

**HOSPITAL ADMISSION RATES:
LITERATURE REVIEW – FULL REPORT**

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National Centre for Health Outcomes Development**

July 2000

UNIT OF HEALTH-CARE EPIDEMIOLOGY

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1. INTRODUCTION

Over the last ten years there has been increasing interest in using admission rates as health outcome indicators to make comparisons over time and between health authorities.

Rates of hospital admission for certain conditions and groups were considered to be useful performance indicators in five of the six areas outlined in the performance assessment framework document (*Department of Health 2000*). These five areas are health improvement, fair access, effective delivery of appropriate health care, efficiency, and health outcomes of NHS health care. The performance indicators in question include:

- hospital admissions for serious accidental injury (health improvement)
- elective surgery rates (fair access)
- surgery rates (fair access)
- inappropriately used surgery (effective delivery)
- acute care management (effective delivery)
- chronic care management (effective delivery)
- day case rate (efficiency)
- emergency admissions of older people (health outcomes).

These areas of the performance assessment framework are interdependent in that the national objective to ensure that everyone with health care needs (fair access) receives appropriate and effective health care (effective delivery) offering good value for money (efficiency) for services as sensitive and convenient as possible so that good clinical outcomes are achieved (health outcomes) to maximise the contribution to improved health (health improvement).

The current published set of performance indicators (which includes indicators compiled from admission rates) are not intended to be direct measures of quality. However, they should be used to ensure that where there are large and unexplained variations in performance, every effort is made to find out why and action is taken to bring about an early improvement.

This literature review has concentrated on the use of admission rates as health outcome indicators. This report contains:

- summary of the key issues
- review of the literature.

Key issues

The *calculation* of admission rates may require the linking of data on hospital episodes for the same patient occurring within a specified time period. The main issues relating to this are:

- methodology used to link hospital episode data
- whether admission rates are person-based or episode-based
- definition of admission in terms of type of hospital admission and diagnostic specificity
- use of finished consultant episode or continuous in-patient spell

- risk adjustment for factors such as age, sex or case-mix
- accuracy and completeness of data required for derivation of the indicator, particularly diagnosis and procedure recording and coding.

The *usefulness* of a health outcome indicator will depend on:

- attributability of the outcome measured to the quality of health care
- reliability of the indicator
- sensitivity of the indicator to changes in the quality of health care.

Key issues relating to the *interpretation* of admission data are:

- statistical power, relating to the adequacy of the number of events and size of the population denominators to show significant variations
- extent to which performance can be quantified by benchmarks
- creation of perverse incentives and games playing.

Literature search questions

In reviewing the literature, an attempt has been made to address the following questions:

- What are the general factors affecting admission rates?
- What factors influence admission rates when they are being used specifically as outcome indicators for chronic medical conditions?
- How should admission rates be calculated when used as health outcome indicators?

Search strategy

Various electronic searches were performed in Medline and EMBASE for the years 1990 to 2000 using various combinations of the following words and phrases:

admission rate; hospitalisation rate; or discharge rate;

combined with at least one of the following:

quality indicator; outcome indicator; clinical indicator; performance indicator; quality of health care; quality of care; quality assessment; outcome assessment; quality comparisons; quality assurance; quality improvement; hospital performance; hospital standards; league table; ranking; performance measurement; outlier; health services research; health policy; length of stay; statistics and numerical data; or surgical volume.

In addition, a number of other strategies were employed to identify relevant publications. These included:

- electronic searching for publications by researchers working in the field
- electronic searching for publications citing key papers on this subject
- hand searching of reference lists of key papers
- electronic or hand searching of recent issues of journals where relevant significant papers are most likely to appear (e.g. *Medical Care*).

2. POTENTIAL USES OF ADMISSION RATES

Unlike indicators based on re-admission or case fatality rates that are intended mainly as potential measures of in-patient quality of care, indicators based on admission rates may have a range of potential uses in the monitoring of health care delivery. These include indicators of:

- inadequate service provision at the population level
- variation in access to health care
- populations with higher than average rates of admission
- significant differences or anomalies between health authority populations that require further detailed investigation
- health outcome.

This review is solely concerned with the use of admission rates as health outcome indicators and the circumstances in which this occurs relate to the effectiveness of:

- primary and community care
- health promotion
- surgical practice.

Effectiveness of primary and community care services

Indicators of the effectiveness of primary care services may relate to:

- acute care management in primary care
- chronic care management in primary care.

In the recent set of clinical indicators (*Department of Health 2000*) emergency admission rates for acute ENT infection, kidney/urinary tract infection, and heart failure, have all been proposed as measures of the level of potentially 'avoidable hospitalisations' for acute conditions which should, at least in part, be treatable in primary care.

Hospital admission is an important outcome of ambulatory care in chronic conditions such as asthma and diabetes where it is believed that hospitalisation may be avoided by appropriate care. Emergency admission for asthma or diabetic ketoacidosis may reflect both the standard of primary care and the quality of self care by the patient. The latter may be related to the standard of care provided by health professionals.

Indicators based on rates of emergency admission may provide a measure of the level of potentially 'avoidable hospitalisations' for conditions that are largely managed in a primary care setting. The frequency of hospital admission or the total length of time spent in hospital within a specified time frame may also be a useful indicator of the effectiveness of antecedent care for particular conditions cared for in the community.

Conditions in which admission rates may be useful health outcome indicators include:

- diabetes
- asthma
- mental illness
- diseases of old people.

Hutchinson (1992) used a Delphi technique in a two round postal survey of general practitioners in academic departments throughout the UK to ask for their opinions as to which clinical problems and types of measure they thought most appropriate for the development of outcome measures for use in primary health care. Ninety eight participants suggested one or more areas in which outcome measures could be developed. Consensus produced in the second round indicated that three clinical conditions were preferred for the development of outcome measures: asthma, diabetes and hypertension. Six categories of outcome measures were developed from the responses given in the first round, one of which was the incidence of complications.

Diabetes

Diabetes is a common disease, which frequently leads to serious, high-cost complications. Research demonstrates that much of the mortality and morbidity associated with diabetes can be prevented, and rigorous evidence-based guidelines have been developed for the care of patients with diabetes mellitus.

Hyperglycaemic emergencies, which carry a significant risk of mortality are mostly avoidable with careful and experienced management (*Tunbridge 1991*). Better control of blood glucose lessens the risk of ketoacidosis. Since these emergencies are potentially avoidable, the objective should be to reduce the rate to as low as possible.

Asthma

In the US, asthma is regarded as the most frequent reason for preventable hospital admissions among children (*CDC 1996*). The rate of paediatric hospital discharge for asthma is one of the indicators included in the Healthcare Cost and Utilization Project's set of 33 clinical performance measures and is used in particular to identify problems in access to primary care in the community. In areas where effective care in the community is in place, patients admitted to hospital may represent a selected group of more severe asthma sufferers. Therefore, this indicator must be presented alongside data on other population-based indicators for asthma.

While emergency admission for asthma has high 'face validity' as an indicator of adverse outcome, patterns of care are changing and emergency admissions are increasing for all conditions, making interpretation of these data increasingly difficult. Monitoring rates of emergency admissions for asthma lasting say two days or longer may help interpret whether variation in admission rates are due to variation in severity or variation in admission threshold.

Evidence indicates that there is a marked increase in self-referral to hospital for acute asthma in children, the current level being about 30-40% of admissions (*Anderson 1989*), while there is evidence for a trend away from GP home visits and towards A&E attendance for asthma (*Strachan 1991*). In some areas of the UK, there is a formal self-admission policy for acute asthma (*Crompton 1979*). In compiling an indicator based on emergency admission rates for asthma, it may be useful to report admissions resulting from general practice referrals separately from admissions resulting from self referrals to hospital A&E departments.

The likely low frequency of emergency admissions for asthma could make it difficult to draw valid conclusions from comparisons based on individual primary care practices.

Mental illness

A widely held aim in the treatment of mental disorders is the avoidance of hospitalisation and the use of community, out-patient and day case centres.

Psychiatric in-patients represent only 1-2% of the total psychiatric morbidity. In mental illness, as with other medical conditions of varying severity such as asthma, some cases do not even come to medical attention. In psychiatric care, hospital admission figures (*Jenkins 1990*) will be affected by:

- availability of beds
- inflow factors (e.g. the availability of alternative services such as day hospitals or community psychiatric hospitals)
- factors influencing length of treatment (e.g. a brief admission policy or in-patient psychotherapy)
- outflow factors which influence the transfer of patients back to the community or to other appropriate units.

The proportion of people with severe mental illness spending cumulatively long periods in in-patient psychiatric care may reflect the proportion of cases for which care in the community is relatively ineffective. The *Working Group Report to the Department of Health on Severe Mental Illness (Charlwood 1999)* included as a candidate indicator the proportion of people with severe mental illness spending more than 90 days in a given year in in-patient psychiatric care. While maintaining people with severe mental illness in the community is generally desirable, relatively brief admissions may be part of appropriate care.

Diseases of old people

The rate of emergency admission of older people has been proposed as an indicator of the effectiveness of community care in preventing the deterioration of the patient's condition to the extent that hospital admission is required.

Effectiveness of health promotion

Admission rates for specific conditions may be used as indicators of the effectiveness of health promotion measures either in the general population or specific high risk groups. Conditions used in this way include:

- fractured proximal femur
- acute myocardial infarction
- stroke
- accidental injury.

Fractured proximal femur

The rate of admission for fractured proximal femur (FPF) has been proposed as a measure of the avoidance or reduction of risk of FPF. Hospitalised incidence of fractured proximal femur serves as a general indicator for 'failure to prevent', and aims to reflect the role which a range of factors (e.g. the physical environment and poly-pharmacy in the elderly) have in the aetiology of such fractures, but which would be impractical to monitor. This indicator may be useful for assessing regional and national trends over time and for population-based geographical comparisons.

The episode rate for FPF has been included as one of the population health outcome indicators and has also formed part of the composite high level performance indicators (*Department of Health 1999*).

Monitoring rates of a second fractured proximal femur in patients who have already suffered one provides an indication of the effectiveness of interventions aimed at reducing subsequent fractures in this high risk group. *Parker (1992)* reported that patients who have suffered one fractured proximal femur have a greater risk (approximately 10%) of a second such fracture. Focusing on fractures of the opposite leg avoids confusion with revisions of previous procedures that are a consequence of other factors. This indicator relies on the coding of the side of the surgical procedure that may be missing.

Acute myocardial infarction

The incidence of hospitalised acute myocardial infarction (AMI) provides information about success in changing people's lifestyles and the management of risk factors through health promotion and other preventative programmes. While the rate of hospital admission for AMI may be used as a proxy for incidence assuming that the majority of AMI patients are hospitalised, it will underestimate the true incidence as it does not include the large proportion of patients who die before they reach hospital or before they are formally admitted to hospital (*Langham 1994*). Therefore, this indicator should be interpreted alongside population-based mortality rates for AMI.

To improve on hospitalised cases as an estimate for true incidence, GP reports of AMIs either through the use of a CHD practice register or other mechanisms in general practice (such as reporting through the weekly RCGP returns service, or via spotter practices) could be used.

Stroke

The hospitalised incidence of stroke has been proposed as an indicator for failure to prevent, based on the assumption that many who suffer a stroke, particularly the more serious cases, are admitted to hospital. Interpretation of national and regional trends over time and geographic variation in stroke admission rates must consider the influence of variable service provision within these areas.

It is likely that effective primary and community services would lead to a reduced number of hospital admissions for stroke. The *Oxfordshire Community Stroke Project (1983)* suggests that some 40-90% of stroke episodes are managed at home. It is well known that those admitted to hospital have the worst strokes. This indicator is therefore more useful if considered alongside an indicator of population-based incidence of stroke.

While rates of admission to hospital may serve as surrogate measures of the incidence of first-ever or recurrent stroke, measuring a change in incidence would ideally use ongoing stroke registers for all patients (*Wade 1994*). Another issue to bear in mind is that it is difficult to distinguish first-ever from recurrent strokes, as it is to separate a slight worsening in long-standing stroke disability from a 'new' stroke.

Accidental injury

In the current set of clinical indicators published by the *Department of Health (2000)* the hospital admission rate for serious accidental injury resulting in a hospital stay exceeding three days has been proposed as one of the indicators of success or failure to prevent adverse medical events in the population. Accidental injury has in the past been one of the most neglected areas for preventive action. Accidents were highlighted as a national priority area in the *Our Healthier Nation* White Paper, and accidental injury puts more children in hospital than any other cause.

Effective surgical practice

The level of activity of a surgical procedure that has been shown to be effective when used appropriately can be used as an indicator of effective surgical practice. Similarly, the rate of a surgical procedure that has been shown to be less effective than another established treatment for the same condition may be used as an indicator of inappropriate practice. Thus, admission rates can be used to monitor surgical procedures that are:

- inappropriate and thus levels of activity should be reduced
- effective and thus higher levels of activity should be encouraged.

Blumenthal (1996) has pointed out that the technical quality of care is thought to have two dimensions: the appropriateness of the services provided and the skill with which appropriate care is performed. Appropriateness studies have been done to establish standards against which the use of a particular medical intervention is judged. The commonly used method for determining appropriateness of care includes an extensive literature review to determine effectiveness, but also relies on physicians' judgement to fill the gaps in the scientific literature.

A recent scoping review by *Schuster (1998)* of 48 papers published between 1993 and 1997 on the quality of health care in the United States concluded that a large part of the quality problem is the amount of inappropriate care provided. A simple average of the findings from those studies reviewed suggests that between 20% and 30% of people receive care that is contraindicated.

Leape (1992) reported that from 8% to 86% of operations, depending on the type, have been found to be unnecessary and have caused substantial avoidable death and disability.

Examples of particular procedures for which admission rates may be used as indicators of effective or ineffective surgical practice are outlined below. A complete review of the literature on the effectiveness of such surgical procedures is beyond the scope of this report and therefore, these will be presented purely as exemplars of the use of admission rates as outcome indicators.

Inappropriate surgical practice

In the current set of clinical indicators published by the *Department of Health (2000)*, two proposed indicators of inappropriate surgery include the admission rate for:

- dilatation and curettage (D&C) in women aged 15-39 years
- grommet surgery in people aged under 15 years.

These are procedures for which a significant amount of activity is thought to be inappropriate. D&C has been shown to actually be an ineffective diagnostic technique for women presenting with menorrhagia and therefore it is generally accepted that the current rate of this procedure should be reduced. It has been established that a significant number of children undergo grommet surgery unnecessarily. Therefore, high rates of this procedure may indicate inappropriate clinical practice.

One of the candidate indicators included in the *Working Group Report to the Department of Health on Urinary Incontinence (Brocklehurst 1999)* is the percentage of anterior repair procedures undertaken in a population of women undergoing surgery for stress incontinence without vaginal prolapse. This indicator is intended to identify provider units who have comparatively high rates of anterior repair, a relatively ineffective procedure, for the treatment of female stress incontinence

Appropriate surgical practice

Admission rates may serve as an indicator of effective delivery of appropriate surgical care where there is evidence that a particular surgical procedure is effective with good outcomes. Conditions in which this occurs include:

- total hip replacement
- total knee replacement
- coronary heart disease surgical procedures
- hernia repair
- cataract removal.

Total hip replacement

Total hip replacement (THR) surgery is one of the most common orthopaedic operations. The rate of admission for THR in people aged 65 years and over is included in the current set of clinical indicators (*Department of Health 2000*).

There is no evidence that the age-specific incidence of hip arthropathies should differ markedly between district populations. Differing levels of cases in the population partially reflect varying levels of past surgical activity. When examining variation between health districts in standardized THR rates, it is important to consider the implications of the accumulated prevalence of successfully treated cases when considering what is an appropriate surgical rate and those not requiring repeat surgery should be removed from the current pool of prevalent disease (*Williams 1994a*).

Decisions concerning referral and hospital admission for THR will be influenced by the accuracy of diagnosis by GPs, the perceptions of potential benefit by GPs and the availability of treatment facilities. With regard to the availability of resources, weak or negative correlations between standardised THR rates in English health districts for 1989/90 and six supply factors relating to manpower, theatre sessions and use of orthopaedic beds, suggest that factors other than supply play a more significant role in explaining variation between districts (*Williams 1994a*).

In a study of three English health authorities, 20% of THRs had been performed privately in 1991 (*Williams 1994b*).

The contribution of different levels of ascertainment and quality of coding have potentially significant effects in explaining variation in THR surgery rates at the district level. A particular problem in this respect is that elective THRs may be confused with the emergency hemiarthroplasties performed in patients with fractured neck of femur. While THR is considered to be an elective procedure, a study of THRs in North West Thames Region residents in 1985 found that 17% were coded as emergency procedures (*Rajaratnam 1990*).

Total knee replacement

The volume of elective surgery for total knee replacement (TKR) in the NHS has increased rapidly in the past 20 years, particularly in those aged over 65 years, due to significant advances in TKR surgery. The rate of admission for TKR in those aged 65 years and over is included in the current set of clinical indicators published by the *Department of Health (2000)*.

Analysis of 1989/90 data on TKR admission rates highlights wide differences between health districts in England for both primary replacement and for revisions. These wide variations can only be partially explained by random variation and the completeness and accuracy of data recording, and therefore some variation must be attributed to diversity in need, supply, demand and clinical decision making. When examining variation it is important to consider the implications of the accumulated prevalence of successfully treated cases when considering what is an appropriate surgical rate (*Williams 1994c*).

The level of TKR activity in independent hospitals and NHS pay beds should also be considered when attempting to estimate appropriate rates of operation.

It is likely that variable demand for hospital treatment in the form of public expectations and GP referral patterns play a significant role in the variation of TKR

rates. With regard to the availability of resources, weak or negative correlations between standardised TKR rates in English health districts for 1989/90 and six supply factors relating to manpower, theatre sessions and use of orthopaedic beds, suggest that factors other than supply play a more significant role in explaining variation between districts (*Williams 1994c*).

Patients with adverse outcomes of primary TKR may require revision surgery. Use of outdated and discredited prostheses may make an unnecessary contribution to the increasing number of revisions.

Coronary heart disease surgical procedures

Chassin (1998) has estimated that the failure to use effective therapies following acute myocardial infarction (AMI) may lead to as many as 18,000 preventable deaths each year.

Two types of interventions are used in the treatment of severe angina: percutaneous transluminal coronary angiography (PTCA) and coronary artery bypass grafting (CABG). Well-controlled trials, supported by clinical experience, provide evidence that CABG is a highly effective treatment for the relief of disabling chronic angina that has not responded to medical treatment (*Langham 1994*). Evidence suggests that PTCA is a cheaper option in the short term with this cost differential being eroded in the longer term.

Age and sex standardised rates of CABG and PTCA for CHD are included as indicators of effective delivery of appropriate health care in the recently published set of NHS clinical indicators (*Department of Health 2000*). CABG and PTCA, which have been shown to be effective when used appropriately, are two procedures where there is considered to be substantial unmet need, as identified in the *CHD National Service Framework*. Variation in the rates of these two procedures may suggest variable access and unmet need.

The White Paper, '*Health of the Nation*', suggested specific national targets for CABG (350 per million) and PTCA (200 per million). A target of 300 CABGs per million set in 1986, had not been reached by most regions by 1994 (*Langham 1994*).

An audit of coronary angiography in the Trent Regional Health Authority in 1987/88 showed that 95% of patients investigated received surgical treatment. Review of a random sample of these surgical cases using 'appropriateness' scores of generally (not universally) agreed criteria concluded that 55% were appropriate, 29% were uncertain and 16% were inappropriate (*Gray 1990*).

Primary prevention of CHD in the entire population includes national disease prevention programmes which encompass health education and health promotion.

Hernia repair

The surgical repair of hernia is another procedure for which considerable unmet need may exist. Unmet need in the community exists in terms of failure of GPs to refer

high risk hernias for a consultant opinion. Variations in standardised hernia repair rates for English health district residents are only partially explained by differences in morbidity, supply and demand (*Williams 1994d*).

Of significant importance are differences in decision-making by clinicians in primary and secondary care. *Williams (1994d)* reported that the acceptability and effectiveness of trusses had not yet been established, and that they may be prescribed inappropriately and cause complications. The frequent use of trusses suggests that hernia sufferers seeking symptomatic relief are being denied access to elective surgery.

With regard to the availability of resources, weak or negative correlations between standardised inguinal hernia repair rates in English health districts for 1989/90 and seven supply factors relating to manpower, theatre sessions and use of general surgical beds, suggest that factors other than supply play a more significant role in explaining variation between districts (*Williams 1994d*).

The prevalence of previously met demand for hernia repair is an important factor in assessing appropriate surgical rates at the health authority level.

Cataract removal

Large geographic or temporal variations in the rates of cataract removal may indicate variation in provision of services; and relatively low surgical rates may suggest unmet need. At the population level, inadequate provision of cataract surgery is likely to lead to inappropriately delayed treatment for individual patients. Hospital admission rates for cataract surgery may be useful for population-based comparisons of service provision with respect to cataract, assuming that the age-specific prevalence of cataract does not vary substantially across regions (*Desai 1993*).

Differing prevalences of cases in the population partially reflect varying levels of past surgical activity. The rate of admission for cataract surgery in those aged 65 years and over is included in the current set of clinical indicators published by the *Department of Health (2000)*.

With regard to the availability of resources, weak or negative correlations between standardised cataract surgery rates in English health districts for 1989/90 and seven supply factors relating to manpower, theatre sessions and use of ophthalmology beds, suggest that factors other than supply play a more significant role in explaining variation in treatment rates between districts (*Williams 1994e*).

Variability in clinical decision making, in both primary and secondary care, has been identified as a major contributory factor in the observed variation in standardised age- and sex-specific cataract rates for English health district residents (*Williams 1994e*).

It appears that NHS utilisation data are an inexact measure of the actual or potential demand for cataract surgery because of the uncertain relationship between surgical activity and the demand for treatment. The length of the waiting list may serve as a proxy indicator of demand.

It has been reported that 11% of national cataract surgery is performed in independent hospitals and NHS pay beds, activity that is not included in routine hospital statistics (*Williams 1994e*).

3. STUDIES REVIEWING FACTORS INFLUENCING ADMISSION RATES IN GENERAL

The level of hospital admissions for a defined population is a product of the complex inter-relationships of need, supply, demand and the influence of clinical decision making. When interpreting variation in rates between populations in Britain, the following factors need to be considered:

- data deficiencies
- distribution of disease (need)
- availability of resources (supply)
- demand for treatment (demand)
- therapeutic choices (clinical decision-making)
- rates of admissions to private hospitals.

Demand for hospital treatment is a complex product of disease levels, public expectations and referral patterns (*Williams 1994e*). The level of unmet need/demand may comprise several components including patients who may:

- not perceive a health problem or the possibility of benefit and therefore do not present for medical or specialist advice
- decline the opportunity of consultant referral having sought advice
- be advised by a GP who fails to refer appropriate cases
- fail to satisfy the local criteria for surgery or be declined elective surgery.

When examining the usefulness of admission rates as performance indicators the following factors may need to be considered:

- need, supply and demand
- age and sex differences
- socio-economic factors
- ethnic factors
- urban/rural influences
- clinical decision-making.

A number of general studies have been done to identify:

- predictors or risk factors for hospital admission
- reasons or causes for hospital admission.

Admission rates in adult populations

The general studies of hospital admission rates in adult populations that have been reviewed are:

- *Fleming (1995)* reviewed the literature on the relationships between primary care, potentially avoidable hospitalisations, and outcomes of care.
- *Ashton (1999)* assessed geographic variations in utilization rates in Veterans Affairs (VA) hospitals and clinics for eight diseases (chronic obstructive pulmonary disease, pneumonia, congestive heart failure, angina, diabetes, chronic renal failure, bipolar disorder, and major depression).

- *Kashner (1998)* examined the effect of private health insurance on the use of medical, surgical, psychiatric, and addiction services for non-institutionalised veterans eligible for publicly supported care.
- *Brownell (1999)* monitored the impact of bed closures in Winnipeg hospitals in 1992/93 on access to care and quality of care.
- *Harrison (1997)* described changes in English hospitals following the NHS and Community Care Act of 1990.
- *Roos (1995)* analysed four years of administrative health data to monitor the impact of hospital bed closures in Winnipeg, Manitoba, using a population-based approach.
- *Stuart (1993)* assessed the degree to which variations in utilisation and cost are attributable to differences in patient mix (i.e. demographic and diagnostic characteristics) by analysing data on Medicaid payments for users of hospital out-patient departments, emergency rooms, federally qualified health centres and office-based physicians.
- *Anderson (1997)* highlighted changes in hospital utilisation that have occurred in association with restructuring of Ontario hospitals
- *Smith (1996)* tested the hypothesis that the Department of Veterans Affairs (VA) hospitals would have substantial over-utilisation of acute care beds and services because of policies that emphasize in-patient care over ambulatory care.
- *Black (1995)* used a population-based approach to analyse hospital utilisation patterns by Manitoba residents during 1991/1992 for eight administrative regions, with use assigned to the patient's region of residence, regardless of the location of the hospitalisation. Findings were related to the regions' composite socio-economic risk indices developed for the Population Health Information System.
- *Mustard (1995)* examined the relationship of a population's socio-economic characteristics to its health status and use of health care services in eight health regions, by developing a composite socio-economic risk index from census data.
- *Katz (1996)* compared hospital use in Ontario and the United States for persons with different socio-economic and health status in a cross-sectional study.
- *Hofer (1998)* examined the association of socio-economic characteristics (SES) with hospitalisation by age group in two cross-sectional analyses using measures of SES at the community level compared with the individual level.
- *Djojonegoro (2000)* assessed whether geographical area income based on census data is a good predictor of preventable (or ambulatory care-sensitive) hospitalisations in a large public hospital system in Texas, and how area income correlates with the socio-economic status reported by patients.
- *Krakauer (1995)* looked at variation between US States and metropolitan statistical areas in hospital admission rates.
- *Miller (1995)* investigated the geographic variation in Medicare physician services by examining population rates adjusted for age, sex and race.

- *Culler (1998)* examined whether the odds of having a hospitalisation associated with an ambulatory care sensitive condition can be explained by observed differences in the predisposing, enabling, and need characteristics among a nationally representative sample of Medicare beneficiaries.
- *Intrator (1999)* tested the effect of selected facility characteristics on the probability of hospitalisation or death of nursing home residents over a six month period, controlling for resident characteristics and the competing risk of death
- *Evashwick (1984)* used factors of the Anderson model of health services utilization (which relates use of service to predisposing, enabling, and need factors) to predict utilization for a population sample of 1,317 elderly persons.
- *Miller (1998)* examined the influence of risk factors such as cigarette smoking, blood pressure, serum cholesterol, or chronic illness on frequency of hospital admission in a population-based sample of 6,461 adults aged 45 years and older.
- *Haapanen-Niemi (1999)* investigated the associations of smoking, excess alcohol consumption, and physical inactivity with the use of in-patient care in a cohort of 19- to 63-year-old Finnish men (n = 2534) and women (n = 2668) followed prospectively for 16 years.
- *Weissman (1992)* examined rates of avoidable hospitalisation in Massachusetts and Maryland to determine whether uninsured and Medicaid patients have higher rates of avoidable admissions than do insured patients.
- *Twigger (2000)* examined whether non-random variability of admission rates and travel time to hospital were related for each of seven conditions in 62 small (mean population 9,900) areas of Surrey, England.
- *Bero (2000)* conducted a systematic review of the literature on the effects of expanding out-patient pharmacists' roles on health services utilisation and patient outcomes.
- *Coast (1996)* attempted to assess the factors associated with inappropriate acute hospital admission using logistic regression analysis of data from two separate studies of acute hospital utilization in south-west England, conducted between 1992 and 1994.
- *Chin (1999)* carried out a prospective cohort study to determine the frequency of potentially inappropriate medication selection for 898 older (aged ≥ 65 years) persons presenting to the emergency department (ED) during 1995-1996, to determine risk factors for sub-optimal medication selection, and whether use of these medications is associated with worse outcomes including admission during the three months after the initial visit.
- *Louis (1999)* examined potential changes in quality of care associated with the implementation of a hospital financing reform system in Italy in 1995 that aimed to control the growth of hospital costs and make hospitals more accountable for their productivity.
- *Freedman (1996)* conducted a longitudinal cohort study of older (aged ≥ 81 years) members of a pre-paid managed care plan in the Denver metropolitan area to examine whether the results of a postal questionnaire can help identify those patients at greatest risk of hospital admission within 4.5 months of completing the survey.

- *Haan (1997)* examined overall and diagnosis-specific trends in the use of in-patient and out-patient medical services among two cohorts of approximately 3,000 older members (≥ 65 years) of a HMO followed up for nine year periods (1971-79 and 1980-88).
- *Boult (1993)* defined a set of screening criteria that identifies elders who are at high risk for repeated future hospital admission in a longitudinal cohort study of a sub-sample ($n = 5,876$) of a multi-stage probability sample of all non-institutionalized U.S. civilians who were 70 years or older in 1984.
- *Billings (1996)* presents a discussion paper on preventable hospitalisations in the US.
- *Majeed (2000)* calculated socio-economic and health status measures for 66 primary care groups in London and examined the association between these measures and hospital admission rates in a cross sectional study of 66 primary care groups with a total list size eight million people.

Some of the observations and conclusions made by *Fleming (1995)* following his review of the literature include:

- A substantial amount of hospitalisation may be potentially avoidable.
- A reduction in unnecessary hospitalisation would affect quality, access and costs.
- If patients can avoid hospitalisation through access to periodic primary care services, they will evade the iatrogenic and other risks associated with in-hospital care; this implies that quality of care is better if hospitalisation can be legitimately avoided.
- The use of primary care may reduce the duration of hospitalisation.
- In cases of paediatric asthma, regular primary care services may reduce the incidence of hospitalisation for this condition.
- The extent to which a causal relationship may exist between access to primary care services and avoidance of hospitalisation probably varies by clinical condition.
- Although progress has been made in understanding the relationship between primary care and hospitalisation, work remains to be done, particularly in elucidating the dynamic process of the delivery of medical care services over time.

In *Ashton (1999)* the risk adjusted average annual number of hospital days per patient, hospital discharge rates, and clinic visit rates between 1991 and 1995 were assessed for the entire system and within the 22 geographically based health care networks. Since the VA health system predominantly serves men with annual incomes below \$20,000, has a central system of administration, and uses salaried physicians, one might expect less geographic variation in utilisation rates. However the main conclusions were:

- Variations in the numbers of hospital days per person-year among the networks were greatest among patients with chronic obstructive pulmonary disease (ranging from a factor of 2.7 to a factor of 3.1) during a given year and smallest among patients with angina (ranging from a factor of 1.5 to a factor of 2.1).

- Levels of hospital use were highest in the Northeast and lowest in the West.
- The variation in the rates of clinic visits for principal medical care among the networks ranged from a factor of approximately 1.6 to a factor of 4.0 and variations in the rates were greatest among patients with chronic renal failure and smallest among patients with congestive heart failure.
- The supply of hospital beds was strongly correlated with the utilisation rates for all eight cohorts of patients and the variations in supply accounted for 32% and 58% of the variation in the number of hospital days.
- Regions with high rates of admission for one condition tended to have high rates for the others, and regions with low overall rates tended to have low rates for all eight categories of disease.
- Given the homogeneity of the patient population, differences in disease severity could not explain the observed variation in utilisation rates.

Kashner (1998) analysed one year follow-up data on 350,000 veterans who had been discharged from a Veterans Affairs (VA) in-patient medicine or surgery bed during a one year period. The key findings were:

- Insured patients were less likely to seek surgical care but were 12 times (≥ 65 years of age) and 73 times (≤ 64 years of age) more likely to initiate out-patient medical visits than were their counterparts, adjusted for patient demographic, diagnostic, and index facility characteristics.
- Patients who had private health insurance also were 3.4 (≥ 65 years) and 2.6 (≤ 64 years) times less likely to use VA surgical care in response to changes in available surgical staff-to-patient ratios than were their uninsured counterparts.
- In conclusion, private health insurance may substitute (reduce) or complement (increase) the continued use of publicly supported health care services, depending on patient age, care setting, and service type.

Brownell (1999) reported that:

- Just as many patients were cared for in 1995/96 as in 1991/92.
- Changes in patterns of care included more out-patient and fewer in-patient surgeries, and a decrease in the number of hospital days.
- The number of high-profile surgical procedures, such as angioplasty, bypass, and cataract surgery, performed increased dramatically during downsizing.
- Re-admission rates were unaffected by bed closures.
- Those in the lowest income group spent almost 43% more days in hospital than those in the middle income group, and research demonstrates that these variations in hospital use across socio-economic groups reflect real and important health differences and are not driven by social reasons for admissions.
- Finally, a large decrease in waiting time for nursing home placement underlines the relationship between downsizing and availability of alternatives to hospitalisation.

Harrison (1997) reported that:

- The NHS and Community Care Act of 1990 radically changed the financial and organisational framework within which hospitals operate, opening the way for competition between hospitals by creating separate purchasing organizations.
- In practice, however, such competition was very limited.
- Central directives aimed at reducing waiting times for non-urgent admissions, as well as at raising the volume of work done relative to the finances available were more significant influences.
- Admissions rose, lengths of stay fell across all age groups and ambulatory care grew rapidly.

Roos (1995) found that:

- Access to hospital services was not adversely affected as the reduction in beds resulted in increases in out-patient surgery and earlier discharges, and access favoured the admission of persons with more health care needs.
- Quality of care, as measured by mortality within three months of admission, re-admission rates within 30 days of discharge, and increased contact with physicians within 30 days of discharge, did not change.
- The health status of the Winnipeg population, measured by premature mortality, did not change.
- However, health status and hospital use were found to be strongly related to socio-economic status.
- The authors conclude that experiments focusing on the determinants of health could help to identify ways of reducing hospital use.

Stuart (1993) reported the following:

- Findings confirmed significant differences in patient demographic and diagnostic characteristics among users of different types of providers.
- Controlling for these patient-mix characteristics explains 44% of the variation in ambulatory use and 21% in hospital admissions.
- The considerable remaining variation suggests differences in provider efficiency. For example, even after patient mix adjustment, 18% of those who rely on out-patient departments are hospitalised annually compared to 10% for users of office-based physicians.

Anderson (1997) analysed Canadian census data and hospital separation data (for period 1991/2 to 1995/6) to provide a population-based description of changes in patterns of hospital utilisation and care that occurred during restructuring. Results revealed that:

- The number of days of care provided per 1,000 population decreased by 30% during the period, the result of declines in both the age-adjusted in-patient separation rates and average length of hospital stay.
- The shift of surgical treatment to out-patient settings contributed to the reduction in in-patient days of care.
- The decline in utilisation was experienced unevenly across age groups, with the elderly experiencing less of the decline than did younger age groups.

- Individuals living in the poorest areas used more in-patient care than did those living in the richest areas, although the gap in utilisation narrowed over the period.

In the study by *Smith (1996)*, reviewers from 24 randomly selected VA hospitals applied the InterQual ISD* (Intensity, Severity, Discharge) criteria for appropriateness concurrently to a random sample of 2,432 admissions to acute medical, surgical, and psychiatry services. Findings were:

- Rates of non-acute admissions to acute medical and surgical services were >38%.
- Non-acute rates of continued stay were > 32% for both medicine and surgery services.
- Similar rates of non-acute admissions and continued stay were found for all 24 hospitals.
- Reasons for non-acute admissions and continued stay included:
 - lack of an ambulatory care alternative
 - conservative physician practices
 - delays in discharge planning
 - social factors such as homelessness.
- Overall, substantial overutilisation of acute medicine and surgical beds was found in a representative sample of VA hospitals.
- Correcting this would require changes in physician practice patterns, development of ambulatory care alternatives to in-patient care, and modification of current VA hospital policies determining eligibility for care.

Black (1995) reported that:

- Marked differences in acute hospital use were found.
- Residents of the urban Winnipeg ('good health') region had the lowest rates of use of acute care overall, and northern rural ('poor health') regions had significantly higher rates of use.
- However, almost one half of hospital days by Winnipeg residents were used in long-stay care (60+ days), while rural residents were more likely to use short-stay hospital care.
- Despite a concentration of surgical specialists in Winnipeg, there were only small regional differences in overall rates of surgery.

Mustard (1995) plotted regional socio-economic scores against an index of health status measures and against measures of health care utilization. Reported findings include:

- Strong regional variations were found in measures of health status and health care utilisation; the socio-economic risk index explained 87% to 92% of the differences in health status and acute hospitalisations.
- Regions with the worst health status on our indicators were found to be among the highest consumers of health services.

Katz (1996) found that:

- Admission rates averaged 31% higher in Ontario than in the United States, but international differences varied markedly across income and health status.
- At each level of health status, poor Canadians received one quarter to one third more admissions than their counterparts in the United States.
- However, higher income Canadians reporting excellent to good health had 50% more admissions than Americans, whereas those reporting fair or poor health had 10% fewer admissions.
- The observation that higher income sick persons receive less hospital care in Ontario than in the U.S. provides support at the population level for what has been observed for specific technologies.
- This represents, in part, a redistribution of in-patient care to those most vulnerable to illness, such as the poor, who receive substantially more hospital care in Ontario.

Hofer (1998) reported that:

- Both analyses showed similar age-specific patterns for income and education; the effects were greatest in young adults and diminished with increasing age.
- Accounting for multiple admissions did not change these conclusions.
- In the individual-level data the addition of variables representing health and insurance status substantially diminished the size of the coefficients for the socio-economic variables.
- By comparison to parallel individual-level analyses, small area analyses with community-level SES characteristics appear to represent the effect of individual-level characteristics. They are also not substantially affected by the inability to track individuals with multiple re-admissions across hospitals.
- The authors conclude that the impact of SES characteristics on hospitalisation rates is consistent when measured by individual or community-level measures and varies substantially by age.

Djojonegoro (2000) reported the following results:

- Living in lower-income zip codes was associated with higher preventable hospitalisation rates for the predominantly low-income population served by the public hospital system.
- A tenfold difference found in the adjusted rates of hospitalisations for preventable conditions compared with control (or marker) conditions among persons living in low-income areas signals the likelihood of substantial unmet needs in this population.
- Small-area analysis and related comparisons of rates of preventable hospitalisations in high- and low-income areas provide useful indicators for monitoring and assessing the performance of public hospital systems in Texas.

Krakauer (1995) reported that:

- Hospital admission rates, adjusted for differences in demographic and socio-economic characteristics of the populations, vary substantially among areas as large as States and Metropolitan Statistical Areas.
- Thus, if overall admission rates in the upper three quartiles of Metropolitan Statistical Areas were brought down to the average of the lowest quartile, there would be 20% fewer admissions.
- The existence of substantial variations suggests that further improvement in the effectiveness of the hospital care received by Medicare beneficiaries may be possible.

Miller (1995) reported that:

- Substantial variation existed across the states in utilization levels (Florida 38% above the U.S. mean; Vermont and Montana 29% below the mean), with a much greater range at the metropolitan area level.
- With the exception of major surgery, urban area beneficiaries generally receive higher amounts of most evaluation and management services (particularly consultations), imaging services, and diagnostic testing.

Culler (1998) reported the following findings from a multivariate cross-sectional analysis of Medicare data:

- Being older, black, or living either in a core standard metropolitan statistical area (SMSA) county or a rural county appears to significantly increase the odds of a preventable hospitalisation.
- Having attended college, or having only Medicare insurance coverage appears to reduce the odds of a preventable hospitalisation.
- Individuals who assessed their health status as poor, have had coronary heart disease, a myocardial infarction, or diabetes, and required assistance with two or more of the six basic activities of daily living were at a greater risk of a preventable hospitalisation.

In the study by *Intrator (1999)*, regression analysis was performed on study data covering 2,080 residents in 253 nursing homes (NHS) in 1993, and included adjustment for the complex sampling design. Results reported include:

- By controlling for resident demographics, advance directives, diagnoses, selected clinical signs, and type of payer, it was found that homes with special care units, more physicians, and any physician extenders (nurse practitioners or physician assistants) were less likely to hospitalise their residents.
- Homes in which over 3.6% of the residents received respiratory treatment were more likely to hospitalise their residents.
- In conclusion, nursing facilities may have the capacity, especially in terms of medical care and clinical resources, to limit hospital admissions.

Findings from *Evashwick (1984)* include:

- Taken alone, the NEED construct was the most important single predictor of use of physician services, hospital admissions, ambulatory care, and home care. PREDISPOSING factors were better predictors of the use of dental services.

- Some of the variables studied were not related to utilization in the direction that would have been predicted from previous studies on general populations.
- Multivariate analyses demonstrated that the three constructs should be applied simultaneously when predicting use of services.

Miller (1998) used software to correct for clustering, stratification, unequal weighting, and multiple observations per respondent. Risk of hospitalisation was higher for:

- current but not former smokers (RR=1.17-1.34 for different age-sex groups; $p<0.01$)
- higher blood pressure (RR = 1.25-1.28 for ages 45-64; RR =1.07-1.15 for ages 65 and older; $p<0.01$)
- lower serum albumin (RR =1.08-1.14; $p<0.01$).

Haapanen-Niemi (1999) found that:

- After adjustment for confounders, male smokers had 70% (95% CI 49%-95%) and female smokers had 49% (95% CI 29%-71%) more hospital days due to any cause than did those who had never smoked.
- Men consuming a moderate amount of alcohol had 21% (95% CI 10%-31%) fewer hospital days due to any cause than did non-drinkers.

Weissman (1992) used a cross-sectional sample of patients under 65 years of age hospitalised in 1987 in non-federal acute care hospitals, excluding hospitalisations for obstetric and psychiatric conditions. The relative risks of admission for 12 avoidable hospital conditions were identified by a physician panel. Key findings were:

- Uninsured and Medicaid patients were more likely than insured patients to be hospitalised for avoidable hospital conditions (AHCs).
- Rates for uninsured patients were significantly greater than for privately insured patients in Massachusetts for 10 of 12 individual AHCs, and in Maryland for five of 12 AHCs.
- After adjustment for baseline utilisation, the results were statistically significant for 10 of 12 AHCs in Massachusetts and seven of 12 AHCs in Maryland.
- For Medicaid patients, rates were significantly greater than for privately insured patients for all AHCs in each state before adjustment, and for nine of 12 and seven of 12 AHCs in each state, respectively, after adjustment for baseline utilisation.
- In conclusion, patients who are uninsured or who have Medicaid coverage have higher rates of hospitalisation for conditions that can often be treated out of hospital or avoided altogether.

Twigger (2000) calculated age and sex standardised admission ratios (SAR), and estimated their dependence on travel time to hospital, adjusting for deprivation (measured by Jarman's score). Key results include:

- An inverse relationship was found between time to hospital and admission ratio for ischaemic heart disease, bronchopneumonia and chronic bronchitis.

- Admission ratios for diabetes mellitus and stroke were related to neither deprivation nor time.
- For these seven conditions there was no simple relationship between non-random variability of admission rates and travel time dependence.

Bero (2000) reviewed studies published up to December 1995. The key results were:

- In the one study which compared pharmacist services targeted at patients versus services delivered by other health professionals, the relative changes in professional outcome measures ranged from a 24% increase in clinic visits to a 16% decrease in hospital admissions. Relative differences in patient outcome measures were not statistically significant.
- Of the seven studies which compared pharmacist services targeted at patients versus no intervention, four measured process of care and demonstrated decreases in health services utilisation from -67% for hospital admissions to -564% for total ambulatory care visits, as well as decreases in the numbers and costs of drugs compared to control patients.
- While the limited number of studies analysed support the expanded roles of pharmacists in-patient counselling, more rigorous research is needed to document the effects of out-patient pharmacist interventions.

Coast (1996) assessed the appropriateness of admission using explicit standardised criteria. Up to 19 explanatory variables were modelled for each of the two centres separately using logistic regression to produce final sets of factors independently related to the appropriateness of admission. It was reported that:

- For one centre, the final model contained age/specialty and use of community services.
- For the other centre, the final model contained two measures of health status on admission-coping failure and admission with stroke.
- The authors conclude that the complex interplay between the characteristics of patients, referrers, alternative forms of care and the acute hospital may result in quite different types of inappropriate admissions in different locations.

Chin (1999) reported that:

- 79% of the patients were African-American and 43% did not graduate from high school.
- Upon presentation, 10.6% of the patients were taking a potentially inappropriate medication, 3.6% were given one in the ED, and 5.6% were prescribed one upon discharge from the ED.
- Emergency physicians added potentially inappropriate medications most often to patients with discharge diagnoses of musculoskeletal disorder, back pain, gout, and allergy or urticaria.
- Potentially adverse drug-disease interactions were relatively uncommon at presentation (5.2%), in the ED (0.6%), and on discharge from the ED (1.2%).
- Potentially inappropriate medications and adverse drug-disease interactions prescribed in the ED were not associated with higher rates of revisit to the ED, hospitalisation, or death, but were correlated with worse physical function and pain.

Louis (1999) studied changes between 1993 and 1996 in hospital admission rates (covering 32 hospitals), length of stay, severity of illness, and re-admission rates for nine common conditions: appendicitis, diabetes mellitus, colorectal cancer, cholecystitis, bronchitis/chronic obstructive pulmonary disease (COPD), bacterial pneumonia, coronary artery disease, cerebrovascular disease, and hip fracture. Key findings include:

- The total number of ordinary hospital admissions decreased from 244,581 to 204,054 between 1993 and 1996, a population-based decrease of 17.3% ($p < 0.001$).
- The mean length of stay decreased from 9.1 days to 8.8 days, resulting in a 21.1% decrease in hospital bed days ($p < 0.001$).
- Day hospital use increased sevenfold from 16,871 encounters in 1993 to 108,517 encounters in 1996.
- The largest decrease in hospital admissions among study conditions was a 41% decrease for diabetes (from 2.25 per 1,000 in 1993 to 1.31 in 1996, $p < 0.001$).
- For eight of the nine conditions, severity of illness at admission increased.

Freedman (1996) derived the predictive model on one-half of the subjects and tested its validity on the other half. It was reported that:

- 3,745 (84.8%) out of 4,414 eligible patients responded to the postal questionnaire.
- Univariate analysis revealed 25 variables significantly associated with hospital admission.
- In a logistic regression model, four significant variables successfully stratified the patients by risk of admission, including:
 - presence of heart disease
 - presence of diabetes
 - need for help preparing meals
 - limited physical independence (requiring the help of a person or mechanical aid to get around).
- In addition, there was an antagonistic interaction between the presence of heart disease and limited physical independence.
- The model successfully stratified patients from low risk (4.5% chance of admission) to high risk (39% chance of admission).

Haan (1997) stratified his study sample ($n=6,057$) by age and sex at baseline. It was reported that:

- Hospital discharge rates (sex-age adjusted) increased by 12% between cohorts, with the largest increases at the oldest ages.
- There was a 25% increase among women and a 9% increase among men.
- Length of stay decreased by 20%.
- Hospitalisation for ischaemic heart disease decreased by 17%.
- Congestive heart failure (CHF) discharge rates (sex-age adjusted) were 92% higher in the 1980-88 cohort.
- For diagnoses related to nursing home institutionalisation and frailty, discharge rates were significantly higher in the 1980-88 cohort:
 - pneumonia (+34%)

- urinary tract infections (+104%)
- dehydration (+110%)
- osteoarthritis (+64%)
- syncope (+246%)
- leg cellulitis (+70%).
- In conclusion, while overall out-patient and in-patient utilisation has largely decreased over the past 30 years as a result of economic factors and improved treatments for some major diseases, there has been an increase in utilisation among older people.
- Hospitalisation for diagnoses associated with end-stage cardiovascular disease (CHF), musculoskeletal disease, frailty and iatrogenic aspects of institutionalisation are clearly increasing substantially.
- The largest impact of aging on health care may be the result of institutionalisation and its sequelae.
- Improved survival in cardiovascular disease patients may also be leading to increased utilisation at later stages in the disease process.

Boult (1993) used logistic regression analysis of data from half of the subjects to identify risk factors for repeated hospital admission, and then tested the ability of these risk factors to identify elders at high risk for repeated future hospitalisation using data from the other half of the subjects. Key findings include:

- Among the subjects in the first half of the sample, eight factors emerged as risk factors for repeated admission:
 - older age
 - male sex
 - poor self-rated general health
 - availability of an informal care giver
 - having ever had coronary artery disease
 - having had, during the previous year, a hospital admission, more than six doctor visits, or diabetes.
- Based on the presence or absence of these factors in 1984, 7.2% of the subjects in the second half of the sample were estimated to have a high probability of repeated admission during 1985-1988.
- In comparison with subjects estimated to have a low risk, this high-risk group's actual experiences during 1985-1988 included a higher cumulative incidence of repeated admission (41.8% vs. 26.2%, $p < 0.0001$) and more hospital days per person-year survived (5.2 vs. 2.6).
- Eight easily ascertained risk factors affect elders' probability of being hospitalised repeatedly within four years.

Billings (1996) states that:

- Disparities in health outcomes for low income populations as documented by rates of preventable hospital admission remain large in the United States, even with the moderate expansion of Medicaid and efforts at the state and local levels to improve primary care services that began in the mid-1980s.
- These differences in outcome for rich and poor are not an isolated phenomenon of a few old and decaying Northeast urban centres but are documented in a broad range of urban areas.

- Much smaller differences are found in urban areas in Ontario, where universal coverage may help to reduce barriers to care.

Results from the study by *Majeed (2000)* include:

- Standardised hospital admission ratios varied from 74 to 116 for total admissions and from 50 to 124 for emergency admissions.
- Directly standardised admission rates for asthma varied from 152 to 801 per 100,000 (mean 364) and for diabetes from 235 to 1034 per 100,000 (mean 538).
- There were large differences in the mortality, socio-economic, and general practice characteristics of the primary care groups.
- Hospital admission rates were significantly correlated with many of the measures of chronic illness and deprivation.
- For admissions for all diagnoses, the strongest correlations were with disability living allowance ($R=0.64$ for total admissions; $R=0.62$ for emergency admissions, $p<0.0001$), incapacity benefit ($R=0.50$ and $R=0.54$ for total and emergency admissions respectively, $p<0.01$), and family credit ($R=0.48$ and $R=0.56$ for total and emergency admissions respectively, $p<0.01$).
- For admissions for diabetes, the strongest correlations were with disability living allowance ($R=0.56$, $p<0.01$), incapacity benefit ($R=0.48$, $p<0.01$), and income support ($R=0.43$, $p<0.01$).
- For admissions for asthma, correlation coefficients were somewhat lower, the strongest correlations being with disability living allowance ($R=0.36$, $p<0.01$), incapacity benefit ($R=0.22$, $p>0.01$), and severe disability allowance ($R=0.22$, $p>0.01$).
- Among the census derived variables, for admissions for all diagnoses, the strongest correlations were with households headed by someone from an unskilled socio-economic group ($R=0.51$ and $R=0.55$ for total and emergency admissions respectively, $p<0.0001$).
- There were also strong correlations between standardised mortality ratios and hospital admission rates.
- Practice characteristics were less strongly associated with hospital admission rates.
- Methods for producing comparative data on general practices can be adapted to produce similar data on primary care groups despite the difficulties posed by the dual responsibility of primary care groups for patients living in their area and patients registered with their constituent general practices irrespective of where they live.
- In summary, primary care groups have highly variable patient and practice characteristics and hospital admission rates are associated with chronic illness and deprivation.

Admission rates among children

The general reviews of hospital admission among children that have been reviewed are:

- *Durojaiye (1989)* compared acute paediatric medical admissions in 1985 in Nottingham Health District with those in 1975 and measured the numbers of preventable admissions.
- *Casanova (1995)* carried out a case-control study of the relationship between avoidable hospitalisations and socio-economic characteristics (illiteracy, unemployment, income) and primary care characteristics (type of physician and facilities for primary care) of children's area of residence in Spain.
- *Casanova (1996)* identified socio-demographic and primary care factors associated with paediatric hospitalisation for ambulatory care-sensitive conditions, in a country (Spain) with a health system that provides universal coverage.
- *Henderson (1992)* analysed data for 1975, 1979, and 1984 on in-patient care in six districts in southern England covered by the Oxford record linkage study to identify the clinical conditions associated with substantial time spent in hospital by children aged 1-14 years.

Durojaiye (1989) reported that:

- Over the study period there was a 100% increase in paediatric admissions in Nottingham, with similar increases throughout Trent Region.
- Apart from ingestions, there were increases in every diagnostic category, with a six-fold increase in the admission rate for lower respiratory tract problems, mostly asthma and wheeze.
- Only 9% were classified as 'social admissions'.
- Improvements in primary care over the study period were not accompanied by a fall in hospital admissions.

Casanova (1995) compared the prevalence of avoidable hospital admissions and their relationship to socio-economic and primary care characteristics in Spain and the United States. It was reported that:

- Neither socio-economic nor primary care characteristics affected the probability of being admitted to hospital for treatment of an ambulatory care sensitive (ACS) condition in Spain.
- The rate of admission for ACS conditions was lower in Spain than in the United States.
- The authors conclude that the provision of universal financial access to care and the availability of a consistent and accountable primary care provider are associated with lower hospitalisation rates for conditions that are preventable with good primary care.

Casanova (1996) conducted a cross-sectional survey of 504 children hospitalised in a District General Hospital in Valencia, Spain. Key findings include:

- Children who were under two years old and female were at significantly higher risk for hospitalisation due to ambulatory care sensitive conditions.

- Socio-economic variables, type of physician or a previous visit to primary care services were not associated with a different risk of hospitalisation due to these conditions.
- Characteristics unrelated to difficulties in access, or to type of provider, influence the risk of hospital admissions for conditions that could be prevented or managed without hospitalisation.

Henderson (1992) reported that:

- Conditions that accounted for large numbers of children with lengths of stay of five days or more included, in particular, congenital anomalies, asthma, and appendicitis.
- Conditions that accounted for the largest numbers of bed days used included congenital anomalies, hypertrophy of tonsils and adenoids, asthma, otitis media, appendicitis and head injury.
- Over the study period, admission rates for children who spent five days or more in hospital each year declined for all common conditions except asthma which increased.
- Total numbers of beds used increased for asthma and otitis media but declined for all other common conditions.

4. STUDIES ADDRESSING ADMISSION RATES FOR CHRONIC CONDITIONS

A number of studies have addressed the admission rates for medical conditions and these have been classified as relating to:

- multiple conditions
- asthma in adults and children
- diabetes
- mental illness
- cardiovascular disease

Multiple conditions

The studies addressing more than one condition that have been reviewed are:

- *Bindman (1995)* examined whether the higher hospital admission rates for chronic medical conditions such as asthma, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and diabetes in low-income communities resulted from community differences in access to care, prevalence of the diseases, propensity to seek care, or physician admitting style.
- *Komaromy (1996)* examined whether variation in hospitalisation rates for asthma, congestive heart failure, and diabetes in 40 medical service areas in California could be attributed to differences in physician practice style. The threshold for admission and the effect of social characteristics that increase patients' vulnerability to illness, including homelessness and drug use, were measured.
- *Lorig (1999)* carried out a six month community-based randomised controlled trial (RCT) to evaluate the effectiveness (including changes in rates of hospital admission) of a self-management program for chronic disease designed for use with a heterogeneous group of chronic disease patients including those with co-morbid conditions.
- *Roblin (1999)* evaluated the effect of primary care visit patterns and therapeutically risky drug combinations on the likelihood of hospital admission in a subsequent three month period among health maintenance organisation enrollees (aged 20-64 years) who had two of three chronic diseases (diabetes, circulatory disorders, obstructive pulmonary disorders).
- *Giuffrida (1999)* analysed hospital admission data for asthma, epilepsy and diabetes for the period 1989-90 to 1994-5 for 90 family health services authorities in England to investigate the impact of factors outside the control of primary care on performance indicators proposed as measures of the quality of primary care.
- *Krakauer (1996)* assessed the effect of variations in the supply and specialty distribution of primary care physicians on admission rates for ambulatory care-sensitive conditions (ACS) and for all causes among Medicare beneficiaries (≥ 65 years old) of various health care service areas (HCSA) in 1992.
- *Begley (1994)* derived population-based hospitalisation rates for preventable conditions for a low-income population in Galveston County,

Texas using discharge data from four area hospitals and demographic data from the U.S. Census.

- *Weinberger (1996)* described the effect of a post-discharge intervention designed to increase access to primary care for severely ill veterans discharged from Veterans Affairs (VA) hospitals on the rate of subsequent hospitalisation.
- *Quinn (1999)* described the effects on hospital admission rates over a six month period following the piloting of a community care management (CCM) model for the high-risk chronically ill, Medicare population in a large national health plan.
- *Bassili (2000)* assessed the quality of primary care (as defined by the degree of adherence to recent therapeutic guidelines) and compliance with the prescribed management in a cross-sectional study over a four month period of 953 children admitted to hospital or visiting ambulatory hospital settings with chronic diseases (asthma, type I diabetes, epilepsy, and rheumatic heart disease) in Alexandria, Egypt.
- *Shi (1999)* assessed patient socio-demographic characteristics associated with adult and paediatric hospitalisations for ambulatory care sensitive conditions (ACSC) in South Carolina in 1995
- *Gill (1997)* determined whether Delaware Medicaid patients (aged 0-64 years) with a regular source of care (RSOC) were less likely to be hospitalised, either for all conditions or for ambulatory care sensitive conditions (ACSCs), than those without an RSOC in a one year population-based survey study (n = 22,862).
- *Schreiber (1997)* assessed the usefulness of admissions for ambulatory care sensitive conditions (ACSC) as measures of access to health care.
- *Parker (2000)* estimated national hospitalisation rates for ambulatory care-sensitive conditions among children and examined the behaviour of the index between subgroups of children.

Bindman (1995) calculated the hospitalisation rates for these five chronic conditions for the 250 ZIP code clusters that define urban California. A random-digit telephone survey among 6,674 adults (aged 18-64 years) residing in a random sample of 41 of these urban ZIP code clusters (stratified by admission rates) was undertaken, as was a mailed survey of 723 generalist and emergency physicians who practiced in the same 41 areas. The study tested whether access to medical care remained independently associated with preventable hospitalisation rates after controlling for the prevalence of the conditions, health care seeking, and physician practice style. The study revealed that:

- Access to care was inversely associated with the hospitalisation rates for the five chronic medical conditions ($R^2 = 0.50$; $p < 0.001$).
- In a multivariate analysis (that included a measure of access, the prevalence of conditions, health care seeking, and physician practice style) to predict cumulative hospitalisation rates for chronic medical conditions, both self-rated access to care ($p < 0.002$) and the prevalence of the conditions ($p < 0.03$) remained independent predictors.
- Communities where people perceive poor access to medical care have higher rates of hospitalisation for chronic diseases.

- Improving access to care is more likely than changing patients' propensity to seek health care or eliminating variation in physician practice style to reduce hospitalisation rates for chronic conditions.

In the study by *Komaromy (1996)*, 1,090 physicians responded (71%). Findings included:

- There was significant variation across areas in both the clinical ($p < 0.0001$) and social ($p < 0.001$) admission scores.
- Variation in hospitalisation rates correlated with physicians' clinical ($r = 0.34$, $p = 0.03$) and social ($r = 0.36$, $p = 0.02$) admission scores.
- Physician practice style was not associated significantly with hospitalisation rates in a multiple linear regression analysis that included adjustment for community socio-demographic factors.

The study by *Lorig (1999)* included 952 patients (aged 40 years or older) with a diagnosis of heart disease, lung disease, stroke, or arthritis. Treatment subjects were compared with waiting list subjects. Treatment subjects, when compared at six months with control subjects, had fewer hospitalisations and days in the hospital, suggesting that this intervention was feasible and beneficial beyond usual care.

Roblin (1999) used a retrospective observational study design. In the regression analysis, adjustments were made for age, gender, and disease state in the prior 12 month period. Findings revealed that:

- HMO enrollees with visits to three or more different primary care physicians were 46% more likely to be admitted than expected ($p < 0.01$) according to their age, gender, and disease state, and those with therapeutically risky drug combinations were 34% more likely to be admitted ($p < 0.01$).
- The risk adjustment models evaluated in this study defined care processes associated with increased risk of subsequent acute level services. Those processes may represent nascent acute disease states or sub-optimal organisation of care delivery.

Giuffrida (1999) undertook a multiple regression analysis and found that:

- At the health authority level, socio-economic characteristics, health status, and secondary care supply factors explained 45% of the variation in admission rates for asthma, 33% for diabetes and 55% for epilepsy.
- When health authorities were ranked, only four of the ten with the highest age-sex standardised admission rates for asthma in 1994-5 remained in the top ten when allowance was made for socio-economic characteristics, health status, and secondary care supply factors.
- The ranking of an individual health authority in 1994-5 compared with 1993-4 changed by ten or more places in 51% of areas for asthma, 31% of areas for diabetes, and 40% of areas for epilepsy.
- Combining rates for asthma, diabetes and epilepsy (as proposed in the NHS Executive's consultation document) did not produce rankings that were notably more stable, with 31% of authorities still changing rank order by more than ten places and 11% by over 20 places.

- There was also substantial year to year variation in the rates, underlining the statistical instability of admission rates for particular conditions.
- The authors concluded that while health outcomes should relate to crude rates of adverse events, performance indicators should relate to those aspects of care that can be altered by staff whose performance is being measured.

Krakauer (1996) found that when comparing the top and bottom deciles of the health care service areas (HCSA):

- Physician supply levels varied nearly fourfold or more, Medicare admissions for ACS conditions varied about threefold, and admission rates for all causes varied about 1.5-fold.
- Physician supply levels and distributions had very little influence on ACS admission rates, and even less on the admissions for all causes, except in HCSAs with very low physician supply levels (one-quarter of the national average or less). However, these HCSAs account for only about 1% of the U.S. population.
- Physician supply levels and the proportions of specialists and generalists have negligible effects on health status as measured by rates of admission for all causes and for conditions presumed to be sensitive to the adequacy of ambulatory care. Reductions in admissions for such conditions are not likely to be achieved through increases in the supply of physicians nor, conversely, through a reduction in any presumed oversupply of physicians.

Begley (1994) compared population-based hospitalisation rates for Galveston County with similar rates for the general populations of Maryland, Massachusetts and New York City. Results support the hypothesis that low income persons lack access to primary care, leading to higher rates of hospitalisation for preventable conditions.

In the study by *Weinberger (1996)* 1,396 severely ill veterans hospitalised at nine VA Medical Centers with diabetes, chronic obstructive pulmonary disease, or congestive heart failure were randomly assigned to receive either usual care or an intensive primary care intervention. The intervention involved close follow-up by a nurse and a primary care physician, beginning before discharge and continuing for the next six months. Key findings include:

- Although they received more intensive primary care than the controls, the patients in the intervention group had significantly higher rates of subsequent hospitalisation (0.19 vs. 0.14 per month, $p = 0.005$) and more days of re-hospitalisation (10.2 vs 8.8, $p = 0.041$).
- Patients in the intervention group were, however, more satisfied with their care.

In the study by *Quinn (1999)*, key elements of the community care management pilot programme included the proactive identification and risk stratification of health plan members; assignment of advanced practice nurses to physicians with high volume high risk members; and ongoing clinical management across the continuum, establishing a continuous relationship with the member. Findings were:

- Plan members in the pilot study experienced both a 42% reduction in institutional days and a 53% reduction in admissions to acute care settings.

- In addition, physician and specialist fees were reduced by 37%.

Bassili (2000) reviewed out-patient clinic records to assess compliance before the index visit with the prescribed management. Key results include:

- Only 52% of mild asthmatics were given inhaled bronchodilators during acute attacks and 6.84% of moderate to severe asthmatics were taking prophylactic drugs (inhaled sodium cromoglycate and/or inhaled beclomethasone) between acute attacks.
- Only 53 of 134 (39.6%) of diabetic children were regularly performing self-monitoring of blood glucose and/or urine testing.
- In contrast, in epileptic children, 121 of 173 (69.9%) were judged as being compliant with anti-epileptic drugs by their managing clinicians.
- More than two thirds 82/123 (66.7%) of children with rheumatic heart disease were compliant with a secondary prophylactic antibiotic.
- This study suggests that cultural and economic factors are the primary predictors of sub-optimal quality of primary care for childhood chronic diseases, as defined by the degree of adherence to recent therapeutic guidelines.
- Non-compliance to medication reflects the quality of delivered care in terms of defective health education rather than problems in the availability of medications in the local market or problems in the access to pharmacy or health services.

Shi (1999) tested the differences between ambulatory care sensitive condition (ACSC) groups and non-ACSC groups in specific socio-demographic characteristics. The main findings include:

- Non-whites, low income individuals, and those residing in more rural areas had significantly more ACSC hospitalisations than their respective counterparts (i.e. whites, high-income individuals, and those residing in metropolitan statistical areas).
- Individuals without a primary care physician were more likely to be hospitalised with ACSC.
- Ambulatory care sensitive condition hospitalisation charges were 12% of total hospital charges for adults and 20% for children.
- The authors conclude that providers can rapidly assess needs and barriers faced by vulnerable population groups by using regularly collected hospital discharge data at the national, state, and community level.

Results from the study by *Gill (1997)* include:

- Patients who had made more than 50% of their physician office visits to the same provider group were considered to have an RSOC. The probability of hospitalisation for all conditions and for ACSCs was compared for persons with and without an RSOC.
- 81% of Medicaid clients had an RSOC, 75% of whom were primary care physicians.
- Persons with an RSOC were not less likely than those without an RSOC to be hospitalised for any condition (15% vs. 14.6%) or for ACSCs (3.4% vs. 3.2%).

- The results were not substantially different for persons who used primary care physicians as their RSOC.
- In summary, having an RSOC is not associated with a lower likelihood of hospitalisation for the Medicaid population, either for all conditions or for ACSCs.

Schreiber (1997) reported that:

- Factors positively associated with ACSC admissions included the percentage of the population below 200% of the federally defined poverty level, the percentage of black people, and the number of primary care providers per 1,000 population
- Population density was negatively associated with ACSC admissions.
- There was no association between the location of the ZIP code in a health professional shortage area and ACSC admissions.
- Proximity to the hospital was found to be positively associated with ACSC admissions but was examined only in the most rural ZIP code group.
- The significant independent variables and the direction of their effects were the same across all ZIP code groups.
- The analysis suggests that high ACSC admissions may be a reflection of deficits in one or more of the following areas:
 - primary care availability
 - accessibility
 - appropriateness.
- In-depth study is needed to determine the relative importance of these factors in a given geographical area.
- There may also be environmental and social factors external to the health care system that contribute to ACSC admissions.
- The findings suggest that ACSC should be used cautiously as a measure of primary care system needs, and in conjunction with other health, demographic, or service utilisation data.

Parker (2000) used data from the 1990-1995 National Hospital Discharge Surveys (NHDS), the US census, and the National Health Interview Survey (NHIS) to calculate hospital discharge rates. It was found that:

- Predictably, Ambulatory Care-Sensitive Conditions (ACSCs) hospitalisation rates were significantly higher among children who were younger, black, had Medicaid insurance, and lived in poorer areas.
- However, the relationship between ACSCs and income and the distributions of conditions within the index varied between children.
- In conclusion, while ACSCs may indicate disparities in access and utilisation of health care, the differing behaviour of the index between sub-groups suggests that inferences from examining rates of ACSCs may not be comparable for all children.

Asthma

The asthma studies that have been reviewed are:

- *Watson (1996)* carried out a one year retrospective study of hospital admissions for asthma in the West Midlands region of England (n =10,044), and in one of the region's wealthier districts, Worcester (n =251), to examine the relationship between asthma admission rates, routes of admission, and socio-economic deprivation.
- *Gilthorpe (1998)* undertook a retrospective study of 15,921 asthma-related admissions between April 1995 and March 1996 among residents of the West Midlands, of whom 8.5% are from black and minority ethnic groups.
- *Bates (1995)* examined patterns of utilisation of health care resources.
- *Heard (1997)* undertook a cross-sectional study of the association between gender and the socio-economic status (SES) of the area of residence of people frequently hospitalised for asthma.
- *Blixen (1999)* undertook a cohort study of 124 African-American (AA) and 67 Caucasian (C) patients, 18-50 years old, enrolled in a large HMO and hospitalised for asthma between 1993 and 1995 to determine whether racial differences in patterns of care persist when financial barriers to health care are minimised.
- *Ayres (1986)* compared admission rates for acute asthma to a general hospital in the East Birmingham among Asian and non-Asian patients between 1972 and 1982.
- *Kolbe (1997)* assessed within 24-72 hours 138 patients (aged 15-50 years) admitted to hospital with acute severe asthma using a number of validated instruments to determine the quality of medical care and the level of socio-economic disadvantage.
- *Griffiths (1997)* carried out a study of asthma admission rates (excluding re-admissions) among patients aged 5-64 years for all 163 general practices in East London and the City Health Authority to determine the relative importance of appropriate prescribing for asthma in explaining high hospital admission rates.
- *Rydman (1998)* conducted a prospective randomised controlled trial to assess whether an accelerated treatment protocol administered to acute asthmatics presenting to a hospital emergency department observation unit can offset the need for in-patient admissions and reduce cost without sacrificing patient quality of life.
- *Burney (1991)* carried out a postal survey in 1986 of a representative sample of 20-44 year old men living in 20 local authority districts in England to identify symptoms associated with asthma and hospital admission for asthma.
- *Osman (1999)* undertook a one year study of 754 asthmatic adult out-patients to assess factors for physician consultation and hospital admission.
- *Mitchell (1987)* studied approximately 200 European children admitted to hospital for asthma to compare the characteristics of those with multiple admissions and those having their first admission.
- *Mitchell (1988)* undertook a study comparing 156 Polynesian children with 199 European children admitted to hospital for asthma.

- *Homer (1996)* examined whether the quality of ambulatory care affects rates of hospitalisation for childhood asthma across three communities with high (Boston), low (Rochester) and intermediate (New Haven) rates. A community-wide retrospective review was undertaken of a random sample (n=614) of all paediatric (aged 2-12 years) asthma hospitalisations between 1988 and 1990.
- *Anderson (1989)* investigated reasons for the increase in paediatric hospital admission rates for asthma in the South West Thames Region (population 2.9 million) over the eight years 1978-85.
- *Connett (1993)* reported on two audits of the admissions policy for acute asthma among paediatric patients at the Royal Alexandra Hospital.
- *McConnochie (1999)* analysed all 2,028 asthma hospitalisations between 1991 and 1995 for children (aged >1 month and <19 years) dwelling in Rochester, New York.
- *Wickman (1998)* examined reasons for the 100% increase in the rate of first time hospitalisation for lower respiratory disease (89.6% of diagnoses were asthma or obstructive bronchitis) between 1973 -1992 in Stockholm County among children aged <2 years.
- *Russo (1999)* undertook a study of all 2,028 hospitalisations for asthma between 1991 and 1995 among children (<19 years) in Monroe County, New York to examine the relation between severity and admission rate.
- *Finkelstein (1995)* determined whether patient race or source of payment was associated with differences in the quality of outpatient and in-patient treatment among 354 paediatric patients (aged 1-6 years) discharged with asthma between October 1989 and September 1990.
- *Weiss (1993)* examined trends in paediatric admission rates for asthma during the 1970s and 1980s in the US.
- *Murray (1995)* compared the medical records of 23 children hospitalised for more than four days between October 1989 and September 1991 with acute asthma with those of 62 sex- and age-matched children hospitalised for two days.
- *Dales (1996)* investigated the association between autumn increases in hospital admission for asthma and respiratory infections among pre-school children in Toronto during the period 1981 to 1989.
- *Conway (1985)* studied the treatment characteristics of 110 children with a total of 142 hospital admissions for acute asthma during a one year period.
- *Prescott (1997)* followed up 13,540 subjects from 1977 to 1993, 160 of whom were admitted to hospital for asthma.
- *Vollmer (1992)* examined trends in hospitalisations for asthma from 1967 to 1987 among members of a large health maintenance organisation.
- *Mayo (1990)* reported on a randomised controlled trial in which 104 adult asthmatics in New York who had previously required multiple hospitalisations for asthma attacks were randomly assigned to an intensive out-patient treatment clinic (n=47) which involved a vigorous medical regimen and educational program or to receive their previous out-patient care (n=57).
- *Aveyard (1997)* compared practice emergency admission rates of asthma by general practice with the practice's performance in measuring the prevalence, peak flow, and number of patients on regular prophylaxis.

- *Emond (1999)* conducted a before-after study of an acute asthma quality improvement initiative in the emergency department of an urban teaching hospital.
- *Crompton (1979)* described the first ten years of the emergency service begun in Edinburgh in 1968 where patients with severe acute asthma can contact an ambulance and present directly to respiratory services when symptoms arise.

Watson (1996) compared age-standardised admission ratios (SARs) for asthma, and the routes of hospital admission, with the Townsend Deprivation Index for the place of residence. The following findings emerged:

- Asthma SAR was strongly associated with deprivation as measured by the Townsend Index for the district of residence (Spearman rank correlation coefficient $\rho = 0.65$; $p = 0.004$).
- Asthma admission rates for all age groups, except those aged over 65 years, were higher in poorer districts.
- A significantly greater proportion of emergency admissions in poorer districts came via A&E departments, rather than general practitioner referrals ($\rho = 0.76$; $p < 0.001$).

In the study by *Gilthorpe (1998)*, findings included:

- Age-standardised admission rates were higher in all black and minority ethnic groups studied than in the white group.
- There were elevated rates in black children aged 5-14 years, and particular differences were observed for Indian and Bangladeshi men and women aged 65 years or over.
- These findings support previous studies that suggest that hospital utilisation rates for asthma among people from black and minority ethnic groups are high compared with the white group.
- Emergency admissions to hospital for asthma were strongly associated with patients' socio-economic background but this was largely observed for black and minority ethnic groups that also generally experience high levels of deprivation.
- This study suggests that ethnic background is more important in asthma admissions than deprivation, which raises serious concerns on the appropriateness and quality of asthma care for these patient groups within our society.
- The authors conclude that further research is needed to examine the health seeking behaviour of black and minority ethnic groups, the type of treatment received at the primary care level and referral patterns to secondary care.

Bates (1995) reported that:

- Patterns of utilisation by asthma patients of health care resources (including hospital emergency departments, individual physicians, etc.) are dependent on economic circumstances.
- Low income children have higher annual morbidity (days in hospital, days off school, etc.) than higher income children and are more dependent on hospital emergency departments for primary care.

Heard (1997) found that:

- Women represented 75% of the re-admission population at a low socio-economic status (SES) hospital and 55% at a moderate-high SES hospital.
- Women at the low SES hospital were significantly more likely to have one re-admission within 12 months and over 30 times more likely to have two or more re-admissions than women at the moderate-high SES hospital.

Blixen (1999) reported the following findings:

- AAs had a significantly lower median household income and made more asthma-related emergency department visits (45.2%) than Cs (22.4%) during the one year after the initial hospitalisation ($p < 0.001$).
- During the same time period, Cs made more asthma-related primary care (70.2%) and allergy/pulmonary visits (38.8%) than AAs (47.6% and 27%, respectively).
- Although there were no significant racial differences in the re-hospitalisation rate, AA Medicaid contract patients (32%) had more re-hospitalisations for asthma than AA regular contract patients (15.8%).
- These differential patterns in the use of asthma-related healthcare in this study indicate that the provision of health insurance alone is not sufficient to promote optimal levels of asthma management by all beneficiaries.

Findings from the study by *Ayres (1986)* included:

- 20% of admissions were in Asian patients who comprised only 9.7% of the population.
- In 1981, admission rates for acute asthma per 100,000 population, assuming equal asthma prevalence rates, was 198 for Asians compared to 79 for non-Asians.
- The authors suggest poor asthma education due to language problems and poor adherence to treatment among Asian patients may contribute significantly to this difference.

In the *Kolbe (1997)* study a detailed history of events of the asthma attack was assessed against predetermined criteria for non or delayed use of oral corticosteroids and non or delayed use of emergency ambulance services. Results show that:

- Although having high morbidity (40% had hospital admission in the last year), patients had evidence of good ongoing medical care (96% had a regular GP, 80% were prescribed inhaled steroids, 84% had a peak flow meter, GP measured peak flow routinely in 80%, 52% had a written crisis plan and 44% had a supply of steroids at home).
- Patients admitted were severely economically disadvantaged (53% had experienced financial difficulties in the last year, and for 35% of households the only income was a social security benefit).
- In the last year, 39% of these patients had delayed or put off a GP visit because of cost.
- Management of the index attack was compromised by concern about medical costs in 16% and time off work in 20%.

- Serious management errors are common in those admitted to hospital with acute severe asthma and most errors relate to patient self-management behaviour
- These errors are predicted by a variety of socio-economic and psychological factors including:
 - unemployment
 - panic during the index attack
 - concerns during the attack about medical expenses and taking time of work.
- Most acute severe asthma attacks are theoretically preventable by currently available strategies and the challenge for the future is to change patients' behaviour in the face of considerable adverse socio-economic and psychological factors.

Griffiths (1997) found that:

- Higher admission rates were most strongly associated with small size of practice partnership: admission rates of single-handed and two partner practices were higher than those of practices with three or more principals by 1.7 times (95% CI 1.4-2.0, $p < 0.001$) and 1.3 times (1.1-1.6, $p = 0.001$) respectively.
- Practices with higher rates of night visits also had significantly higher admission rates: an increase in night visiting rate by 10 visits per 1000 patients over two years was associated with an increase in admission rates for asthma by 4% (1% to 7%).
- These associations were independent of asthma prescribing ratios, measures of practice resources, and characteristics of practice populations.
- The authors emphasise the need to evaluate ways of helping smaller partnerships develop structured pro-active care for asthma patients at high risk of admission.

Rydman (1998) compared post-intervention patient quality of life for EDOU care versus standard in-patient care as measured by the standardized medical outcomes Study (MOS) SF-36 instrument. Subjects included 113 eligible patients from a consecutive sample of 250 acute asthmatic patients presenting to an urban hospital emergency department who could not resolve their acute asthma exacerbation after three hours of emergency department therapy. It was found that:

- Patients assigned to the EDOU had lower mean costs of treatment and higher quality of life outcomes after intervention in five of eight domains measured by the MOS SF-36.
- No differences were found in clinical outcomes as measured by peak flow rates or post-intervention relapse free survival.

Burney (1991) reported that:

- Admission rates for asthma were related to the prevalence of night time breathlessness but not significantly related to prescription rates of either corticosteroids or beta-2-agonists for symptomatic men.
- On the basis of their findings, the authors concluded that admission rates for asthma are not dictated solely by health service characteristics, such as availability of beds or the "style" of the physician, but also reflect need.

Osman (1999) found that sub-optimal use of inhaled steroids (defined as less than five prescriptions per year) and over-reliance on bronchodilator medication (seven or more prescriptions per year) was associated with a significantly higher risk for family physician consultation ($p < 0.05$) and hospital admission ($p < 0.05$) for acute asthma episodes.

Mitchell (1997) found that the main difference between the two groups of paediatric asthma patients was asthma drug management in the 24 hours prior to the index admission and six months later.

Mitchell (1988) found that:

- After controlling for socio-economic status, the number of previous hospital admissions for asthma was significantly higher in Polynesians than Europeans.
- However, 33% of Polynesian children were not receiving any asthma drugs in the 24 hours prior to admission compared with 14% of Europeans (RR=1.94, 95% CI 1.25-3.00).
- The authors conclude that these differences in hospital admission rates cannot be explained by genetic or socio-economic factors.

Homer (1996) reported the following results:

- Compared with Rochester children, Boston children were less likely to have received maintenance preventive therapy (OR=0.4; 95% CI 0.2-0.9), acute "rescue" therapy (OR=0.2; 95% CI 0.1-0.4), or inhaled beta-agonist therapy (OR=0.5; 95% CI 0.3-1.0).
- A larger proportion of admitted asthmatic patients in Boston (34%) were in the least severely ill group (oxygen saturation 95% or above) compared with patients in Rochester (20%).
- These results suggest that the quality of ambulatory care, including choice of preventive therapies and thresholds for admission, likely plays a key role in determining community hospitalisation rates for chronic conditions such as childhood asthma.

Anderson (1989) reported that:

- The number of hospital admissions among those aged 0-4 and 5-14 rose by 186% and 56% between 1978 and 1985.
- The findings indicate that there has been no reduction in severity on admission or increase in re-admission rate since 1978.
- No significant shift was found in the mode of referral, a finding which contrasts with findings from an earlier study (1970-8) in the same region, in which a fivefold increase in self referred admissions was observed together with an increase in the re-admission rate and a reduction in the duration of the attack.
- The authors conclude that the increase in admissions may be due to an increase in the number of asthmatic children experiencing severe attacks rather than changes in medical practice or labelling shift.

Connett (1993) reported the following:

- In the first study the on call senior house officer (SHO) was replaced by an experienced registrar and over a four month period 53 children out of 158 were sent home from the receiving room compared with six out of 39 seen by the SHOs.
- In the second study an SHO training programme was established together with a home treatment package.
- Over a 12 month period the on call SHOs assessed 687 children with acute asthma; 229 (43.5%) were deemed fit to be sent home. Only seven of these were readmitted within one week.
- Diary symptom score cards filled in by parents indicated that children sent home without admission fared no worse at home (than those admitted and then discharged) for the two weeks after leaving hospital.
- The development of strategies to improve assessment and immediate management in the hospital receiving room can reduce hospital admissions.

McConnochie (1999) reported that:

- The hospitalisation rate of asthma in boys was almost twice the rate of asthma in girls. The greatest gender difference was observed among children who were <24 months old.
- This gender difference diminished gradually in older age groups to the extent that there was no difference among girls and boys between the ages of 13 and 18 years.
- Although rates within the community followed a distinct geographic pattern of suburban (1.05/1000 child-years) < other urban (2.99/1000) < inner-city (5.21/1000), the proportions of admissions with low severity did not vary among areas.
- Likewise, the proportions of admissions that were severe were not significantly different (44.8, 45.7, and 52.1% for suburban, other urban, and inner-city areas, respectively).
- The distributions of asthma severity, measured by the duration of frequent nebulized bronchodilator treatments and the length of hospital stay, were also similar among children from different socio-economic areas.
- In conclusion, the marked socio-economic and racial disparity in Rochester's asthma hospitalisation rates is largely attributable to higher incidence of severe acute asthma exacerbations among inner-city children; it signals greater need, not excess utilisation.
- Both adverse environmental conditions and lower quality primary care might explain the higher incidence.

Wickman (1998) reported that differences in hospitalisation between municipalities seemed to be partly explained by differences in the admission practices of the four paediatric hospitals in the area.

Russo (1999) reported that:

- Between 1991 and 1995, asthma severity increased significantly among those hospitalised while the overall hospitalisation rate remained relatively stable.

- As a proportion of all asthma hospitalisations in this period, severe episodes increased from 31.5% to 60.4% while mild episodes decreased from 14.1% to 4.7%.
- It appears that the health care system responded to an increase in severity of asthma by raising the severity threshold for admission.

Findings from the study by *Finkelstein (1995)* include:

- After adjustment for confounders, hispanic patients were less likely than white patients to have taken inhaled beta-agonists before admission.
- Both black and hispanic patients were less likely than white patients to have taken anti-inflammatory medications before admission.
- After adjustment for the patients' primary care practice type, the effect of patient race did not persist for these indicators of out-patient care.
- No differences by patient race were found in emergency department care.
- After adjustment for confounders, there were no differences in the quality of asthma care by source of payment.

Weiss (1993) reported that:

- A steady increase in the rate of hospitalisation for asthma was observed in children under the age of 15 during the 1970s and 1980s.
- During the 1980s, the increase in hospitalisation among children appeared to be restricted to those under five years.
- Although the 0-4 year age group had been exhibiting increased hospitalisation rates, this age group did not appear to be expressing increased morbidity as it became older.
- One possible reason for this age-specific trend is an increasing tendency among physicians to admit young children who present to the hospital emergency room.

Murray (1995) reported that:

- Only one of the 23 patients in the long-stay group had augmented asthma treatment within 24 hours before hospitalisation, compared with 39 of the 62 patients with short stays ($p < 0.001$).
- During hospitalisation, a greater proportion of children in the long-stay group than the short-stay group received supplemental oxygen ($p < 0.01$).

Dales (1996) reported the following results:

- There was a fourfold increase in asthma admissions between July and October which was unaccompanied by similar increases in non-respiratory admissions.
- After adjusting for serial correlation, trends, climate, ambient air pollution and aeroallergens, the seasonal pattern of respiratory infection explained 14% of the variance in asthma admissions.
- Respiratory infection is the major identifiable risk factor for the large autumnal increase in asthma admissions.

Conway (1985) found that:

- 34 of 106 (32%) children with previous wheezing had not been diagnosed as asthmatic, nor had received effective anti-asthmatic medication.
- Of the 36 previously diagnosed but under-treated cases, 19 (53%) were under the care of hospital paediatricians.
- Good parental understanding of their child's illness was strongly associated with adequate treatment; parental understanding was, however, poor in 58 of 137 (42%) admissions.

Prescott (1997) reported that:

- After controlling for self-reported asthma and smoking, women had a higher risk of being admitted to hospital than men (relative risk=1.7; 95% CI 1.2-2.4).
- This increased risk was not due to misclassification of chronic obstructive pulmonary disease (COPD) as asthma.
- These findings indicate gender-related differences in either the severity, perception, or management of asthma.

Vollmer (1992) reported that:

- Between 1967 and 1987 asthma discharges increased significantly among children, and especially among boys under the age of five years.
- Changes in the International Classification of Diseases coding of asthma and diagnostic shift by physicians accounted for only part of the increase.
- 95% of the increase in discharges among boys was explained by a corresponding increase in the number of boys who were hospitalised; increased re-admissions did not account for the rise.
- This is more consistent with an increase in the prevalence of asthma than with an increase in the underlying severity of asthma, since in the latter case one might also have expected an increase in the number of hospitalisations per child.

Results from the study by *Mayo (1990)* include:

- Prospective comparison of treated compared with untreated patients found a threefold reduction in re-admission rate ($p < 0.004$) and a twofold reduction in hospital day use rate ($p < 0.02$) among the former.
- Using retrospective data with patients serving as their own controls, a threefold reduction was observed in re-admission rate and in hospital day use ($p < 0.003$) during a 32 month follow-up period.
- A similar magnitude of reduction in hospital utilisation was found when 19 control patients were crossed over to the intensive out-patient treatment group ($p < 0.004$).

Aveyard (1997) used prescribing analysis and costing (PACT) data and census linkage were used to assign social class to patients and, when aggregated, to practices. The key findings were:

- A high rate of admission for asthma in practices was correlated with deprivation of the patients, in the form of a practice Townsend score ($r = 0.33$, $p=0.003$), and also with poorer prescribing, measured by the preventer-reliever ratio ($r = -0.38$, $p=0.001$).
- Regression analysis showed that the relationship between good prescribing and low admission rates was not explained by confounding variables.
- Only 32% of the variation in admission rates between practices was explained by the regression equation.
- None of the variables recorded in the annual report from the practice to the health authority were significantly related to admission rates.
- Prescribing, as measured by the preventer-reliever ratio, and hospital admission rates have limited usefulness in monitoring general practice performance.

Emond (1999) compared the 'before' group which comprised all 51 adults with acute asthma seen during January 1994 with 'after' groups comprising all adults with acute asthma seen during October 1994, February 1995, and June 1995 ($n=145$). It was found that:

- Patient demographic characteristics and asthma severity were similar in the 'before' and 'after' groups.
- Initial peak flow measurements were obtained in 20% of patients before intervention, compared with 82%, 84%, and 83% during the post-intervention months (p for trend <0.001).
- Median delays to beta-agonist and steroid therapy decreased by approximately 16 minutes ($p<0.001$) and 34 minutes ($p=0.04$), respectively.
- The median emergency department length of stay decreased by 58 minutes ($p=0.01$).
- Outcomes improved with fewer in-patient admissions ($p=0.05$).
- There was no significant change in four week relapse to the study hospital.

Crompton (1979) reported that during the first ten years of the Edinburgh Emergency Asthma Admission Service (EEAAS):

- Requests were made to admit 112 patients to a respiratory unit; four of the patients died of their disease, one in hospital and three before admission.
- It was thought that the death rate would have been much higher had conventional admission procedures been observed; however, this was not a randomised controlled trial and substantive proof that the service reduced deaths from asthma was lacking.

In a later study, *Simpson (2000)* compared pre-hospital treatment of three different groups of patients referred to hospital with acute asthma: those in the Edinburgh Emergency Asthma Admission Service (EEAAS) ($n = 38$), those under continuing supervision at a hospital respiratory out-patient clinic ($n = 54$), and those managed solely in primary care ($n = 58$). It was found that:

- In each group airflow obstruction had improved upon arrival at hospital, the effect being most marked in patients transported by ambulance ($p<0.001$) and in those receiving nebulised beta(2)-agonists prior to admission ($p<0.005$).

- EEAAS patients were least likely to receive nebulised beta(2)-agonists before arrival at hospital ($p < 0.05$); this observation was attributable to a tendency for these patients to travel to hospital by car rather than by ambulance.

Diabetes

The diabetes studies that have been reviewed are:

- *Krein (2000)* reported on the Quality Enhancement Research Initiative for Diabetes Mellitus (QUERI-DM) which aims to develop an efficient, validated system for monitoring key diabetes quality standards in the Veterans Health Administration and to evaluate the effectiveness of current approaches to diabetes care and the success of guideline implementation initiatives.
- *Hofer (1999)* carried out a cohort study of 3,642 patients with Type 2 diabetes cared for by 232 different physicians between 1990 and 1993 at three sites to determine the reliability of a set of physician performance measures and to examine whether physicians could substantially improve their profiles by preferential patient selection.
- *Rith-Najarian (1998)* examined strategies for the prevention of lower-extremity amputation (LEA) in a prospective study of 639 American Indians with diabetes in a rural primary care clinic.
- *Brown (2000)* evaluated the long-term (between 1987 and 1996) impact on outcomes of a comprehensive diabetes management program instituted throughout the Kaiser Permanente Northwest health maintenance organisation (HMO).
- *Benotmane (2000)* examined factors affecting outcomes (including lower limb amputations) of 132 diabetic patients (88 men and 44 women) referred for treatment of foot lesions between January 1989 and December 1993.
- *Baumer (1998)* investigated the effects of social disadvantage and family composition on prevalence and outcome of diabetes in a retrospective audit of 801 children with diabetes mellitus in the south west of England.
- *Nelson (1998)* conducted a four year prospective study to compare in-patient and out-patient utilization rates between prepaid (PPD) and fee for service (FFS) insurance coverage for 1,681 patients undergoing treatment for hypertension, diabetes, myocardial infarction, or congestive heart failure in Boston, Chicago, and Los Angeles.
- *Cohn (1997)* examined gender differences in hospitalisations for IDDM to investigate the need for gender-specific interventions to reduce diabetes-related morbidity.
- *Palta (1997)* investigated the post-onset hospitalisation rate and risk factors during 1987-1994 in a population-based, incidence cohort followed from diagnosis of Type 1 diabetes mellitus at ages 0-29 ($n = 577$) in Wisconsin.
- *Morgan (1997)* tested the hypothesis that a relationship between ill health and deprivation exists for patients with diabetes, distinct from that experienced by the non-diabetic population.
- *Goyder (1996)* examined whether the minority of practices not qualifying for payment for structured diabetes care programmes differ systematically from those that do using data collected for all Leicestershire general

practices on practice size, population structure, deprivation indices, diabetes related admissions over two years and number of insulin treated patients on the district register.

- *Wysocki (1996)* examined the effect of different levels of IDDM self-care autonomy on diabetes outcomes in a cross-sectional study of 100 young people.
- *Currie (1996)* described, by means of a retrospective study of three years' routine district health authority data (financial years 1991/92 to 1993/94), the in-patient and out-patient activity for patients with diabetes, and compared this with the non-diabetic population.
- *Caddick (1994)* examined the relationship between hospital admissions for patients with diabetes mellitus and residence in an area of social deprivation.
- *Brown (1992)* examined the extent to which both the supply and organization of primary and secondary health care affect rates of hospitalization.

Krein (2000) reported that in 1994, 12.5% of out-patients in the Veterans Health Administration (VHA):

- received diabetes-specific medications
- accounted for almost 25% of all VHA pharmacy costs
- had a hospitalisation rate 1.6 times that of veterans without diabetes
- made 3.6 million out-patient visits to VA clinics.

Hofer (1999) reported that:

- For profiles based on hospitalisation rates, visit rates, laboratory utilisation rates, and glycaemic control, 4% or less of the overall variance was attributable to differences in physician practice and the reliability of the median physician's case-mix-adjusted profile was never better than 0.40.
- For profiles based on glycaemic control, high outlier physicians could dramatically improve their physician profile simply by pruning a selected couple of patients from their panel; this advantage from gaming could not be prevented by even detailed case-mix adjustment.
- The findings of this study suggest that physician "report cards" for diabetes, one of the highest-prevalence conditions in medical practice, were unable to detect reliably true practice differences within the three sites studied.
- Use of individual physician profiles may foster an environment in which physicians can most easily avoid being penalised by avoiding or deselecting patients with poor adherence or response to treatments.

Rith-Najarian (1998) compared rates of LEA in three different treatment periods: the standard care period (1986 to 1989), during which patients received foot care at the discretion of the primary care provider; the public health period (1990 to 1993), during which patients were screened for foot problems and high-risk individuals received foot care education and protective footwear; and the Staged Diabetes Management (SDM) period (1994 to 1996), during which comprehensive guidelines for diabetic foot management were adapted by the primary care clinicians to their practices and were systematically implemented. Analyses revealed that:

- Patient sex distribution, mean age, and mean duration of diabetes were similar in the three periods of observation.
- The average annual LEA incidence was 29/1000 diabetic person-years for the standard care period (n =42), 21/1000 for the public health period (n =33), and 15/1000 for the SDM period (n =20), an overall 48% reduction (p=0.016).
- Overall, the incidence of a first amputation declined from 21/1000 to 6/1000 (p<0.0001).

Brown (2000) compared HMO members with diabetes (ranging in number from 5,331 in 1987 to 13,099 in 1996) with equal numbers of members without diabetes. By 1996:

- The prevalence of diabetes identified in this population had risen from 2.54% in 1987 to 3.66%.
- The use of home glucose testing had increased from 32.4% of diabetic members in 1987 to 53.0%.
- The use of lipid lowering drugs had increased from 3.5% to 19.8% among diabetic members.
- Mean blood pressure had decreased from 144/82 mm Hg (+/- 0.8/0.4) to 138/79 mm Hg (+/- 0.3/0.15).
- Mortality had decreased from 4.8% (+/- 0.3%) to 3.6% (+/- 0.2%) among members with diabetes (p<0.01).
- The annual ratio of visits to the emergency room by HMO members with diabetes to members without had fallen from 2.5 to 1.8.
- The annual ratio of the number of days spent in acute care in hospital by HMO members with diabetes to members without in the hospital had fallen from 3.6 to 2.5.

Benotmane (2000) reported that:

- 89% of patients presented with Type 2 diabetes and 11% of patients Type 1 diabetes.
- The rate of hospitalisation was 11.17% for men and 6.82% for women (p <0.001).
- There was no significant difference between men and women as far as the prevalence of complications was concerned.
- Inadequate footwear was considered as the major exogenous risk factor leading to a foot lesion.
- The seriousness of foot lesions and consequently the rate of amputations were greater in men; this was probably due to smoking habits.
- Factors influencing outcome appeared to be:
 - male gender

- delay of management
- quality of medical treatment
- surgical attitude
- inadequate level of amputation
- lack of structured prevention.
- Prevention then should be based on the patient's education, general practitioners' training and a better and more efficient cooperation between surgeons and diabetologists.

Results from the study by *Baumer (1998)* were as follows:

- There was no association between social status and diabetes prevalence.
- Social deprivation increased the likelihood of hospital admission for hypoglycaemia.
- Children living with a single parent were more likely to be admitted to hospital with a diabetes related problem and stay in hospital longer.
- Having either a parent with diabetes or a single parent increased the rates of clinic non-attendance.
- No association was identified between medium term diabetes control and either social disadvantage or single parent status.
- In conclusion, social disadvantage has no effect on diabetes prevalence and little on diabetes outcome in childhood, while family structure and parental diabetes have adverse effects on some aspects of diabetes outcome.

Nelson (1998) found that:

- Compared to FFS, PPD patients had 31% fewer observed hospitalisations before adjustment for patient differences ($p=0.005$) and 15% fewer hospitalisations than expected after adjustment ($p=0.078$).
- The observed rate of FFS hospitalisations exceeded the expected rate by 9%.
- These results are not explained by system differences in patient mix or trends in hospital use over four years.
- Half of the PPD/FFS difference in hospitalisation rate is due to intrinsic characteristics of the payment system itself.

Cohn (1997) analysed data on hospital discharges with any mention of IDDM ($n = 2,889$) and the subset of these for IDDM as a principal diagnosis ($n = 2,270$) in California children aged 0-18 years during 1991. Pregnancy-related hospitalisations were excluded. It was found that:

- Females had more diabetes hospitalisations among discharges with any mention of diabetes, among discharges with diabetes as a principal diagnosis, and among discharges with ketoacidosis as a principal diagnosis.
- For diabetes as a principal diagnosis, females had 40% more hospitalisations, 44% more repeated hospitalisations, 23% more individuals hospitalised, and significantly higher rates of hospitalisations for ages 10-14 years (50 vs 38 per 100,000) and for 15-18 years (68 vs 29 per 100,000).
- Gender differences occurred primarily in adolescents, were independent of complicating conditions at the time of hospitalisation, and were observed for diabetic ketoacidosis alone.

- The underlying cause of the higher observed diabetic hospitalisation rate among females may be biological or behavioural.

Palta (1997) reported the following findings:

- The overall hospitalisation rate was 8.9 +/- 0.60 (standard error) per 100 person-years of diabetes, whereof 5.7 was due to hyperglycemia, 1.9 to hypoglycemia, and 1.3 to other and undetermined causes.
- Major risk factors for hospitalisation were:
 - longitudinally measured glycosylated hemoglobin level (rate ratio = 1.5 per 2% increase, 95% CI 1.4-1.7)
 - black/other race (rate ratio = 1.9, 95% CI 1.0-3.6)
 - diagnosis in a non-university-based setting (rate ratio = 1.9, 95% CI 1.2-3.2)
 - female sex (rate ratio = 1.5, 95% CI 1.0-2.4 at age 11)
 - age in males (rate ratio = 0.6, 95% CI 0.4-0.8 per 5-year increase)
 - public or no insurance up to 18 months post-diagnosis (rate ratio = 2.2, 95% CI 1.1-4.4).
- For individuals less than 18 years, "black/other race" was replaced in the model by "having other than two biologic parents in the home" (rate ratio = 2.0, 95% CI 1.1-3.5).
- Hospitalisation is common in children, adolescents, and young adults with diabetes, primarily for problems with glycemic control.

Morgan (1997) correlated age standardised admission and appointment rates and proportion of total activity for patients with and without diabetes with the Townsend index of social deprivation for the health district of South Glamorgan (population 408,000). Findings were:

- Both diabetic ($r = 0.78$, $p < 0.001$) and non-diabetic ($r = 0.74$, $p < 0.001$) in-patient admissions were positively correlated with social deprivation.
- This relationship also existed for attended out-patient appointments ($r = 0.67$, $p < 0.001$ and $r = 0.45$, $p < 0.01$, for diabetic and non-diabetic respectively).
- The proportion of diabetic to non-diabetic admissions by ward also showed a positive correlation for in-patients ($r = 0.47$, $p < 0.001$).
- This remained true for IDDM ($r = 0.23$, not significant) and NIDDM ($r = 0.62$, $p < 0.001$) diabetes, for admissions for coronary heart disease ($r = 0.50$, $p < 0.001$) and cerebrovascular disease ($r = 0.29$, $p < 0.05$), elective admissions ($r = 0.30$, $p > 0.05$), and emergency admissions ($r = 0.46$, $p < 0.001$).
- These results suggest that admission is positively correlated with social deprivation and that this relationship is stronger in the diabetic population.
- This may be due to different prevalence rates or increased complications requiring hospital treatment in different social circumstances.

Results from the study by *Goyder (1996)* revealed that:

- The 21 practices not offering structured diabetes care had a median list size of 3,204 compared to 6,340 for the other 124 practices ($p < 0.001$).
- Jarman and Townsend scores were higher for these practices and estimated prevalence of diabetes was 29% higher (95% CI: 26-32%).

- Crude admission rates were significantly higher in those practices not offering structured care. However rates adjusted for diabetes prevalence were similar (39.3 vs 39.2 per 100 insulin treated diabetics per year, $p=0.9$).
- These results suggest that some practices face specific problems related both to small practice size and higher prevalence.
- If these issues are not addressed, inequalities in access to diabetes care between practice populations will persist.
- While there is no evidence that the provision of structured care is associated with lower admission rates in this district, more information, particularly in relation to prevalence of diabetes, is needed in order to accurately quantify this relationship.
- Variations in prevalence between practices should be adjusted for in any comparison of admission rates or spurious conclusions may be drawn.

In the study by *Wysocki (1996)*, participants were categorized as exhibiting constrained (lower tertile), developmentally appropriate (middle tertile), or excessive (higher tertile) self-care autonomy based on the ratio of the self-care autonomy index to the psychological maturity index. Controlling for age, analyses revealed that:

- The excessive self-care autonomy group demonstrated less favorable:
 - treatment adherence
 - diabetes knowledge
 - hospitalisation rates
 - glycemic control, marginally.
- Excessive self-care autonomy increased with age and was less common among intact two parent families but was unrelated to other demographic factors.
- The findings indicate caution about encouragement of maximal self care autonomy among young people with IDDM and suggest that families who succeed in maintaining parental involvement in diabetes management may have better outcomes.

Findings from *Currie (1996)* include:

- Patients with diabetes were responsible for 5.5% of admissions; however, because of increased length of stay, patients with diabetes occupy 9.4% of bed days.
- The relative risk of admission for diabetes related complications was:
 - coronary heart disease 11.8 (95% CI = 11.4-12.3)
 - cerebrovascular disease 11.8 (10.8-12.8)
 - neuropathy and peripheral vascular disease 15.6 (13.6-17.9)
 - eye complications 10.4 (9.3-11.7)
 - renal disease 14.7 (12.6-17.3).
- Recognised diabetes related vascular complications accounted for at least 23% of admissions of patients with diabetes.
- The relative risk of admission for diagnoses and procedures not known to be related to diabetes were similar for non-diabetic and diabetic patients.
- The pattern of out-patient activity mirrored that of the relative probability of admission.

- The authors conclude that previous estimates of the proportion of NHS resources used for the treatment of patients with diabetes had been significantly underestimated.

Caddick (1994) identified admissions of patients with diabetes mellitus between 1987 and 1992 using the district patient information service. All persons admitted were assigned to an electoral ward on the basis of their postcode. Age standardised admission rates were compared to the Townsend Deprivation Score for each electoral ward. A positive correlation was found between age standardised admission rate and Townsend Score ($r = 0.76$, $p < 0.001$).

Findings from *Brown (1992)* include:

- Diabetes discharge rates were found to be most highly correlated with hospital bed supply in five of the eight years studied (1979-1986).
- Stepwise regression analysis indicated area rates of diabetes hospitalisation were significantly influenced by resource factors even after controlling for differences in the socio-demographic characteristics of the area populations.
- Rates of diabetes hospitalisation appearing to have more to do with the availability of medical resources than to population needs.
- At the local level, hospital admission patterns were found to vary by general practitioner age, practice type and diabetic caseload.
- Overall, insulin-treated diabetic patients most likely to be hospitalised were those in the care of young doctors new to general practice, and those who attended doctors who had small diabetic caseloads.
- Solo practitioners had the lowest rates of patient hospitalisation.
- There were marked disparities in patient access to specialist diabetes education and clinical out-patient services by patient age, duration of diabetes and attendance on primary care.
- Overall, no significant differences were found in the propensity for hospitalisation between users and non-users of these specialist services.
- This does not imply service ineffectiveness but rather is indicative of the complexity of the local diabetes care organisation and the differing needs of the insulin-treated diabetic population within the community as a whole.

Mental illness

The mental illness studies that have been reviewed are:

- *Leslie (1999)* assessed changes in in-patient mental health utilisation and costs between 1993 and 1995 in a privately insured population by analysing data on adult users of mental health services ($n = 45,579$) from a national sample of over 3.8 million privately insured individuals.
- *Cooper (1994)* compared characteristics of 559 patients with major depression who received care in general medical and specialty mental health settings.
- *Rost (1998)* examined whether depressed rural individuals receive less out-patient treatment and report higher rates of hospital admittance and suicide attempts than their urban counterparts, given the smaller number per capita of providers trained to deliver mental health services in rural areas.

- *Cavanagh (1999)* used data from Scottish mental health units during 1980-1995 on first admission rates for major mental illness in order to explore links with an increase in psychiatric morbidity and mortality in men.
- *Jerrell (1995)* reported on the outcome of specialised treatment of 147 people with severe mental illness and substance use disorders in a controlled clinical trial of three interventions: behavioral skills training, case management, and 12 step recovery.
- *Banks (1998)* evaluated basic outcome indicators of community support program treatments for major depression as well as the degree to which the programs conform to practice guidelines for major depression.
- *Rosenheck (1999)* examined the relationship between a range of performance indicators derived from administrative data sets and six clinical outcome measures addressing symptoms, substance abuse, and social functions in an interview-based study of 4,165 veterans discharged from 62 specialized VA in-patient programs for treatment of post-traumatic stress disorder.
- *Chiverton (1999)* randomly assigned psychiatric in-patients to either transitional case management services (n = 121) or traditional care (n = 122) to investigate differences in rates of recidivism and re-hospitalisation.
- *Ziguras (2000)* used meta-analytical methods to investigate the effectiveness of mental health case management over 20 years and to compare outcomes for assertive community treatment and clinical case management.
- *Gorey (1998)* used meta-analytic techniques to synthesize the findings of 24 published studies dealing with the effectiveness of case management with the severely and persistently mentally ill.
- *Salkever (1999)* determined the effect of the program for assertive community treatment (PACT) model on psychiatric in-patient service use over an 18 month period in a population of non-emergency psychiatric patients with severe chronic mental illness, and tested for variations in this effect with program staffing levels and patient characteristics such as race and age.
- *Burns (1995)* reviewed the results of randomised clinical trials of assertive community treatment for seriously mentally ill patients published between 1990 and 1994 to synthesize the state of knowledge about this research.
- *Schalock (1995)* analysed data on 32 predictor variables to assess factors associated with recidivism to a mental health residential facility over a five year period.
- *Segal (1998)* examined patient characteristics and other factors that contributed to the involuntary return of patients to a psychiatric emergency service at seven county general hospitals in California within 12 months of an initial evaluation in the service.
- *Latimer (1999)* reviewed 19 randomised studies and 15 non-randomised studies on economic outcomes of assertive community treatment (ACT) for severely mentally ill individuals.
- *Marshall (2000a)* determined the effects of 'case' or 'care' management (rather than 'assertive community treatment') as an approach to caring for severely mentally ill people in the community in a Cochrane database systematic review of randomised controlled trials

- *Marshall (2000b)* determined the effectiveness of assertive community treatment (ACT) as an alternative to standard community care, traditional hospital-based rehabilitation, and case management, for severe mental disorders in a systematic review of randomised controlled trials

Ziguras (2000) identified 44 controlled studies of case management published between 1980 and 1998, quantitatively combined the results, and compared these with the results of studies of mental health services without case management. Results include:

- Of the 44 studies analysed, 35 compared assertive community treatment or clinical case management with usual treatment, and nine directly compared assertive community treatment with clinical case management.
- Both types of case management were more effective than usual treatment in three outcome domains: family burden, family satisfaction with services, and cost of care. The total number of admissions and the proportion of clients hospitalised were reduced in assertive community treatment programs and increased in clinical case management programs.
- Although clients in clinical case management had more admissions than those in usual treatment, the admissions were shorter, which reduced the total number of hospital days.
- In both programs the number of hospital days used was reduced, but assertive community treatment was significantly more effective.
- The two types of case management were equally effective in reducing symptoms, increasing clients' contacts with services, reducing dropout rates, improving social functioning, and increasing clients' satisfaction.

Banks (1998) measured hospitalisation rates subsequent to community support program treatment, and determined the correlation between hospitalisation rates and practice patterns. The analysis of data sets of out-patient and in-patient services over a four year period indicated that there was substantial variation among the community programs in practice patterns and hospitalisation rates, and that the two were negatively correlated.

Findings from *Gorey (1998)* were:

- Overall, case management interventions are effective: 75% of the clients who participate in them do better than the average client who does not.
- The estimated preventive fraction (e.g. prevention of re-hospitalisation) among clients who experience relatively intense case management service (case loads of 15 or less, 89%) is nearly 30% greater than that estimated among similar clients receiving less intensive service.
- Various case management practice models did not differ significantly on estimated effectiveness.
- Important questions concerning the differential effectiveness of case management by specific program, worker, client, and client worker relationship characteristics remain to be answered.

Salkever (1999) analysed data from a randomised trial of PACT in South Carolina in which 144 patients (recruited between August 1989 and July 1991) were randomly

assigned either to one of two PACT programs or to usual care at a local mental health centre. Findings include:

- PACT participants were about 40% less likely to be hospitalised during the follow-up period; the effect was stronger for older patients.
- Lower PACT client/staff ratios also reduced the risk of hospitalisation.
- No evidence of differential race effects was found.
- Given some hospital use, PACT did not influence the number of days of use.

Burns (1995) reported the following findings:

- Controlled clinical trials have been conducted with a wide range of severely mentally ill populations, including patients with recent-onset schizophrenia, veterans, dually diagnosed clients, and homeless persons.
- Methodological improvements in some studies include increased attention to monitoring the experimental and comparison interventions, as well as larger sample sizes and longer duration of the clinical trials than in earlier efficacy trials.
- Strong positive effects of assertive community treatment on hospital days and on patient and family satisfaction were found.
- Gains in functional outcomes, such as employment, may require interventions specifically targeted to these outcomes.

Schalock (1995) found that the following factors were significantly associated with recidivism to a mental health residential facility:

- health problems
- instrumental activities of daily living
- employment status
- number of previous admissions.

Segal (1998) reported the following:

- Of the 417 patients initially admitted to the psychiatric emergency service 29% were involuntarily returned to the psychiatric emergency service within 12 months.
- The likelihood of involuntary return was increased by:
 - a psychotic diagnosis
 - indications of dangerousness at the initial evaluation.
 - having insurance.

Results from the study by *Latimer (1999)* include:

- Higher-fidelity programs appear to reduce hospital days by about 23% points more than lower-fidelity programs (95% CI -41.2 to -5.2).
- The estimated regression coefficients imply that a high-fidelity program reduces hospitalisations by about 58% over one year if the alternative involves some type of case management and by 78% if it does not.
- ACT appears to increase the proportion of clients who live in independent housing situations.
- The most reliable cost offset to ACT treatment costs appears to be reduced hospital use.

Findings from the systematic review by *Marshall (2000a)* include:

- Case management increased the numbers remaining in contact with services (for case management OR= 0.70; 99% CI 0.50-0.98; n=1,210).
- Case management approximately doubled the numbers admitted to psychiatric hospital (OR=1.84; 99% CI 1.33-2.57; n=1,300).
- Present evidence suggests that case management also increases duration of hospital admissions, but this is not certain.

Results from the systematic review by *Marshall (2000b)* include:

- Those receiving ACT were more likely to remain in contact with services than people receiving standard community care (OR=0.51, 99% CI 0.37-0.70).
- People allocated to ACT were less likely to be admitted to hospital than those receiving standard community care (OR=0.59, 99% CI 0.41-0.85) and spent less time in hospital.
- Those receiving ACT were no more likely to remain in contact with services than those receiving hospital-based rehabilitation, but confidence intervals for the odds ratio were wide.
- People getting ACT were significantly less likely to be admitted to hospital than those receiving hospital-based rehabilitation (OR=0.2, 99% CI 0.09-0.46) and spent less time in hospital.

Leslie (1999) reported that:

- In-patient mental health costs fell 30.5% over the period, driven primarily by decreases in the number of hospital days per treated patient per year (-20.0%), with smaller changes in the proportion of enrollees who received care (-0.2%), and per diem costs (-13.1%).
- Patients whose primary diagnosis was mild/moderate depression saw the largest decrease in costs per treated patient (44.5%), and those diagnosed with schizophrenia experienced the smallest decrease (23.5%).
- There was no evidence of substitution of medical for psychiatric care.
- Further research is needed to evaluate the impact of these changes on outcome, quality of care, and patient satisfaction.

Cooper (1994) reported that:

- Patients who received care in the general medical sector were more likely to be black, older than 65 years, have a high school education or less, and to be women, and less likely to be in the highest socio-economic quartile.
- A higher proportion of specialty mental health patients had a lifetime history of psychiatric hospitalisation, while depressed patients seen in the general medical sector had a lower chance of meeting criteria for major depression one year later.
- A multivariate analysis of socio-demographic factors indicated that the following were significantly associated with receiving care in the specialty mental health care sector: age groups 31-50 and 51-65, and single marital status. Black race was inversely correlated with use of specialty mental health care.
- Demographic differences between the specialty mental health and general medical sectors could be associated with differences in knowledge,

attitudes, interpretation of symptoms, and treatment preferences related to depression.

Rost (1998) recruited 74% of eligible participants (n = 470) from a 1992 telephone survey and followed up 95% of subjects for one year. Findings include:

- Although there were no rural-urban differences in the rate, type, or quality of out-patient depression treatment, rural subjects made significantly fewer specialty care visits for depression.
- Depressed rural individuals had 3.05 times the odds of being admitted to the hospital for physical problems (p=0.02) and 3.06 times the odds of being admitted for mental health problems (p=0.08) during the year.
- Elevated rates of hospital admission disappear in models controlling for number of specialty care depression visits in the previous month.
- Rural subjects reported significantly more suicide attempts during the period of one year (p=0.05).
- Additional work is warranted to determine how to alter barriers to outpatient specialty care if the rural health care delivery system is to provide cost effective depression care.

Cavanagh (1999) reported that:

- Admission rates for both schizophrenia and affective disorders remained constant in men, while decreasing in women.
- Paranoid states increased in men and remained constant in women.
- This provides evidence for an increase in the proportion of men, particularly younger age groups, hospitalised with major mental illness.
- Possible reasons include:
 - co-morbidity
 - biological variables
 - responses to and changes in health-seeking behaviour in men
 - increased prevalence of major mental illness in men.

In the study by *Jerrell (1995)*, the clients were assessed every six months over a two-year period. Findings included:

- Client self reports showed changes in psychosocial functioning, especially increased functioning in residential stability and work, and reductions in alcohol and drug symptoms and usage.
- Data on service utilisation showed decreased use of acute and sub-acute mental health services and increased use of out-patient and case management services over time.

Rosenheck (1999) reported that:

- The number of hospital re-admissions during the six months after the index discharge was significantly related to poor outcomes on all five of six clinical outcome measures.
- Measures of post-discharge hospital use and re-admission were more strongly and consistently related to clinical outcome measures than to measures of access, intensity, or continuity of out-patient care.
- However, correlations were modest in magnitude indicating that these two types of performance measures assess different aspects of quality and cannot be substituted for one another.

In the study by *Chiverton (1999)* it was reported that:

- Fewer patients in the intervention group (nine vs. 16 in the control group) were re-admitted to the hospital over the course of the project.
- Similarly, only one patient in the intervention group versus 18 patients in the control group used the emergency department.

Cardiovascular disease and stroke (non-surgical)

The cardiovascular and stroke studies that have been reviewed are:

- *Green (1994)* tested the hypothesis that variations in rates of hospitalisation across small geographic areas reflect differences in physicians' decision making when confronting uncertainty in a small areas variation analysis of suspected acute cardiac ischaemia (ACI) admissions in northern Michigan.
- *Piette (1996)* undertook a study to examine whether patients admitted for treatment of an AMI who live farther from their source of care are less likely to be followed in an out-patient clinic, and whether patients who receive follow-up care are less likely to die or to have a subsequent acute care admission.
- *Wolinsky (1997)* evaluated previously reported risk factors for hospitalisation for congestive heart failure (CHF), in a nationally representative sample of 7,286 older white and black adults.
- *Wolinsky (1998)* identified risk factors for hospitalisation for ischaemic stroke and estimated their relative importance in a large, nationally representative sample of 6,071 non-institutionalised adults aged 70 years or older at baseline.
- *Paul (2000)* evaluated the effects of a multidisciplinary out-patient heart failure clinic developed in 1995 in which advanced practice nurses coordinate care, on the clinical and economic management of 15 patients with congestive heart failure (CHF).
- *Andrade (1999)* compared the rates of hospitalisation and low density lipoprotein cholesterol (LDL-C) levels during and after discontinuation of antihyperlipidemic drug therapy in a retrospective cohort study of 2,369 patients at two health maintenance organizations (HMOs) during the period 1988 to 1994.
- *Wolinsky (1999)* prospectively examined factors associated with the risk of hospitalisation for AMI in a large, nationally representative sample of 6,071 non-institutionalized adults aged 70 years or older at recruitment into the Longitudinal Study of Aging.
- *Alexander (1995)* determined whether the higher rate of hospitalization among African Americans for congestive heart failure (CHF) could be explained by racial differences in the prevalence of clinical risk factors for CHF.
- *Struthers (2000)* examined whether social deprivation has any independent effect on emergency cardiac hospitalisation in a follow-up study of 478 patients in Tayside with chronic heart failure (CHF) who had a previous CHF admission before 1993, had a previous MI, and who were on diuretic treatment.

Green (1994) selected two demographically nearly identical towns differing by a factor of three in ACI admission rates and analysed data from medical records of all patients evaluated in the emergency departments for suspected ACI in 1988. Findings included:

- Logistic regression of admission on patient characteristics, other illnesses, probability of ACI, and community revealed no difference in admission decisions between the two hospitals (odds ratio for community =0.766, 95% CI 0.542-1.08, n = 787, p >0.1).
- Nearly twice as many patients with ACI presented to the emergency department of the high admitting hospital as to the low admitting hospital.
- The authors conclude that, at least for ACI, population-based area discharge rates do not necessarily reflect case-based decision rates.

Piette (1996) analysed data from Department of Veterans Affairs (VA) databases on a national sample of 4,637 AMI patients discharged in 1992. The findings suggested that:

- Patients living more than 20 miles from their admitting hospital were less likely to use ambulatory services.
- Patients receiving ambulatory care were 79% as likely to die within the year as those without any follow-up care (95% CI 0.66-0.94).
- Patients living more than 20 miles from their admitting hospital were more likely to die independent of their likelihood of receiving VA out-patient follow-up.
- Among those who did not die in the subsequent year, those receiving ambulatory care were 33% more likely to be re-admitted to a VA hospital with a cardiac diagnosis (95% CI 1.12-1.57).
- The authors conclude that distance may pose a barrier to out-patient follow-up for some VA patients after an AMI and that it may also limit patients' ability to access medical care quickly in the event of a recurrent acute event.

The key findings by *Wolinsky (1997)* were:

- Over the eight year period, 1984 to 1991, 15.1% of the study population were hospitalised for CHF (7.1% with first-listed and 8.1% with second through fifth-listed diagnoses).
- In descending order, the major risk factors for being hospitalised for CHF were:
 - age
 - being a white man
 - having lower body functional limitations
 - having self-reported medical histories of coronary heart disease, heart attack, diabetes and angina.

In the study by *Wolinsky (1998)*:

- 503 persons (8.3%) had at least one primary discharge diagnosis of ischaemic stroke.
- In descending order of importance, the salient risk factors for hospitalisation were:
 - previous history of stroke (adjusted hazards ratios [AHR] = 2.86)
 - age (AHR =1.04 per year)
 - diabetes (AHR =1.78)
 - male gender (AHR =1.42)
 - lower body limitations (AHR =1.09 per limitation)
 - arthritis (AHR =0.74)
 - hypertension (AHR =1.29)
 - poverty (AHR =1.33).

Paul (2000) found that:

- The patients had a total of 38 hospital admissions (151 hospital days) in the six months before joining the clinic and 19 admissions (72 hospital days) in the six months afterwards.
- The mean length of stay decreased from 4.3 days in the six months before joining to 3.8 days in the six months afterwards, and the number of emergency department visits also decreased, although neither decrease was statistically significant.
- Mean in-patient hospital charges decreased.

Andrade (1999) reported that:

- The rate ratio for CHD hospitalisation during periods of antihyperlipidemic drug use compared with periods of non-use was 1.02 (95% CI 0.74-1.40), excluding the first six months after initiation or discontinuation and controlling for patient sex, age, history of CHD, hypertension, diabetes, and HMO site.
- By contrast, the adjusted rate ratio was 0.70 (95% CI 0.61-0.80) for non-CHD hospitalisation.
- The percentage of patients with a history of CHD who achieved LDL-C levels <130 mg/dL was 27% =< six months after initiation of antihyperlipidemic drug therapy compared with 18% during gaps in drug therapy (p=0.04).
- This study failed to demonstrate the effectiveness of lipid-lowering therapy in reducing CHD hospitalisations in community settings, apparently because most recipients either discontinued therapy or failed to achieve the desired LDL-C reduction while receiving therapy.

Analyses by *Wolinsky (1999)* revealed that:

- Of the sample, 357 persons (5.9%; 172 women and 185 men) had at least one primary discharge diagnosis of AMI.
- Significant (p<0.05) risk factors for being hospitalised with an AMI (adjusted hazards ratios in parentheses) from the pooled analysis were:
 - male gender (1.86)
 - having no more than a grade school education (1.35)
 - atherosclerosis (1.43)

- hypertension (1.29)
- coronary heart disease (1.63)
- angina (1.60)
- previous AMI (1.52)
- diabetes (1.89)
- four or more lower body limitations (1.43).
- The gender-specific analyses, however, revealed that hypertension, angina, diabetes, and lower body limitations were risk factors only for women, and that having no more than a grade school education was a risk factor only for men.

Alexander (1995) carried out a retrospective cohort study of a sample of 64,877 enrollees (27% African American and 73% white) of a large health maintenance organization (HMO) who took at least one multi-phasic health checkup (MHC) at or after the age of 40 years and were free of CHF at that time. Adjustments were made for risk factors and length of follow-up. Reported findings include:

- Among cohort members younger than 60 years at baseline MHC, the age-adjusted risk ratio (RR) (African American/white) for CHF first hospitalisation was 2.14 for men and 2.73 for women, while for persons 60 years of age and older at MHC, the age-adjusted RR was 1.48 for both sexes.
- In persons aged 60 years and older, the race difference was explained by greater prevalence of hypertension and diabetes in African Americans (RR = 1.12; 95% CI 0.94-1.34 after adjustment for hypertension and diabetes).
- In those younger than 60 years, findings differed by sex. For men, African-American race was no longer a significant predictor of CHF after adjusting for hypertension, diabetes, left ventricular hypertrophy on electrocardiogram, and body mass index (adjusted RR = 1.16; 95% CI 0.86-1.56). However, among younger women, African Americans continued at increased risk despite adjustment for these variables as well as smoking, plasma cholesterol, renal function, alcohol use, and myocardial infarction (adjusted RR = 1.49; 95% CI 1.00-2.21).
- In this HMO population, the race differences in first hospitalisation for CHF are largely explained by known clinical and behavioural risk factors, although in younger women these risk factors do not completely explain the excess risk among African Americans.
- These findings highlight the role of hypertension and diabetes in the development of CHF, particularly among African Americans.

Struthers (2000) reported that:

- Deprivation was significantly associated with an increase in the number of emergency cardiac hospitalisations ($p=0.007$). This effect was mainly caused by increasing the proportion of patients hospitalised in each deprivation category (26% in deprivation category 1-2 versus 40% in deprivation category 5-6, $p=0.03$).
- This effect of deprivation was independent of disease severity, as judged by the dose of prescribed diuretic, the death rate, and the duration of each hospital stay.

- Non-adherence with diuretic treatment could not account for these findings either.
- Possible explanations for the above findings are that doctors who look after socially deprived patients have a lower threshold for cardiac hospitalisation of their patients, or that social deprivation alters the way a CHF patient accesses medical care during decompensation.
- Understanding how social deprivation influences both doctor and patient behaviour in the pre-hospital phase is now crucial in order to reduce the amplifying effect that social deprivation appears to have

5. STUDIES EXAMINING TECHNICAL ISSUES IN COMPILING HOSPITAL ADMISSION RATES

The main technical issues that need to be addressed in compiling admission rates are:

- definition of admission to be used
- diagnostic specificity
- risk adjustment for factors such as age, sex or case-mix
- accuracy and completeness of data
- statistical power.

Definition of admission

When using British data about admission rates it is possible to derive them in a number of different ways depending on which of the following definitions are used:

- finished consultant episodes or continuous in-patient spells as the counting currency
- episode–spell or person-based which can be the first in the year or the first ever admission
- emergency only or all types of admission.

Administrative units of activity in the NHS are generally measured in terms of finished consultant episodes (FCE). An FCE corresponds to a period of care under one consultant. Rates of hospital admission may be calculated from HES data by only counting the first FCE in each continuous in-patient spell.

One potential problem with using FCEs as the unit of activity arises in analyses of emergency FCEs. Selecting emergency episodes only would miss any non-emergency episodes occurring after transfer of a patient initially admitted as an emergency. This can be overcome when using a filter to select for emergency episodes only, by only applying it to the first episode in the spell.

Hospitalisation can be measured by its incidence (admitted vs. not admitted) or by its duration (length of stay). Multiple hospitalisations within a period can be measured by the frequency of admission or by their total length of stay (total number of days in hospital). It is unlikely that the probability of a hospital re-admission, particularly one that occurs within a short time period of the previous hospital discharge, is identical in form to the index hospital episode; both clinical and care-related factors may influence the risk of being re-admitted (*Fleming 1995*). Outcome indicators based on rates of first ever admission or first admission in the study period can overcome this problem of multiple admissions.

Gonnella (1990) developed criteria to distinguish between early, timely and late hospitalisation for fourteen different conditions based on the severity of the disease. The authors applied these criteria to 2,713 patients admitted to one of two hospitals. It was found that the average length of stay and average charges for the 20% of admissions judged to be late were two to three times as high as those for the timely admissions. Presumably some of these late hospitalisations could have been avoided by access to primary care at an earlier stage of illness. This suggests that outcome indicators based on the total number of days spent in hospital for a particular

condition may help in the interpretation of indicators based on hospital admission rates.

A large proportion of the studies reviewed in this report have been carried out in the US health care system which has a number of major differences compared with the British system administrative data. *McKee (1997)* undertook a selective review of published literature related to the use of administrative data collected in British NHS Hospitals, with emphasis on how these data differ from those available in the United States. In particular, American studies tend to use the continuous in-patient spell and not the FCE as the basis for calculating admission rates.

Many of the admission definitions require the capability of linking patient records. The essential feature of medical record linkage is the bringing together of computerised abstracts of records that relate to the same individuals, so that data relate to people as well as spells and episodes of care. In studies of hospital care, record linkage provides the means to take account of multiple admissions per person so that statistics such as treated period prevalence (counts of people admitted per annum) can be readily calculated. The crux of the actual process of linkage is the comparison of two records and the decision as to whether or not they refer to the same person.

Gill (1993) and *Kendrick (1993)* have outlined the four main steps involved in the linkage of records:

- file blocking
- matching
- linkage
- validation and checking.

The first step is *file blocking* which involves putting records in an order (e.g. alphabetical) to make searching more efficient for the purpose of making comparisons between records. With very large data sets, comparing every record in a system with every other record may be impossible, and blocking is used to minimise the number of comparisons needed. It is desirable to use at least two different methods of blocking to effect matches by one method that may have been missed by the other (e.g. blocking on dates of birth followed independently by blocking on names). Thus records will fail to be compared only if they differ on an item from both sets of blocking criteria.

The next step is *matching* which is the process of comparing records to determine whether they do or do not relate to the same person. When records created at different times and in different places are to be linked, it should be possible, in principle, to link these using a personal identification number such as the NHS number.

Currently, partial identifiers such as forenames, surname, sex, date of birth, and postcode of residence, are used to identify different records relating to the same individual. When using partial identifiers, such as forenames and surname, character by character matching is not recommended if precision of matching is required. 'Failure to match' records belonging to the same person on this basis occurs partly because there are fairly high levels of error in spelling and recording names, and

particularly because the recording of names may vary. For each of the identifying items used to link records, there may be a discrepancy rate of up to 3% in pairs of records belonging to the same person. Thus exact character by character matching could miss up to 15% of true links if five separate identifying items are used (the sum of the item-specific discrepancies).

In computerised linkage of medical records, probability matching, using an array of identifiers, achieves much higher levels of correct matching than is generally achievable by exact character by character comparisons. A composite score or match weight can be calculated for each pair of records indicating the probability that they relate to the same person, using calculations based on the discriminating power of each identifying item used in the matching process. In the Scottish Record Linkage System which employs probability matching (using name, initial, sex, and date of birth) clerical checking shows that on a pair-wise basis, both the false positive rate (the proportion of linked pairs of records which do not in fact refer to the same individual) and the false negative rate (the proportion of truly matched pairs which the system fails to link) are around 1%.

After records have been matched, *linkage* is undertaken, which is the process of assembling correctly matched records, identified as relating to the same person, into a time-sequenced composite record for the individual.

Finally, *validation checks and corrections* are carried out in which any inconsistencies between different records for the same person are identified and corrected. This cycle may, in practice, account for a significant part of the resource required to match and link records in an established linkage system.

In the recent set of national performance indicators (*Department of Health 2000*) linking of episodes for the same patient was achieved by 'fuzzy matching' based on a number of key fields (postcode, date of birth and sex).

It is possible to adjust routine national HES data to take account of multiple episodes within a single admission. *McColl (1998)* investigated the validity of routine hospital and mortality hip fracture data in one English Region (Wessex) and estimated trends in hip fracture between 1978-1981 and 1993-1995 using Hospital Episode System (HES) data for patients aged over 65 years. It was determined from the discharge method code whether an individual had died during that admission. The number of individual regional and district admissions and deaths were compared with those presented in the Public Health Common Data Set. It appeared that:

- National comparative indicators for hip fracture overestimated individual admissions in Wessex by 17% (in health authorities by 1-56%).
- National comparative indicators for hip fracture mortality underestimated individual deaths in Wessex by 48%.
- Between 1978-1981 and 1993-1995 the age-sex-standardized hip fracture rates rose from 1.90 to 2.63 per 1000 per year for men and from 5.70 to 7.70 per 1000 per year for women. Rates increased in all age groups except those aged 65-69 years.

Diagnostic specificity

Admission rates used as health outcome indicators will usually be condition-specific as the outcome will relate to specific diseases or surgical procedures. In the British system the rates can be calculated either from the condition being the main diagnosis or recorded anywhere in the medical record.

In examining the association between primary care and subsequent hospitalisation, the question is whether being engaged in a primary care relationship over a period of time reduces the probability of being hospitalised for any illness (including the condition under study) or whether the primary care must be for preventive care, the illness in question, or a related co-morbidity (*Fleming 1995*).

In the US primary continuing care is frequently provided by specialists. Therefore, it is impossible to use specific diagnoses or problems to distinguish between primary care and specialty care.

Weissman (1992) used four criteria to select medical conditions that represent potentially avoidable hospitalisations in his study of rates of avoidable hospitalisation in Massachusetts and Maryland. The four criteria include:

- consensus on the basis of previously published studies
- importance of the condition
- clinical face validity in terms of whether hospitalisation could be potentially avoidable
- data clarity.

Risk adjustment

Socio-economic factors may influence both health and the outcomes of health care, irrespective of the quality of care. Variations in the social and economic mix of local populations will be reflected in the numbers and types of patients admitted to hospital.

Social and economic factors may explain variation but do not necessarily justify it. In the national performance indicators (*Department of Health 2000*) adjustment of indicators for socio-economic characteristics was not undertaken since such adjustment may mask the very inequalities that the NHS should know about and address.

Patients frequently have multiple diseases occurring simultaneously which can lead to episodes of health care that are 'linearly additive' (where the diseases are independent of each other although care may occur simultaneously) or 'interactive' (where the complexity of treatment for one disease is influenced or potentiated by the presence of another) (*Hornbrook 1985*). Therefore, it may be necessary to identify which co-morbidities potentially interact with the condition under study and to carry out adjustments for those co-morbid conditions when using admission rates as outcome indicators of antecedent ambulatory health care.

Accuracy and completeness of data

A high level of accuracy and completeness (record coverage) of coded clinical data are required to ensure the reliability and validity of indicators based on admission rates. Audits have consistently identified that the majority of errors in clinical coding are due to inadequate information contained in the source documentation used for abstraction. Hospital case notes provide the most comprehensive source documentation while use of discharge summaries and proformas can result in poor recording of secondary diagnoses/procedures.

In the current set of clinical indicators published by the Department of Health, the number of total finished consultant episodes as a proportion of the resident population for each health authority has been used as a measure of completeness of record coverage. Health authorities with low coverage HES data will have a low ratio of activity to population.

Hyndman (1994) described trends in hospital admission rates for asthma as the principal diagnosis for the East Anglian region between 1976 and 1992. Rates showed a peak in 1985 with some indication of a decline in rates thereafter; the latter may partly reflect the change in England in 1987 of the system for the collection of hospital admission data. However, the fact that the rates for East Anglia seemed to decline before 1987 and other considerations, suggest that the observed trends, although partly reflecting the disruption of the coding during the changeover in systems, may not be entirely artefactual.

The importance of high quality clinical coding relates to all indicators compiled from hospital episode and mortality data and is not addressed in depth in this report.

Statistical power

The use of population-based outcome indicators has certain advantages over provider-based measures. In particular, the larger numbers involved in population-based measures mean that variation is less likely to be due to chance, while variation in outcomes due to differences in incidence of disease or to variation in data methods are less likely at the authority-level than they are at the provider level.

Giuffrida (1999) found substantial year to year variation in admission rates for asthma even at health authority level, demonstrating a lack of statistical power associated with this measure. The authors suggested that this difficulty could be partly reduced by using rates based on three year moving averages.

Shwartz (1994) investigated the degree to which estimates of the magnitude of small area variations in hospitalisation rates depend on both the estimation method and the number of years of data used by analysing hospital discharge abstracts for patients (aged 65 years and older) from acute care hospitals in Massachusetts from 1982 to 1987. Two approaches to estimating the magnitude of small area variation were used:

- empirical Bayes, an approach adjusting more fully for random variation
- systematic coefficient of variation statistic, the approach used in many current small area variation studies.

It was reported that:

- Regardless of method, the same conditions were identified as relatively more variable and the same geographic areas were found to have higher than expected hospitalisation rates.
- The magnitude of differences in hospitalisation rates depends on how the data are analysed and how many years of data are used.
- Hospitalisation rates across small geographic areas may vary substantially less than reported previously.

6. SUMMARY OF FINDINGS FROM LITERATURE REVIEW

In reviewing the literature we attempted to address the following questions:

- What are the general factors affecting admission rates?
- What factors influence admission rates when they are being used specifically as outcome indicators for chronic medical conditions?
- How should admission rates be calculated when used as health outcome indicators?

General factors

The general studies of admission rates show that they are affected by many factors. Potential sources of variation in hospitalisation rates include differences in:

- patient characteristics such as age, ethnicity and socio-economic grouping
- severity of underlying morbidity and co-morbidities
- access to care and availability of resources
- clinical judgement of need for admission
- quality of antecedent care delivered.

Outcome indicators for chronic medical conditions

The prime purpose of this study has been to review the use of admission rates as outcome indicators for specific conditions. Although some work has been done on surgical procedures the main thrust has been on chronic medical conditions where an admission can suggest ineffective disease prevention or inadequate care outside hospital.

Fleming (1995) has reviewed the literature on the relationships between primary care, potentially avoidable hospitalisation, and outcomes of care. His main conclusions were:

- A substantial amount of hospitalisation may be potentially avoidable.
- If patients can avoid hospitalisation through access to periodic primary care services, they will evade the iatrogenic and other risks associated with in-hospital care; this implies that quality of care is better if hospitalisation can be legitimately avoided.
- The use of primary care may reduce the duration of hospitalisation.
- The extent to which a causal relationship may exist between access to primary care and avoidance of admission probably varies by condition.
- Although progress has been made in understanding the relationship between primary care and admission, work remains to be done, particularly in elucidating the process of the delivery of medical care over time.

The main conditions that have been considered in this review are:

- asthma
- diabetes
- cardiovascular disease and stroke
- mental illness.

The literature on *asthma* is extensive and the main factors identified as influencing admission rates in both UK and USA are:

- socio-economic factors, in particular social deprivation and ethnicity
- quality of ambulatory care
- severity of the condition
- admission procedures and criteria.

Diabetes has also been well investigated and the main factors identified as influencing admission rates are broadly similar:

- socio-economic factors, in particular ethnicity and social deprivation
- sex
- structure of continuing care
- co-morbidities.

Cardiovascular disease admission rates are particularly influenced by the presence of co-morbidities

Mental illness is common in primary care, a large proportion being treated without specialist referral. A significant proportion may be undetected or inadequately treated. Under-recognition and under-treatment of mental health disorders in primary care may be associated with poor health outcomes and increased health care costs.

Interventions such as assertive community treatment (a team-based approach aiming at keeping ill people in contact with services, reducing hospital admissions and improving outcome, especially social functioning and quality of life) lead to fewer and shorter admissions.

Calculation of admission rates

When using British data about admission rates it is possible to derive them in a number of different ways depending on which of the following are used:

- finished consultant episodes or continuous in-patient spells as the counting currency
- episode–spell or person-based which can be the first in the year or the first ever admission
- emergency only or all types of admission
- condition as main diagnosis or recorded anywhere in the medical record.

Currently there are few studies that identify the effect that using different definitions may cause. Most articles are based on USA experience where invariably the rates are calculated as all in-patient spells with the diagnosis anywhere on the record. A major feature of the Oxford NCHOD work programme is to compare the use of admission rates derived in the different ways and to identify the most robust method for presenting comparative information about populations.

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