tr>
<td>All lower RTIs</td>
<td>4511</td>
<td>45</td>
<td>207</td>
<td>2</td>
<td>1815</td>
</tr>
<tr>
<td>Influenza</td>
<td>340</td>
<td>4</td>
<td>49</td>
<td>0</td>
<td>145</td>
</tr>
<tr>
<td>Total</td>
<td>19965</td>
<td>40</td>
<td>4445</td>
<td>25</td>
<td>6141</td>
</tr>
</tbody>
</table>

¹acute laryngitis and tracheitis, acute obstructive laryngitis (croup) and peritonsillar abscess.

There was, comparing the health centres, independently of the number of encounter per 1000 inhabitants, a significant correlation (0.80, 95% confidence interval 0.42 - 0.94) between percentages of bacterial RTI diagnoses* and percentages of encounters ending in an antibiotic prescription.

*Common cold, Acute pharyngitis, Acute laryngitis and tracheitis, acute obstructive laryngitis, Acute bronchitis and Influenza

Data quality analysis concerning Paper IV and Paper V

The medical recordings from 153 encounters diagnosed as pneumonia on 71 different patients in one health centre were read. All correctly registered data were retrieved accurately. Sixty-six encounters dealt with acute illnesses (10 of which were concerning patients not responding to the previously prescribed antibiotic). In 17 encounters outside of regular hours prescriptions were
registered incorrectly and could not be retrieved. This was also the case for three of the encounters during regular clinic hours. In ten encounters the encounter was wrongly labelled with the diagnosis pneumonia. A few encounters were follow-ups of pneumonia that had been treated outside the health centre.

In two health centres we examined the medical records of 18 encounters with a CRP level above 60 mg/l and, according to the data retrieval, no antibiotic prescription. In one encounter the prescription was not registered properly, seven patients had received an antibiotic prescription some day before or after the retrieved encounter, seven patients had been referred and six of these received their antibiotic at the hospital (one lacked a referral answer), and only three out of the 18 were definitely not prescribed antibiotics.

The routines for medical recording were studied finding that in one health centre only 10%-20% of the StrepA tests were recorded correctly and possible to retrieve. In another health centre we found that, out of a total of 777 StrepA analyses performed in 2001, only 279 (36%) and, out of a total of 1657 CRP analyses, only 352 (21%) were caught in our data retrieval. This was due to the registering of these tests on non-diagnosed contacts with the laboratory or the nurses. Both health centres were therefore excluded in the comparisons between health centre concerning StrepA, and the second was also removed from the comparisons concerning CRP.
GENERAL DISCUSSION

The general results of this thesis are as follows. A relative expansion of the primary care component of the overall health care system may result in better health as measured by public health indicators, a lower consumption of hospital care and lower total expenses for care (I). Hospitalisations were closely, and positively, associated with hospital outpatient visits, while GP visits were weakly negatively correlated to hospitalisations. The hospitalisation rates varied considerably between different hospitals (II). Between patients the variation in costs for primary care was immense. Age and gender could explain a small part of this variation, while a diagnosis-related case-mix adjustment system could explain a substantial part (III). Patients with respiratory tract infections were frequently prescribed antibiotics by GPs in southeast Sweden, albeit, or possibly because of, an excessive use of rapid tests for C-reactive protein and Group A beta-haemolytic streptococci. Computerised medical records could be used effectively for audit, feedback and surveillance of adherence to practice guidelines (IV, V).

Methodological considerations

Paper I

A preliminary literature search revealed that some articles seemed to be contributions to the controversy between specialist and generalists. In view of this we designed the literature search to be as unbiased as possible and avoided using references of the included articles. We also found that articles about similar topics were differently labelled by medical subject headings (MeSH). We therefore used the following procedure to make it possible to find all articles of interest. The search was widened by using MeSH terms as close as possible to the origin of the branches in the MeSH tree, and employed an expanded search mode. The negative aspects of this method were that it resulted in a great manual workload reading thousands of titles and hundreds of abstracts with risk of ignoring relevant articles. In order to reduce the numbers of titles somewhat, we set an arbitrary limit in time back to 1988. This time limit can be criticised and, to estimate the loss of information, an identical search has been made including the years 1966-1987. In this search 1685 new
titles were found and out of these 14 were of interest. Abstracts were available for 10 of these and the findings of these studies seemed to be in line with our earlier conclusions. The restriction to the Medline and Cochrane databases can also be questioned. Hence, a search was made in other databases. We searched Econlit and using the Cambridge scientific abstract service also the Social service abstracts databases, Sociological abstracts and Sociology without finding any references satisfying our criteria. The search of DARE yielded two reviews with results in line with our earlier findings. These findings indicate that our time limits and choice of databases did not jeopardize our conclusions.

In spite of the wide search procedure, surprisingly, few articles were found. This might be due to incompleteness of our method or that the number of published papers concerning organisational research is limited. Our experience that articles about similar topics were very differently labelled in MeSH terms, also stresses the importance of a correct MeSH labelling of articles.

Most of the comparisons between generalist care and specialist care merely studied patterns of health care utilisation/costs and did not consider patient outcomes. There were studies comparing medical quality as well as medical procedures (73, 95) and also studies comparing outcome data such as functional outcomes (71), complications of diabetes, mortality (96), complications of diabetes total mortality, stroke mortality and functional outcomes (94), satisfaction scores and readmissions (98-101). However, there is a great need for broadly based studies, comparing primary care with specialist care, considering both costs and patient-related outcome data.

The level of evidence of the studies included was not high. However, there are reasons why non-randomised and uncontrolled studies merit consideration. In studies on a societal level comparing countries or states there are many confounding factors that are hard to control. These studies may, indeed, yield most valuable information. Randomized studies may be less suitable in comparison of health care organisations. Patients randomised to either specialists or general practitioners would be unlikely to benefit from the long-term doctor-patient relationship. Physicians may hesitate to participate in studies of remuneration systems where their income would be randomly determined. Still these issues require to be studied.

There is limited evidence concerning quality and efficacy of primary care compared to specialist care emanating from Europe and Sweden. Several important differences exist between the health care systems in the USA and
Canada compared to Europe and Sweden and this may limit the validity of the American studies for the European health care systems.

Paper II

The register data used in our study originated from registrations at hospitals and health centres. Hospitalisations were adequately and similarly registered at the four hospitals studied. Outpatient visits to physicians were registered at the cashier’s office, thereby giving reliable data even though the definition of outpatient visits to hospitals could vary and may include day-care, outpatient surgery or delegated nurse-based visits. About 15% of the outpatient visits in the study area were made to private physicians, and those visits were not registered in such a way that they could be included in the study. To estimate the influence of visits to private physicians a special study was made. During three months in 2001 all visits to private physicians were assigned to the different health centre areas in the Jönköping hospital district. Comparing the different health centre areas, the visits to private physicians were distributed similarly as the hospital outpatient visits. Hence the relative ratios, GP visits to other outpatient visits, between the areas of the different health centres did not change if visits to private physicians had been included. In all we judge the register data used in our study as fairly reliable.

Our prime interest was to study the effects of GP visit rates on the rates of acute hospitalisations, which we considered could be avoidable by primary care measures. Planned hospitalisations were less expected to be reduced by efforts of primary care. Unfortunately the registration of the hospitalisations as acute or planned was totally inconsistent and thus we studied the total hospitalisation rates.

Since our data were aggregated on health centre area level the study was an ecological cross sectional study. This fact is in part an explanation for the high R² values in the multiple regressions. It is important to remember that our aggregated results do not necessary mean that the associations hold at the individual level. The results are, nevertheless, of interest since this kind of study has not been performed in Sweden before.

Paper III

Registration of patient contacts in the computerised patient record was a prerequisite, for the care giver, to be able to record medical information. We therefore consider that the drop off rate was very low, and that the contact-
based analysis of individual patients’ primary care utilisation was sufficiently
detailed to provide a reliable distribution of costs between patients. However,
the cost calculations for different kinds of patient encounters involved some
assumptions. We were unable to allocate the costs of diagnostic procedures,
such as laboratory tests and x-ray examinations, to the individual patient.
These costs, about 10% of the total, were therefore allocated, as a fixed sum,
uniformly to all physician consultations.

In creating the ACG weights, the population of the rural health centre
was too small to create valid weights. This was mitigated, to some extent, by
aggregating data from two different years. There remained, however, some
ACGs with only a few patients, making these weights uncertain. Constructing
weights for a larger population might have resulted in greater explanatory
power. However, weights provided by the ACG software (106), based on a
reference population of 2 000 000 subjects < 65 years in the USA, gave a R² as
low as 0.17 in our population. Hence, data from a Swedish health centre was
found to yield more valid relative weights for a Swedish primary care setting
than existing statistically well-founded data from the USA.

The accuracy of the diagnostic data in this study (i.e. the correctness and
the completeness) can be discussed because of known variations in the
diagnostic habits of GPs (35, 36). The fact that ACG grouping is not based on
the number of encounters with a specific diagnosis, but on the appearance of a
diagnosis, once or on several occasions during a whole year, should make the
ACG grouping less sensitive to variations in the completeness of diagnosis
recording. The effects of physician preference are further reduced since the
ACG system categorises over 14 000 ICD9 diagnostic codes in only 32 types of
morbidity.

The computerised patient record systems in the rural and urban health
centre differed in several ways. In the rural health centre the medical record
was conventionally organised. The system in use in the urban health centre
was problem-oriented, and did not allow the recording of clinical data without
an obligatory diagnosis code for each problem dealt with during the
consultation. In our study, the mean ACG weight in the urban health centre
was 1.07 compared to the rural where it was 1.0 by definition, as the rural
health centre was the reference for construction of the weights. After adjusting
for differences in age between the two populations a mean ACG weight of 1.20
was obtained for the urban health centre, indicating a higher rate of morbidity,
which was in contrast to the 20% lower mean cost per patient. The ACG
weighting thus seems sensitive to the thoroughness with which physicians
enter diagnoses into the computerised patient records.
The distribution of CNI scores was skewed due to the method of assigning area scores to individual subjects, augmented by the small number of individuals from one health centre area. Only five different SAMS contained 85% of the patients of the urban health centre. Variance component estimation, between CNI levels, showed that only 0.5% of the variance of costs was CNI related indicating that CNI was not appropriate to use at health centre level. Individual socioeconomic data would have been needed to better predict individual patients’ costs but were not available.

Paper IV and V

The recruiting of health centres to the study was made as an offer to participate in an audit project, based on computerised patient records, with options to compare practice with other health centres. All health centres who wished to participate were included. This could mean that the participating health centres were more interested in quality of practice than others. In spite of this we consider the participating health centres fairly representative for the area.

The retrieval of data from the electronic patient records was based purely on finding encounters by diagnostic codes of the specified RTI diagnoses, included in chapter ten of the Swedish primary health care version of the International Classification of Diseases and Related Health Problems (ICD-10) (58). The criteria for diagnostic labelling used by the different physicians, however, have been shown to be unknown and variable (35, 36). Effects of this are somewhat compensated for, since most of our presented results are calculated on chapter level or for aggregate diagnoses. Our findings regarding antibiotic treatment can be considered fairly valid due to automatic coding of prescriptions in the current computerised patient record systems.

The examination of medical records, regarding encounters with pneumonia and encounters with a C-reactive protein value above 60 mg/l and, according to the retrieval, no antibiotic prescription, revealed that essential information about management of patients could occasionally not be found in the electronic data retrieval. Antibiotic prescribing had occurred and been registered on non-diagnosed types of encounters. We also found that results of some tests were coded incorrectly, hence not possible to retrieve. Many tests were registered on separate encounter notes not assigned any diagnosis. Another important limitation was that this retrieval could not catch information recorded in plain text such as patient history and clinical signs. Hence, we could not evaluate the basis of the GPs’ decisions and we did not
know if an individual test was motivated or not. We assumed though, that by collecting a large number of visits, effects of the exceptions would diminish and that customary procedures would dominate.

The organisation of care and the routines for medical recording varied between the health centres. This had apparent effects on the organisation of data in the computerised records, and thus on the accuracy of the retrieved data.

**The role of primary care in health care systems**

Primary care has been considered to be a very important part of health care systems by both international (3, 4) and national authorities (5, 7). Primary care is expected to be the first level of contact with the national health system, and to be the first element of a continuing health care process. Primary care is expected to bring about a health service that protects and promotes health.

Our review showed that expanding the primary care part of the health care system improved health in populations (I). Primary care has also been shown to reduce some of the adverse effects of lack of equity (63, 107, 108). Effects that are coherent with the postulated benefits of primary care (3-5, 7).

In paper II, we found that rates of GP visits correlated negatively to hospitalisation rates. This is in line with paper I, where we found that increased availability of GPs reduces costs and hospital care consumption (66, 67). Subjects with personal primary care physicians had lower rates of emergency room visits, were less hospitalised (69), and their costs of care were considerably lower (68, 70). Studies emanating from Sweden (109, 110) and UK (111) have shown reduced consumption of hospital care with increasing accessibility to primary care.

The personal long-term patient-doctor relationship has been found to be one of the core elements of primary care effectiveness and quality.

In paper I we found that personal continuity increased patient satisfaction, reduced emergency department visits and hospital admissions, saved time and tests in primary care and increased the recognition of important psychosocial problems (70, 82-86, 112, 113). Sustained physician-patient partnerships with bonds of trust and knowledge of patients entailed improved adherence, satisfaction and health status (114). The long-term patient-doctor relationship has been found to be facilitated by free choice of doctor (78, 115).
Accessibility, especially concerning the underprivileged, has been found to be essential to prevent avoidable hospitalisations (104, 116, 117) and to achieve continuity (91).

The competence of a generalist is crucial to achieve both continuity and comprehensiveness. Primary care physicians, compared to other physicians, deal with a broader range of problems, both with individuals and over their practice population. In paper I we found that generalists used less diagnostic and therapeutic modalities and their patients had lower rates of hospitalisation (88, 90, 102, 103). In paper II we found a close association between hospital outpatient visits and hospitalisations. One reason for lower rates of avoidable hospitalisations is that, unlike specialists, general practitioners are trained to interpret poorly specified and vague complaints of patients in populations with a low probability of being ill with serious or rare conditions (115). The predictive value of laboratory tests in these patients is low and tests should be used with caution (118). The importance of this is illustrated in paper V. Generalists, who consider this, may protect their patients from inappropriate overuse of medical care with its added risks (103). The risk of adverse events during an episode of hospitalisation has been estimated to be 5%-10% (119) and each additional day in hospital increased risk by 6% (120). The risk for adverse events was markedly higher among the elderly (121).

Patient centring should be one of the principal elements of primary care consultations and has been shown to enhance medical quality (122, 123). GPs with an integrated patient- and goal-oriented approach performed many necessary but few superfluous diagnostic activities (124). Patient centeredness in diabetes care was found to increase patient satisfaction and well-being. However, the patients’ knowledge scores turned out to be lower and weight, along with other cardiovascular risk factors, higher (125). “The intellectual framework within which general practitioners operate is different from, and complementary to, but no less demanding than that of specialists. General practitioners must achieve a working diagnostic and therapeutic knowledge across the reach of biomedical science and must be able to forge effective and continuing relationships with an enormous range of individual patients. They need to understand the processes, by which illness is socially constructed, within the patient’s life, and they must mediate between the patient’s subjective experience of illness and the scientific explanation” (Heath et al. (126)).

Comparing different countries, there are great variations in the proportion of total physicians that work as primary care generalists (6).
Available evidence supports an enlargement of this proportion but evidence is lacking concerning the optimal proportion of primary care in health care systems. In western countries, with greater total resources and a large quantity of age related morbidity, a larger part of hospital care might be appropriate. Yet, elderly patients, who often have combinations of diseases, also could benefit from general practice. A larger fraction of primary care would be appropriate in countries dominated by contagious and poverty related diseases.

Evidence is also lacking on how much countries should spend totally on health care. In a study of the OECD countries, no connection was found between health expenditures per capita and health indicators such as infant mortality, postnatal mortality or life expectancy (2). In comparisons between very poor countries and very rich countries health expenditures per capita correlate with health. However in these comparisons the country’s overall wealth stands out as one major determinant of health (127). Comparing rich countries such as the OECD countries the correlation between life expectancy and mean income was as low as 0.08 (128). The equity in the distribution of wealth has a greater impact on health (128-130). This impact has been found to be more important than variations in the supply of primary care (62), which, however, as earlier mentioned, could somewhat reduce the undesirable effects of lack of equity (63, 107, 108).

**Health care need and health care utilisation**

Health care utilisation and health care need are two different entities. Health care need as defined by patients is different from that defined by health care professionals and health authorities/insurances. The way these different views are weighted together has a crucial effect on the patterns of utilisation.

To attain a health care system that is equal in accessibility and quality of care health care, resources should be distributed according to the need of patients and populations. Since there are no direct measures of health care need, indicators of need such as age, gender, socioeconomic measures e.g., income, level of education, marital status and ethnicity have been used to assess need for populations (131). Health care need is, however, closely linked to morbidity. In the study of primary care costs (III) we found a huge variation in the primary care costs of individual patients, and morbidity and in particular co-morbidity was associated with high costs for care.

The utilisation of health care is often used as a (gold) standard in evaluations of indicators of need. However, health care utilisation is not only
dependent on need, but accessibility both geographically and economically also has a great influence (131, 132). Increased distance from patients’ home to hospital has been found to reduce rates of both hospitalisations and hospital outpatient visits, and increased distance from one’s GP also reduces the inclination to consult (133, 134). In paper II distance to hospital correlated negatively with both hospitalisations and hospital outpatient visits, and the hospitalisation rates were much influenced by hospital structure. Secondary care supply factors explained a substantial part of the variation in hospitalisation rates between different areas (135). The amount of hospital care people receive is also influenced by local variations between hospitals in routines and physicians’ criteria for hospitalising patients (132). Increased cost sharing of patients in Sweden since the 1970s has reduced the morbidity-adjusted utilisation of outpatient services for manual workers but not for professionals (136). Hence, when using health care utilisation as standard in finding methods to distribute health care resources these effects must be considered.

Costs

The variation between patients in their primary care costs in paper III was great. The total number of patients was 4458 and the cost for the 100 most expensive patients was 18% of total or equal to that of the 2350 cheapest patients who represented 53% of patients. This variation was mainly dependent on morbidity. Age and gender explained this great variation in individual patient costs to a minor degree (11%), while the addition of the morbidity related ACG weight improved the explanatory ability to 38%. This is in line with earlier findings in other countries and in studies of both primary care costs and total health care costs (21, 24, 137, 138).

Introducing morbidity-related indicators could thus add precision to models for distribution of health care resources. However, it is essential to combine morbidity measures with socioeconomic indicators. The increased morbidity due to deprived socioeconomic conditions (139) would most probably be reflected in diagnosis-related indicators. This is, however, not the case for the increased need for home care due to lack of social support e.g., as a consequence of living alone. In our study (III) the absolute major part of the costs for the most expensive patients was attributable to house calls of nurses, who are more often needed for the elderly living alone. Further research on socioeconomic determinants and individual patients’ costs is needed to better predict costs and allocate resources according to need.
In paper I the total costs of health care were shown to be lower in areas with better availability of primary care physicians (66, 67) and for subjects using GPs as their prime source of care (68-70). Evidence concerning mechanisms for these effects is incomplete, but there is some evidence regarding the influence of gatekeeper systems and systems of funding. Gatekeeper systems have been shown to reduce costs without decreasing the patients’ rating of care (2, 79-81, 140), but the knowledge concerning the effects on patient outcomes is limited. The direction of possible change of outcomes is unclear since gatekeepers might deter patients from getting necessary care but might also shelter patients from unnecessary and potentially dangerous intervention (141).

The way primary care physicians are paid has an impact on both costs in primary care and elsewhere in the health care system. In fee-for-service practices, physicians tended to be more flexible, to order more tests, consultations and elective procedures but their patients’ rates of hospitalisation were higher compared to those of physicians financed by capitation (74, 77, 142, 143). When physicians had ownership of consulting services their rates of utilisation of these ancillary services was higher. Payment by salaries was associated with the lowest use of tests and referrals compared with fee-for-service and capitation. Salary payment was also associated with lower throughput of patients per doctor, longer consultations and more preventive care (144).

Hence, physician practice is strongly influenced by the way it is remunerated. All payment systems have drawbacks that presumably could be counteracted by a cautious use of mixed systems of remuneration.

The conclusion, in a review of payment systems by Goodson et al., was: “In the light of the strong influence on practice of financial incentives, patients should have the right to know how their physician is paid!” (144).

**Quality in primary care**

The goals for primary care are set high and wide-ranging, and so is the scope for evaluation of primary care quality. Important categories of core primary care quality are accessibility, person-focused care over time, comprehensiveness, coordination and medical quality. To achieve a measurement of total quality, their links to health and health care utilisation will have to be measured, as discussed earlier.

In paper I we found that group practices, as a rule, had higher standards of medical quality than single practices (73, 77). Community health centres,
compared to hospital outpatient departments and office based physicians, had
the best scores for medical quality in a retrospective evaluation of medical
records (73).

Evidence supports the significance of the way practice is organised and
funded, concerning both the effects of primary care on costs and utilisation, as
well as concerning the medical quality in practice (I).

In Paper I we found that medical quality of primary care was equivalent
to hospital outpatient care for a number of common conditions (94–96, 98, 100,
101). Evidence concerning comparative quality, however, is lacking for most
aspects of general practice, and there is a great need of further studies.

Methods for quality development in primary care

Quality in primary care can be evaluated by a number of methods such as
surveys of patients, quality indicators, tracer condition techniques, internal
audit, peer review and practice visiting (I).

Patient surveys are suitable to measure different aspects of care, but in
general, they are used to measure satisfaction with care. Patient surveys can
explore such items as accessibility, treatment, information on health problems,
participation, trust and continuity.

Tracer condition studies have been described by Kessner (145) and imply
investigation of the medical records for a random sample of subjects with
some defined conditions. Each random sample is carefully analysed regarding
medical quality. Important prerequisites are high quality medical records and
established criteria for the treatment of the conditions. Diseases to be studied
as tracer conditions should be well defined and of great importance to the
individual. They should have prevalence high enough to allow the collection
of adequate data even in a limited population, and they should have well
established treatment methods. Finally, the natural history must be changed
by the medical interventions. In the analysis, the influence of socioeconomic
factors should be considered (146).

External audit or peer review in the form of practice visiting have, in
Sweden, been used to stimulate quality development and to evaluate health
centres. Practice visiting includes audit using quality indicators covering both
accessibility, organisational and medical quality. This information is
completed by interviews of GPs and nurses, and by a patient survey covering
accessibility and patient satisfaction. The method has been evaluated and
introduced into Sweden by Lindström (1, 147).
Medical audit means that, during short or long periods, the individual physician, most often in co-operation with colleagues, evaluates different aspects of his or her practice, using the information gathered for quality assessment. Audit may with advantage be done using information in the CPRs. (28, 31). Data from CPRs were used in Paper IV and V to study the management of respiratory tract infections.

Computerised patient records

Data from computerised patient records were, in paper IV and V shown to be feasible for large-scale data retrieval in order to study practice and variations in practice. Data from CPRs can also be used to identify subgroups of patients who will benefit from specific interventions (29, 31). Data retrieval from CPRs enables the collection of many observations and to study everyday clinical practice without expensive and complex study designs and without the physician’s behaviour being affected by the study situation. Using data from CPRs may be a pragmatic method to study adherence to guidelines in daily practice. Data from CPRs can also be used for feed-back to GPs on their patterns of practice which has been shown, especially in combination with educational activities, to promote favourable changes in practice (28, 31, 33, 148-150).

Procedures to implement research findings and guidelines into practice have to overcome human reluctance to change. Computer-generated feedback may be a valuable tool in this process. Passive dissemination of information and guidelines is generally ineffective, while the combination of feedback and local educational activities is the most effective way to change practice (151).

Our studies illustrate some of the difficulties with retrieving data from CPRs. Although all correctly registered data were retrieved accurately, there were considerable data quality problems, such as incorrect coding of data. In our studies we could not estimate the frequency of this. In a study of 400 records of 20 randomly selected GPs the proportion of correct codes was estimated at 97% (152), while in a review of 20 studies of accuracy in CRPs highly variable levels of accuracy were found (153).

In addition, our studies showed that the organisation of work at health centres had an impact on the structure of medical recording, and could cause splitting of the documentation for one encounter to several encounter notes. Overleaf some of the limitations and advantages of CPR data retrieval are listed (table 11).
Table 11. Limitations and advantages of studying practice by data-retrieval

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>No selection bias</td>
<td>Physicians assign different diagnoses for the same set of symptoms</td>
</tr>
<tr>
<td>No study situation to influence the physicians' way to practice</td>
<td>Data may be lost due to incorrect coding</td>
</tr>
<tr>
<td>Access to large number of observations</td>
<td>Medical procedures may have been registered in non retrieved encounter notes</td>
</tr>
<tr>
<td>Easy to link to quality improvement</td>
<td>Data has to be uniformly registered - strings of text are less suitable</td>
</tr>
<tr>
<td>Easy to repeat for comparisons over time</td>
<td>Difficult to differentiate between first and subsequent visits</td>
</tr>
</tbody>
</table>

Actions are needed to increase the usefulness of the large quantity of data in our CPRs. Standardisation of record systems and controlled vocabularies is one step but this has to be combined with measures to attain correct and complete registration of data. Feedback to physicians from CPRs could improve their willingness to register data in line with the recommended structure (154).

Structured forms in CPRs have been shown to increase the completeness of both diagnostic and preventive activities (155-157), and should be introduced broadly in primary care. Evaluation of practice by data retrieval should gain accuracy if data in the CPRs could be organised in relation to the episodes of care.

An important prerequisite to be able to use data from CPRs is completeness and correctness of diagnoses. In paper III we found that the completeness in registering of diagnoses was enhanced by using a problem-oriented medical record (158) which also has been found in other studies (26). Hence, we propose the introduction of CPR systems that enforce problem-oriented medical records. Improvement of coding routines and coding tools is essential as well as education and training in classification and coding (152). Criteria for diagnostic labelling used by different physicians have been shown to be opaque and variable (35, 36). Actions directed to reduce this variation are necessary, in particular concerning the most common chronic diseases that make up a great part of the work of GPs. Diagnostic criteria for these relatively few diagnoses should be possible to integrate into the CPRs.
Management of respiratory tract infections

Respiratory tract infections were found to be a common reason to consult in primary care, especially for pre-school children in Paper IV. There was a great variation between health centres in rates of visits for RTIs, percentages of patients tested for CRP or StrepA, frequencies of diagnoses and percentage of visits ending in a prescription and, finally, also in choice of antibiotic. When comparing the health centres in Paper V a significant association was found between the frequencies of StrepA test and CRP tests, indicating that the variation in frequency of testing among GPs was more general for testing per se, than specific for any of the different diagnostic tests. Further a positive correlation was found between the percentage of patients tested and the percentage of patients prescribed antibiotic, which is in line with earlier findings (124). The great variation in management between the health centres in our study cannot easily be explained by differences in morbidity. The most plausible explanation is variations in GPs’ ways of practising, variations that in earlier ecological studies, have also been shown to be great (159, 160). However, in a study of test ordering and prescriptions by GPs using multilevel analysis only 10% of all variability could be attributed to the doctor level while the remainder was due to case-mix and patient factors (161).

In paper V we found an excessive use of rapid tests in encounters for RTIs. The findings indicate that StrepA and CRP tests were used inappropriately and often with minor contributions to the management. Only 27% of the StrepA tests were positive while in adequately selected patients this would have approached 50% (162). In our study, 49% of StrepA tests were performed in patients who received diagnoses such as common cold, sinusitis, acute bronchitis, pneumonia or influenza. These diagnoses all included additional symptoms (coryza, facial pain or cough) not to be expected in an illness caused by GABHS. Consequently, very few StrepA tests showed GABHS, indicating that the tests were performed on patients with a very low probability of GABHS. Most of these StrepA tests were probably not performed on a population where the test could be valuable to select patients eligible for antibiotic treatment.

A sore throat is a common symptom in most RTIs and many patients do not benefit from antibiotic treatment. Only those who would benefit should be tested for GABHS and finding them is best done by using the Centor criteria (163). The Centor criteria (tonsillar exudates, swollen tender anterior cervical nodes, history of fever, and lack of cough) (164) are considered the most reliable, and the use of them could decrease inappropriate antibiotic use (162). In studies of sore throat, where inclusion criteria were three or more Centor
criteria, antimicrobial treatment reduced the duration of illness by 1 to 2.5 days, if the etiological agent was GABHS (165, 166). If, however, the only inclusion criterion was a sore throat, antimicrobial treatment reduced the duration of illness by less than 24 hours, even when a culture showed GABHS (167). However, 51% of the antibiotic prescriptions for tonsillitis were not preceded by a StrepA test and 13% were preceded by a negative test. Those prescriptions can be discussed, since studies have shown that if culture did not show GABHS, antibiotic treatment did not reduce the duration of illness (165).

The majority (70%) of CRP tests were performed in conditions finally diagnosed as upper respiratory infections where the diagnostic value of CRP is unclear and under debate (47, 168-173). These tests were presumably done to rule out conditions where antibiotic treatment could be of value, however, in upper RTIs when CRP values were as low as 20-50 mg/l antibiotic prescriptions were issued in 51% of encounters.

In lower RTI in adults or adolescents, current evidence shows that a CRP > 100 mg/l strongly indicates an acute pneumonia (174) and that if CRP is less than 50 mg/l a bacterial pneumonia can be excluded with 95% likelihood (175). In paper V, patients with lower RTI and a CRP value in the 20-50 mg/l range were prescribed an antibiotic in 68% of cases. This indicates that the CRP value had minor influence on the management of these patients. 1458 CRP analyses were performed in children under 15 years although there is evidence that CRP tests could not differentiate between viral and bacterial lower RTIs in children (176, 177).

The use of antibiotic treatment may influence the choice of diagnosis, as family physicians with high antibiotic prescription rates have been shown to have higher rates for diagnosed bacterial RTIs compared to physicians with low prescribing rates (178, 179). In our study there was, comparing the health centres, a significant correlation between percentages of bacterial RTI diagnoses and percentages of encounters ending in an antibiotic prescription. Still, antibiotics were prescribed in 23% of encounters diagnosed as viral infections such as common cold, acute pharyngitis, acute laryngitis, acute bronchitis and influenza. The most frequently used antibiotic was phenoxymethylpenicillin used in 61% of prescriptions, which is in line with what is recommended. However, in its entirety, the patterns of management found is far from the practice recommended in current guidelines for acute respiratory tract infections (180). The recommendations for management of sore throat (163) were issued in 2001 and were not put into practice during the study period. The findings in this thesis indicate a need for actions to implement these guidelines in order to achieve a better quality of care.
Implications for change and future research

A change of health care systems to become more primary-care oriented is supported by available evidence, which, together with evidence concerning efficient ways to organise health care, should be made known to the public and politicians. To be able to target health services according to need, it is necessary to develop better methods to assess need. In this process, diagnosis-related morbidity measures most probably would be of value.

Fulfilment of the mission of primary care is dependent on the way it is organised, and among other things the organisation should promote a long-term doctor patient relationship.

Most comparative studies of different ways to organise and remunerate care have been conducted in the USA. The results from studies from commercialised health care systems in the USA may not be generalised to Western Europe. The sparseness of studies of the European and the Scandinavian health care systems implies that those who organise health care, to a great extent, are acting without knowing.

Further research on effects of different ways to organise and remunerate health care is needed, but is also bound to unique conditions. Physicians might be reluctant to accept to be randomised to remuneration system, and probably, health authorities would be as hesitant to accept that decisions, concerning their organisation of health care, are left to chance. Since the long-term doctor-patient relationship is crucial to primary care effectiveness, study procedures that interfere with this will seriously bias the results. These difficulties in creating valid experimental situations make it necessary to study the complex reality.

In most of those countries in Western Europe, where doctors in primary care are specialised in general practice, there is also a gatekeeping system. Because of this, comparative studies between GPs and other specialists are difficult to perform. This kind of studies could, however, be performed in Sweden. The absolute majority of GPs in Sweden are vocationally trained, there is no gatekeeping system and there are high quality data on socioeconomic factors, health care utilisation and health. Between the counties and regions, there are differences in the organisation of health care, which should offer good opportunities for this kind of research.

The disproportion between what is possible to perform medically, the public demand and the resources available for health care will necessitate research on health care utilisation/costs related to health care need.

In the case of respiratory tract infections, a gap exists between practice and guidelines, and presumably, this applies to many other parts of general
General discussion

practice. A combination of feedback generated from computerised medical records and educational activities has the potential to bring practice closer to science. Further research on adherence to and implementation of guidelines is crucial for the development of quality in general practice. Generally recognised indicators of medical and organisational quality, preferably with reference standards, can facilitate comparisons, enhance quality and aid in the detection of important areas for research.

Computerised patient records could be used for feedback and surveillance of adherence to guidelines. However, the variations in data quality, due to differences in routines of care and routines for documentation in the computerised patient records, necessitate that all data are interpreted locally, paying regard to these confounding factors, before the accomplishment of external comparisons and evaluations.
CONCLUSIONS

• There is evidence that increased accessibility to physicians working in primary care contributes to a better public health, as it was expressed through different health parameters, and to a lower consumption of medical care, leading to lower costs in the health care system. The fulfilment of the effects above was enhanced by personal continuity of care, generalists as primary care physicians, reimbursement by capitation and group practices.

• The rates of GP visits correlated negatively, but weakly, to hospitalisation rates, while hospital outpatient visits correlated positively. Socioeconomic factors and health care structure were also important predictors of the rates of hospitalisation. When evaluating the role of the primary care, socioeconomic factors must be taken into consideration as well as health care structure.

• The diagnosis based Adjusted Clinical Groups weight was the major factor underlying the level of variation in patient costs, a variation that could only to a minor extent be attributed to age and gender.

• The Adjusted Clinical Groups system might be of value in the calculation of weighted capitation in Swedish primary care, but appears to be sensitive to the thoroughness with which physicians register diagnoses.

• Respiratory tract infections were common reasons for consulting a GP, especially for pre-school children. Percentage of subsequent visits was low. The most frequently used diagnoses were common cold, acute tonsillitis and acute bronchitis. Antibiotic treatment was common. Penicillin V was by far the most frequently prescribed antibiotic.

• Rapid tests for Group A beta-haemolytic streptococci and C-reactive protein were often used when not appropriate, and hence with minor contributions to the management.
Conclusions

- Data-retrieval from computerised medical records enables collection of many observations and to study everyday clinical practice, without expensive study designs and without the physician’s behaviour being affected by the study situation.

- There are problems concerning the quality of data in computerised medical records such as incorrect coding, but also organisational routines that entail fragmented information on encounters. There is a need for future efforts to improve the accuracy of electronic patient records by standardisation of terminology and computerised support of structured data entry.

- The variations in data quality, necessitates that all data are interpreted locally, with consideration of local factors that confound data, before the effectuation of external comparisons and evaluations.
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SUMMARY IN SWEDISH

Denna avhandling beskriver olika sätt att dels värdera hur primärvården fungerar som en del i sjukvårdsystemet och dels att värdera hur primärvården fungerar i sig själv.

Syftet med avhandlingen var att beskriva och analysera primärvårdens roll i sjukvårdsystemet utifrån effekter på hälsa, sjukvårdskonsumtion och kostnader. I syftet ingick även att studera hur information som återhämtas från datajournaler kan användas för att följa den medicinska kvaliteten i den dagliga praktiken.

Avhandlingen består av fem delarbeten:
- En systematisk litteratur översikt syftande till att sammanställa evidens i den vetenskapliga litteraturen för effektiviteten av läkarverksamhet i primärvård i olika länder, både ur kostnads- och kvalitetssynpunkt.
- En studie där vi med hjälp av registerdata studerar konsumtion av vård på sjukhus respektive i primärvård med beaktande av socioekonomi, avstånd till sjukhus och organisatoriska skillnader mellan olika sjukhus.
- En studie där vi, genom att kombinera information från datajournaler med information om vårdcentralernas kostnader för olika verksamheter, studerar kostnader för patienter i primärvård i förhållande till ålder, kön, socioekonomi och sjuklighet.
- Två studier av handläggningen av luftvägsinfektioner i primärvård baserade på en sammanställning av information ur datajournalsystemen på tolv vårdcentraler.

I registerstudien jämfördes 50 vårdcentralsområden med avseende på antalet inläggningar på sjukhus per 1000 invånare i förhållande till antalet läkarbesök inom primärvård och på sjukhus. I en multipel regressionsmodell inkluderades även ålder, kön, socioekonomi och avstånd till sjukhus. Ålder och antalet läkarbesök på sjukhus var de viktigaste förklaringsfaktorerna till variationer i frekvensen inläggningar. Vilket sjukhus som betjänade en vårdcentrals område hade också stor betydelse. Detta antyder att skillnader i lokala rutiner kan ha stort inflytande på frekvensen inläggningar. Läkarbesök i primärvård hade en minskande inverkan på antalet inläggningar på sjukhus.

I studien av kostnader för olika patienter deltog 2 vårdcentraler. Vi studerade relationerna mellan kostnad per individuell patient och ett antal faktorer. Dessa var ålder, kön, vårdbehov enligt ett socialt mått (Care Need Index) och vårdtyngd enligt ett diagnosbaserat system för att gradera vårdbehov (Adjusted Clinical Groups). Care Need Index baseras på skillnader mellan bostadsområden beträffande sju mått (ensamboende äldre, barn under 5 år, ensamföräldrar, flyttning under senaste året, invandare, arbetslösa, och lågutbildade) som sammanvägs till en uppskattning av invånarnas relativa vårdbehov. Adjusted Clinical Groups systemet grupperar individerna, beträffande förväntad vårdkonsumtion, utgående från vilka diagnoser som sjukvården åsatt individerna under en period, vanligen ett år. Grupperingen sker i 2 steg. I steg 1 beaktas för varje diagnos både kliniska karakteristika och förväntat resursbehov. I steg 2 vägs individens olika diagnoser samman och efter hänsynstagande till åldergrupp och kön resulterar detta i en kategorisering av individens förväntade behov av vårdresurser. Kostnader per individuell patient på den ena vårdcentralen användes för att konstruera vikter i det diagnosbaserade systemet. Dessa vikter användes sedan för att på den andra vårdcentralen i en multipel regressionsmodell studera sambanden mellan de individuella patienternas kostnader och ovannämnda faktorer. Det sjuklighetsbaserade måttet kunde förklara 37% av variationen i kostnader per patient vilket kan jämföras med 7% för ålder och kön tillsammans. Det sociala måttet, baserat på bostadsområden, var inte användbart på befolkningen inom en så begränsad yta som ett vårdcentralområde. Det sjuklighetsbaserade måttet bör kunna användas för att på tillfälligt betydande sätt räknas ut kapitationsersättning till vårdcentraler. Våra resultat tyder dock på att måttet är känsligt för varierande fullständighet vid registrering av diagnoser.

Studierna som baserades på en sammanställning av information ur tolv vårdcentralers datajournalsystem omfattande 19 965 besök för luftvägsinfektioner. De vanligaste diagnoserna var förkylning (40%), halsfluss (18%) och akut luftrörskatarr (15%). Antibiotika förskrevs vid 47% av
sjukdomsepisoderna och den andelen varierade mellan 34-63 % för de olika vårdcentralerna. De mest förskrivna typerna av antibiotika var penicillin V (61%), tetracykliner (18%) och makrolider (8%). Vid 43 % av besöken utfördes någon form av snabbtest. Snabbtest för streptokocker i halsen gjordes i 22% och snabbtest för C-reactivt protein (mått på inflammationsaktivitet) i 30%.

Andelen besök med utförda snabbtest varierade mellan 27-66 % för de olika vårdcentralerna. Resultaten tyder på att dessa snabbtester utfördes på för vida indikationer och ofta utan att provresultaten verkade påverka handläggningen.


Slutsatser

- En ökad tillgänglighet till läkare inom primärvård kan bidra till lägre kostnader för sjukvård och en bättre folkhälsa. Hur primärvårdens organiseras inverkar i åstadkommandet av detta. En långvarig patient-läkarrelation och att primärvårdsläkarna är generalister har stor betydelse, men även ersättningsystem inverkar.

- Det är, mellan patienter, en stor variation i kostnaden för primärvård. Ålder och kön kan förklara en mycket liten del av denna variation medan ett diagnostiserat mått kan förklara en större andel. Detta mått skulle kunna vara av värde för att räkna ut en ersättning till vårdcentralerna som bättre överensstämmer med patienternas behov.

• Återfångst av data från datajournaler möjliggör att man samlar stora mängder data och därmed kan studera kvaliteten i vården. Det finns dock problem med datakvaliteten både beroende på fel i journalföringen men också på grund av hur mottagningsverksamheten organiseras.

• Problemen med datakvaliteten nödvändiggör att data tolkas lokalt innan de används för externa jämförelser och utvärderingar.
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