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Variations in hospital admission rates: a review of the literature

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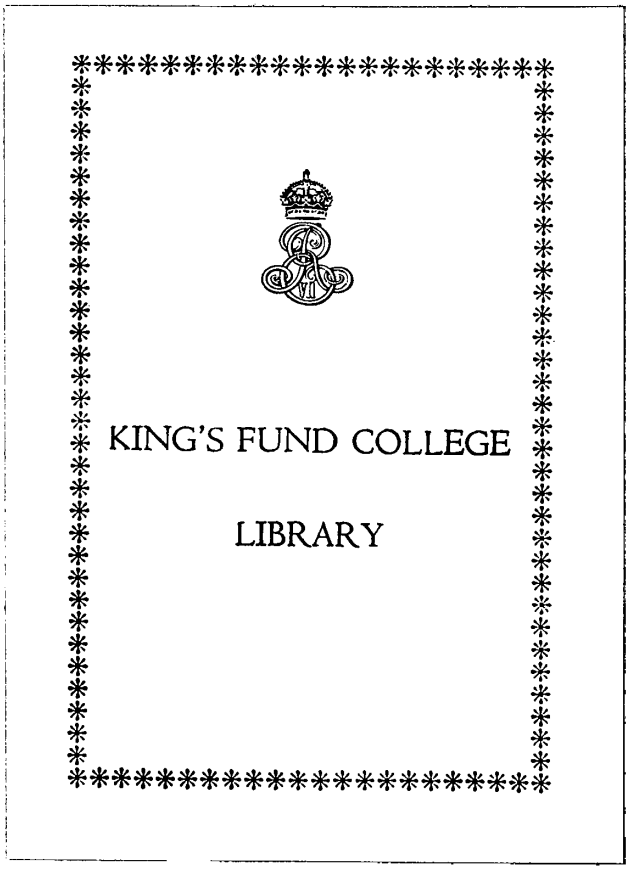

VARIATIONS IN HOSPITAL ADMISSION RATES: A REVIEW OF THE LITERATURE

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VARIATIONS IN HOSPITAL ADMISSION RATES: A REVIEW OF THE LITERATURE

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INTRODUCTION AND OVERVIEW

There is a large and growing body of research demonstrating geographical variations in hospital admission rates, both between and within countries. Most of the research arises from North America (US and Canada). There has been a smaller but significant quantity in the UK and work has been identified in Australia, New Zealand, Norway, Denmark, Sweden, West Germany and the Netherlands. Many theories have been proposed to explain such variations, testing the influence of supply, demand and clinical decision-making factors on utilisation rates. A number of initiatives have been tested, particularly in the United States, to alter rates of hospitalisation, triggered by escalating costs of health care.

The aggregate cost to a population of their hospital health care, measured in terms of annual costs per capita, is the product of two independent components. The first, and most assiduously studied, is the average cost per case. This is relatively easily measured, and attempts to control, for example, diagnostic tests or length of stay can affect the magnitude of cost per case. The second component, less intensively studied but just as important, is average annual admission rate per capita. This component is often assumed to be a manifestation of unambiguous medical need and hence not subject to the control of the health service.

Since this review will draw attention to the increasing literature on variations in admission rates and their causes, it will implicitly assume that an admission rate is not necessarily reasonable until demonstrated to be so. Such a demonstration assumes, for simplicity, that the cost per case is commensurate with reasonable standards of hospital practice and efficiency. However, such a change of emphasis assumes a broader concept of efficiency, which requires not so much that all activities in hospital are done efficiently, but that whether what is done in hospital bestows sufficient benefit to justify the admission at all. According to a classical perception of the role of medicine, this appears at first sight to be heretical. For many causes of admission, such as acute appendicitis, trauma or infections, questioning the reason for admission is obviously unnecessary. But since there are very large variations in admission rates for many conditions which clearly cannot be explained by variations in the incidence of disease, there is no alternative but to question the reasons for admission. Such questioning leads to a greater interest in measuring the outcome associated with hospital admissions, and comparing such outcomes with those associated with alternative forms of treatment. This is complementary to looking for cheaper ways to provide care, whether it is justified or not.

Variations in many parameters of acute hospital service use have been the focus of much managerial study in the 1980s, manifested by the development of performance indicators. Performance indicators use routine statistics such as measures of staffing, bed supply, length of stay, waiting lists and waiting times for treatment to compare the performance of health authorities. Underlying the development of such indicators of efficiency in the health service is an assumption that measures of throughput and activities (that is, cost per case) can be used to assess the quality and efficiency of care;

that hospital procedures reflect need for care and are for the good of patients indicates an implicit assumption that everything that happens in hospital is worthwhile. Thus, increases in hospital admissions are sometimes taken to indicate increased output and are therefore deemed to be more efficient, even when there is no evidence to suggest that high admission rates are justifiable in terms of their outcomes, or whether increases in admission rates reflect genuine increases in efficiency.

Variations in hospital admission rates have received less attention than variations in other parameters of hospital use. They are, however, of great concern because, as this review will discuss, they clearly demonstrate the degree of uncertainty surrounding the treatment of many common conditions requiring medical or surgical intervention. Rather than always reflecting the individual's need for hospital care, and a clear-cut decision by medical staff on the appropriate treatment, the decision to hospitalise an individual and administer a particular treatment is made in the face of considerable uncertainty about the outcome of specific procedures and consequent improvements to an individual's quality and quantity of life.

Although the aims of the Resource Allocation Working Party have been to reduce inequalities in service provision between areas, based on current levels of service and utilisation, the existence of variations may in themselves create inequalities. As Ham (1988) stated:

> A key objective of the NHS is to provide services on the basis of need. Do variations in utilisation rates indicate that the NHS is responding to differences in needs between areas or do these variations in themselves give rise to inequities in service provision?

Geographical variations in admission rates may be caused by a number of factors. The most obvious cause is that of geographical variations in morbidity, and for some conditions there is a direct relationship between incidence of disease and admission rates. However, for many conditions the causal relationship is far less direct, and admission rates are related to factors such as the supply of resources, patient demand and clinical opinion. For conditions where diagnosis and treatment are clear-cut and unequivocal, admission rates do reflect morbidity of the population. For other conditions, rates of admission reflect the availability of beds, staff and medical resources. But for a large number of conditions where there is uncertainty and little consensus regarding treatment, rates of admission depend far more on the clinical opinions of staff within that geographical area than the population's need for particular medical or surgical treatments. The existence of considerable uncertainty within the practice of medicine points clearly to a major recommendation arising from the study of variations: that far more work needs to be done to assess the outcomes of common medical and surgical procedures—outcomes in terms of people's quality of life as well as morbidity and mortality.

This report summarises the literature on geographical variations in hospital admission rates in the UK and internationally. Although studies have reported variations in a number of related parameters, such as length of stay and outpatient activity, the review is restricted to studies of inpatient admissions. The literature was identified from various sources: a) Dr Klim McPherson and Ms Angela Coulter have collected a number of papers in the Department of Community Medicine and General Practice and the Unit of Clinical Epidemiology, University of Oxford; b) a small number of literature reviews have already been published, and papers from these are identified; c) the Copenhagen Collaborating Centre has published two bibliographies (1985, 1987) concerned with regional variations in the provision, utilisation and outcomes of health care; d) references are identified from the categories of 'hospitalisation' and 'patient admissions' in Index Medicus. The references included are dated up to and including September 1988.

From the references identified, a microcomputer database was compiled using IBM compatible programme Cardbox Plus (Business Simulations Ltd), which includes full references, abstracts, and categories for selecting and sorting publications according to topics. The database is described in Appendix B. A bibliography, comprising abstracts or extracts of references cited in this report, as well as additional material of relevance to the study of geographical variations in admission rates, is available from the authors.

The report is divided as follows: chapter one describes the evidence for geographical variations in hospital admission rates in the UK, North America and other countries; chapter two reviews the causes of geographical variations, identifying need and demand factors, supply factors and clinical decision-making factors as postulated causes of geographical variations; chapter three reviews the possible consequences of variations in terms of financial implications, and whether high rates of hospitalisation in certain areas are associated with unnecessary or inappropriate use (with implications for patients' safety); chapter four reviews interventions to alter geographical variations and discusses the possible relevance to the UK; chapter five summarises the research and makes recommendations about future directions. The methodology used to study geographical variations in hospital admission rates is described in Appendix A; Appendix B comprises a description of the database of relevant literature on geographical variations.

1 THE EVIDENCE FOR GEOGRAPHICAL VARIATIONS IN ADMISSION RATES

INTRODUCTION

An early study of regional variations, published in the United States in 1850, noted that the population to patient ratio in the state lunatic hospital from 1832 to 1849 varied from 116.8 in Worcester County to 397 in Berkshire, Massachusetts (Jarvis 1850). In 1856, William A Guy noted that the annual per capita rates for hospitalisation in King's College Hospital, London varied from 325 per 1,000 population in St Mary le Strand to 1 per 1,000 in Marylebone District (Barnes 1982). In his often-quoted papers, Glover (1938, 1948) reported wide variations in the rate at which tonsils were removed in different parts of England.

Since then, the literature has expanded considerably. The Copenhagen Collaborating Centre in its two volume bibliography on health care variations identifies 191 references concerned with geographical variation. The present literature review identifies 350 papers of relevance.

In this chapter the evidence for variations is reviewed, documenting differences between countries in admission rates and small area variations in the US and other countries. Finally, variation studies in the UK are described.

INTERNATIONAL STUDIES: VARIATIONS IN ADMISSION RATES BETWEEN COUNTRIES

The literature on variations in utilisation rates between countries has been reviewed by Coulter (1986) and Ham (1988). A number of studies have documented large variations between countries in hospital admission rates for surgical and medical causes. The first international study was by Pearson and others (1968) who noted striking differences in the frequency of operations between Liverpool, the Upsala hospital region in Sweden and New England. The Liverpool region discharged fewer patients than the other two, despite having more discharges of adults than any other hospital region in England and Wales. Tonsillectomy and adenoidectomy were performed more than twice as often in New England as in Liverpool and four times as often as in Upsala; although Upsala and Liverpool had similar surgical rates, Upsala had significantly more gallbladder and gynaecological operations than the UK region.

Comparing operations and surgeons in the United States and in England and Wales, Bunker (1970) found that there were twice as many surgeons in proportion to population in the US as in England and Wales and that the population underwent twice as many operations. Comparing specific operations, Bunker reported that tonsillectomy and adenoidectomy were performed almost twice as often in the United States, cholecystectomy almost three times as often, and hernia repair operations almost twice as often. Vayda (1973) compared surgical rates in Canada with England and Wales, and standardised the rates for age and sex. Comparisons showed that surgical rates in Canada in 1968 were 1.8 times greater for men and 1.6 times greater for women than in England and Wales. The standardised rates for diverse elective and discretionary

operations such as tonsillectomy, haemorrhoidectomy and hernia repair operations were two or more times higher in Canada than in England and Wales.

Both Bunker and Vayda comment on the fact that the disparity between the two countries must be due to sources other than the incidence and prevalence of disease, relating them particularly to the supply of services and number of surgeons. In a later paper, Vayda and others (1982b) compared surgical rates in Canada, England and Wales and the United States between 1966 and 1976. They again reported that overall surgical rates in the US were twice those of Britain, while Canadian rates were one and a half times the British rates. Kohn and White (1976) examined hospital utilisation rates in twelve areas of seven countries and found that standardised hospitalisation rates varied more than two-fold between areas. The availability of short-term beds was found to account for most of the variation.

McPherson and others (1981) studied the use of common surgical procedures within and between England and Wales, Canada and the United States. The authors reported that rates of surgical utilisation, standardised by age and sex, varied up to seven-fold between countries. Appendicectomy was the only operation carried out at similar levels in these countries. Large variations were found between regions of the countries, and although supply variables might account for the international differences, the causes of variation within countries was less certain.

In a later paper, McPherson and others (1982) examined the incidence of seven common surgical procedures in hospital areas in Norway, districts in the West Midlands of the UK, and hospital service areas in the US. Surgical rates were higher in the New England states than in the UK or Norway, but the authors observed consistency among the countries in the rank order of variability for most procedures: tonsillectomy, haemorrhoidectomy, hysterectomy and prostatectomy varied more from area to area than did appendicectomy, hernia repair or cholecystectomy. They concluded that the degree of variation generally appeared to be more characteristic of the procedure than of the country in which it was performed, suggesting that uncertainty among professionals about the indications for a procedure may explain more of the variation between small areas than differences in resource levels. Finally, Bridgman (1979) presented an international study on hospital utilisation in nine regions of eight countries. One of the significant outcomes of the study was to show the correlation between the pattern of hospital utilisation and the level of socioeconomic development of the countries.

Other studies have noted significant international variations for specific procedures. The rates of hysterectomy are much lower in Norway than in Denmark and Massachusetts (Anderson and Kamper-Jorgensen 1984); and the strikingly low rate of hysterectomy in Norway was noted by McPherson and others (1982). Women in Italy are much more likely to have a hysterectomy than those in France (Van Keep and others 1983). Caesarean section rates similarly show large variations between countries: national rates vary four-fold from less than 5 per cent of all deliveries in the Netherlands and Fiji to nearly 20 per cent in Singapore, Canada and the US (Chalmers 1985). Notzon and others (1987) studied caesarean rates in 19 industrialised countries of Europe, North America and the Pacific and showed sharp differences in rates per 100 hospital deliveries in 1981, ranging from a low of five in Czechoslovakia to a high of 18 in the US. The percentage of mothers who had a vaginal birth after a previous caesarean section was only five in the US compared with 43 in Norway. Women in the US have a significantly higher rate of caesarean section for dystocia or abnormal labour than women in Ireland (Sheehan 1987). Ulcer disease accounts for 35 per cent more bed days per 100,000 population in Denmark than in Sweden, the main source of the difference being accounted for by admissions for duodenal ulcer (Joensson and Silverberg 1982).

The higher consumption of hospital care in Denmark is largely explained by the fact that more medical cases are treated as inpatients in Denmark than in Sweden. The appendicectomy rate in the Federal Republic of Germany was two to three times higher than that of other comparable European countries (Lichtner and Pflanz 1971). Plant and others (1973) compared the number of gallbladder operations in 1961 and 1971 in three similar towns in Canada, France and England, and concluded that the incidence of gallbladder disease was six times higher in North America than in Western Europe because of the much higher rate of cholecystectomy in the US. In 1982 the number of cardiac operations in the UK (107 per million population) was significantly lower than in other countries, such as Australia with 410 per million or 750 per million in the United States (English and others 1984).

In *The Painful Prescription*, Aaron and Schwartz provide an illuminating analysis of the provision of ten medical procedures in the US and Britain. Most services are provided at lower levels in Britain than in the US: for example, the overall rate of treatment for chronic renal failure in Britain is less than half that in the United States, and the rate of coronary artery bypass surgery in Britain is only ten per cent of that in the US. Three procedures—bone marrow transplants, radiotherapy for cancer and treatment for haemophilia—were provided at essentially the same level in both countries (Aaron and Schwartz 1984, Schwartz and Aaron 1984). The low rate of treatment for patients with kidney failure in the UK in comparison with other countries has also been commented on by Wing (1983).

Studies of variations in hospital admission rates between countries reveal significantly lower rates in the UK compared with other economically comparable countries, such as the US and Canada. However, as discussed by Coulter (1986), international comparisons must be interpreted with caution: different forms of health care organisation and different methods of data collection limit the sensitivity of such comparisons, making it difficult to distinguish 'true' variations caused by genuine differences in need between populations from those caused by social and economic characteristics or the effects of the type of health care system. While comparisons between countries give valuable information about health care delivery, in order to assess causes of geographical variations within countries it is of greater value to focus on studies of admission rates between small, homogeneous areas within countries.

GEOGRAPHICAL VARIATIONS WITHIN THE US, CANADA AND OTHER COUNTRIES

North America (US and Canada)

The literature on geographical variations in hospital utilisation rates in North America is extremely large. It has been recently reviewed by Paul-Shaheen and others (1987), Burns and others (1987), Lohr and others (1985), Rothberg (1982), Fineberg (1984) and Ham (1988). For full details of the literature the reader is referred to the reviews.

One of the earliest studies of small area variations was the analysis by Lewis of the incidence of surgery in Kansas (Lewis 1969). The rate at which appendicectomy, hernia repair, haemorrhoidectomy, cholecystectomy, tonsillectomy and varicose veins operations were performed in 11 areas was described, and three to four-fold variations were found. Ten-fold variations in tonsillectomy rates and three and four-fold variations in the rates at which other common elective procedures were performed were reported by Wennberg and Gittelsohn (1973). Similar variations have been reported in Canada in tonsillectomy and adenoidectomy rates in small areas in Manitoba (Roos and others 1977). The papers are summarised in the review by Paul-Shaheen and others (1987).

Table 1 Classification of modified diagnoses related group categories by degree of variation in hospitalisation rate

MEDICAL CAUSES OF ADMISSION	SURGICAL CAUSES OF ADMISSION
Low variation	*Low Variation*
Acute myocardial infarction	Inguinal and femoral hernia operation
Specific cerebrovascular disorder	Major small/large bowel operation
	Gallbladder disorders with cholecystectomy
	Hip repair except joint replacement
Moderate variation	*Moderate variation*
Gastrointestinal haemorrhage	Appendicitis with appendicectomy
High variation	*High variation*
Urinary tract stones	Hysterectomy
Digestive malignancy	Major joint operations
Syncope and collapse	Major cardiovascular operations
Heart failure and shock	Other adult hernia operations
Respiratory neoplasms	Anal operations
Seizures and headaches	Soft tissue operations
Angina pectoris	Lens operations
Toxic effects of drugs	Foot operations
Cardiac arrhythmias	Transurethral operations
GI obstruction	
Adult simple pneumonias	
Miscellaneous injuries to extremities	
Very high variation I	*Very high variation I*
Kidney and urinary tract infections	Back and neck operations
Adult gastroenteritis	Hand operations except ganglion
Medical back problems	Knee operations
Circulatory disorders excluding AMI, with cardiac catheterisation	
Red blood cell disorders	
Cellulitis	
Adult diabetes	
Very high variation II	*Very high variation II*
Chest pain	Tonsillectomy
Deep vein thrombophlebitis	Extra-ocular operations
Acute adjustment reaction	Miscellaneous ENT operations
Adult otitis media and URI	Other T & A operations
Respiratory signs and symptoms	D & C, conisation except for malignancy
Chronic obstructive lung disease	Breast biopsy and local excision for non-malignancy
Trauma to skin, subcutaneous tissue and breast	Other female laparoscopic operations
Adult bronchitis and asthma	Tubal interruptions for non-malignancy
Hypertension	Dental extractions and restorations
Paediatric gastroenteritis	Laparascopic tubal interruption
Peptic ulcer	
Paediatric bronchitis and pneumonia	
Organic mental syndromes	
Atherosclerosis	
Paediatric otitis media and URI	
Paediatric pneumonia	
Chemotherapy	

Source: Roos, Wennberg and McPherson (1988).

Most of the published studies have reported large and significant variations in utilisation rates for many procedures between large and small areas of the countries. In summarising the evidence for small area variations in North America, Paul-Shaheen, Clark and Williams noted four patterns that emerge from the research.

The first pattern is that some procedures (such as hysterectomy and tonsillectomy) have a greater variation than others (such as appendicectomy and hernia repair), no matter where the procedure is studied. This pattern was initially described by Wennberg and Gittelsohn (1975) and has been reported by other researchers. Wennberg, McPherson and Caper (1984) have classified diagnosis related groups by the degree of variation in hospitalisation rate, indicating that certain medical and surgical procedures show low, moderate, high or very high variation regardless of where the procedure is performed. The causes of admission classified by degree of variation in hospitalisation rate are summarised in Table 1.

The second pattern, also identified by Wennberg and Gittelsohn (1975), concerns the consistency of use rate over time. Over a number of years, within certain communities, procedure-specific use rates that are relatively high remain high and those that are low remain low. As stated by Paul-Shaheen and others: '... when depicted graphically, a unique surgical signature for the community is displayed'.

Another pattern is consistency across high and low use areas. That is, certain areas have high rates of admission and others have low rates regardless of the category of admission, and such differences remain constant over time.

The fourth pattern is the difference in variation between medical and surgical admissions. Initial work concentrated on specific surgical procedures and found very wide variations. Once the research widened to include variations in medical admissions, the ranges across areas were even greater. This is indicated in Table 1, with significantly more medical procedures showing high variation in comparison with surgical procedures.

Other countries

Geographical variations appear to be universal. A number of studies in Denmark, Sweden, Norway, Germany, and Australia and New Zealand have demonstrated significant regional variation in admission rates for a number of surgical and medical procedures. In Table 2 selected studies demonstrating geographical variations are shown. Data has been collected at differing levels of aggregation, including counties, regions, towns, health boards and hospital market areas. Rates of admission for hysterectomy, peptic ulcer, cataract surgery, common elective surgical procedures, appendicectomy and psychiatric admissions have all been found to vary widely between large and small areas within countries.

GEOGRAPHICAL VARIATIONS IN THE UK

No review has fully and comprehensively described geographical variations in the UK and, for a number of historical and policy reasons, the literature is significantly smaller than that from North America.

Glover is commended as being the first author to write about geographical variations in the UK (1938). Using official returns from local authorities, comparisons between neighbouring or similar areas showed substantial differences in tonsillectomy rates. From 1936 to 1938, Kent County Council had exactly the same average percentage rate as England and Wales as a whole. Seven urban areas in Kent had practically the same

Table 2 Studies showing variations in admission rates in Denmark, Norway, Sweden, Germany and Australasia

COUNTRY	ADMISSION	STUDY	AGGREGATION	RANGE
Denmark	Medical and surgical	Kamper-Jorgensen (1984)	Counties	Inter-county variations range from 84% to 120% of country's overall admission rate
	Hysterectomy	Andersen, Madsen and Loft (1987)	Counties and hospital market areas	Varies by a factor of 6 for women 30–60, and by a factor of 20 for women over 60 years
	Peptic ulcer	Joensson and Silverburg (1982)	Regions	Large regional variations
	Cataract surgery	Bernth-Peterson and Bach (1983)	Counties and towns	Significant regional variations; lowest rate in areas with shortage of ophthalmologic services, but no direct correlation between supply and operation rate
Norway	Elective surgery	McPherson and others (1982)	Counties	Most variation in tonsillectomy, haemorrhoidectomy, hysterectomy and prostatectomy; less variation in cholecystectomy, appendicectomy and hernia repair
Sweden	Psychiatric	Stefannson (1984)	Sub-areas used for MAP analysis	Method demonstrates variations in utilisation of psychiatric services
	Peptic ulcer	Joensson and Silverburg (1982)	Regions	Large regional variations
	Cholecystectomy; kidney stone; prostatectomy	Carlsson (1986)	Districts	Coefficients of variation: 30% (cholecystectomy); 21% (kidney stone); 16% (prostatectomy)
Germany	Appendicectomy	Lichtner and Pflanz (1971)	Residential areas within city	Rate varies between residential areas

continued

COUNTRY	ADMISSION	STUDY	AGGREGATION	RANGE
Australia	Common surgical	Schacht (1979)	Statistical divisions	Ratio of lowest-rate division to highest varies from 1:15.0 (breast operations) to 1:1.4 (hysterectomy)
			Local authority areas	12 areas high or low for hip operations; 87 areas high or low for tonsillectomy
	Caesarian section	Opit and Selwood (1979)	States	High inter-state variation; rate related to obstetricians per capita in different states
New Zealand	Surgical	Simpson (1986)	Health boards	Rate of highest to lowest varies from 1.2 (cholecystectomy) to 2.9 (tonsillectomy)
	Hysterectomy	MacIntosh (1987)	Health boards	Rate varies from 1.5 to 7.1 per 1,000 population

rate as the county and as England and Wales. In comparison, Canterbury, Bromley and Folkstone had twice the rate and Bexhill and Royal Tunbridge Wells nearly three times the rate. Thus a child in Bexhill elementary school was five times more likely to have his tonsils out than a child in Ramsgate. Glover said that: 'One cannot avoid the conclusion that there is a tendency for the operation to be performed as a routine prophylactic ritual for no particular reason and with no particular result'. He explained geographical variations in tonsillectomy rates in terms of variations in medical opinion on when the operation should be performed.

Glovers' original observations gave rise to a significant amount of research. For surgical and medical causes of admission, studies documenting variations between different geographical areas are summarised in Table 3, showing the population aggregation used and the range of rates of the procedure between the highest and lowest measures. The table indicates which studies have used sex and age standardised data, allowing comparisons between studies. Population aggregation used in the studies include regional and district health authorities, health boards, towns, local educational authorities and general practices. Variations in surgical rates between social classes or consultants have also been studied.

It is clear from Table 3 that surgical admissions have been examined in greater detail than medical admissions, despite evidence that variations in medical admissions are often far greater than those for causes requiring surgical intervention. The studies demonstrate that for all population aggregations studied, and for different medical and

Table 3 UK Studies showing variations in surgical and medical admissions

ADMISSION	STUDY	POPULATION AGGREGATION	RANGE REPORTED
General surgical and medical	Beresford (1982)	Regions	*730 (Midlands)—910 (NW and NE Thames) per 10,000 population
		Districts	*Range between districts within regions: 14 (E Anglia)—57 (SE Thames)
		County districts in East Anglia	*490 (Broadland)—1,000 (E Cambridge and Norwich) per 10,000 population
	Cullis and others (1981)	Regions	*758.4 per 10,000 population mean admission rate for all acute specialties; coefficient of variation: 8.8%
		Districts (within Trent)	*666.0 per 10,000 population mean admission rate for all acute specialties; coefficient of variation: 50.9%
	Haynes (1985)	Regions	*26.9 (Oxford)—42.0 (North Western) daily bed use rates per 10,000 population
	London Health Planning Consortium (1979)	Regions	*1,153 (Inner London), 1,003 (Outer London) and 861 (Thames) admissions per 10,000 population compared with 910 in England (excluding regional acute specialties)
	Winyard (1982)	Regions	**753 (Wessex)—988 (NE Thames) per 10,000 population
		Districts	**671.3 (Walsall)—1,181.4 (City and Hackney) per 10,000 population
General surgical	Beresford (1982)	Regions	*176 (E Anglia)—251 (SW Thames) per 10,000 population
		Districts	*Range between districts in E Anglia: 179–245 per 10,000 population
	Buttery and Snaith (1980)	Consultants	*In 6 specialties: operations per consultant ranged from 662 (Northern)—1,288 (SW Thames)
	Cullis and others (1981)	Regions	*197.2 per 10,000 population mean admission rate for all general surgery; coefficient of variation: 11.1%
		Districts (within Trent)	*187.2 per 10,000 population mean admission rate; coefficient of variation: 53.9%
	DHSS (1981)	Regions	*186.5—254.2 discharges and deaths per 10,000 population (general surgery)
	Nicholl and others (1984)	Regions	Private sector contribution varies from 5.2% (Northern)—21.8% (NW Thames)
	Heasman and Carstairs (1971)	Consultants	Percentage of patients operated on once admitted to surgical units varies between consultants from 45%–86%
	Logan and others (1972)	Regions	*400 (Sheffield)—579 (Liverpool) per 10,000 population

continued

ADMISSION	STUDY	POPULATION AGGREGATION	RANGE REPORTED
General surgical	Winyard (1982)	Districts	**69–140 standardised admission rates for general surgery; large variation for specialties
Tonsillectomy with/without adenoidectomy	Black (1978, 1985d)	Regions	**Low variation between regions: 45 (NW Thames)—60 (E Anglia) per 10,000 population 0–9 years
	Bloor and Venters (1978)	Scottish regions	*26.8 (North)—506 (South East) per 10,000 population
	Bloor, Venters and Samphier (1978)	Towns	**62–158 per 10,000 population
		Specialists	**Operation rates vary from 45.8%–84.5% of all children seen as outpatients
		Social class	Little difference in operation rates
	Coulter and McPherson (1985)	Social class	Higher rates in higher social classes
	Glover (1938, 1948)	Local education areas	*Annual percentage rate, 1936–1938 ranged from 0.9% (Ramsgate)—5.0% (Bexhill)
	Jessop (1988)	Towns	**82 (Lexden)—180 (Harwich); standardised discharge ratios
	McPherson and others (1981)	Regions	**14 (Northern)—25 (NE Thames) per 10,000 population
	McPherson and others (1982)	Districts	**7.5–27.5 per 10,000 population at risk
	Wilson (1978)	Health boards	*T&A: 28 (Lanarkshire)—51 (Ayr–Arran); All ENT surgery: 54 (Lanarkshire)—99 (Lothian) rate per 10,000 population
Appendicectomy	Barker and Liggins (1981)	Towns	**6.8 (Stoke)—12.7 (Preston) per 10,000 population
	Coulter and McPherson (1985)	Social class	Higher rate in higher social classes
	McPherson and others (1981)	Regions	**12.9 (Trent)—19.4 (NE Thames) per 10,000 population
	McPherson and others (1982)	Districts	**14.0–21.0 per 10,000 population
	West and Carey (1978)	Districts	**141–656 admissions in 1976
Hysterectomy	Coulter and McPherson (1985)	Social class	No social class gradient
	Coulter, McPherson and Vessey (1988)	General practices in one district	**12–37 hysterectomies per 10,000 women
	Jessop (1988)	Towns	**66 (Halstead)—142 (Harwich); standardised discharge ratio

continued

The Evidence for Geographical Variations in Admission Rates

ADMISSION	STUDY	POPULATION AGGREGATION	RANGE REPORTED
Hysterectomy	McPherson and others (1981)	Regions	**18.1 (Mersey)—28.7 (NE Thames) per 10,000 population
	McPherson and others (1982)	Districts	**7.5–15.0 per 10,000 population
	Savage (1983)	Regions	**27.1 (Trent)—47.3 (Wessex) operations per 10,000 women age 20–74
	Teo (1988)	Scottish health boards	†Eastern health boards perform more hysterectomies than those in the West
	Williams and others (1988)	Regions	Range of hysterectomies performed in private sector varies from 10–34% among regions
Cholecystectomy	Fowkes (1980)	Scottish health boards	**11.3 (Ayr and Arran)—20.0 (Borders) per 10,000 population
	Jessop (1988)	Towns	**90 (W Mersea)—160 (Harwich); standardised discharge ratios
	McPherson and others (1981)	Regions	**5.7 (Trent)—9.7 (Oxford) per 10,000 population
	McPherson and others (1982)	Districts	**7.0–11.0 per 10,000 population
Prostatectomy	McPherson and others (1981)	Regions	**5.8 (W Midlands)—13.2 (NW Thames) per 10,000 population
	McPherson and others (1982)	Districts	**4.5–9.5 per 10,000 population
Hernia operations	Coulter and McPherson (1985)	Social class	Higher rate in manual occupations
	Heasman and Carstairs (1971)	Consultants	Operation rate varies from 50%–95%
	Holland (1986)	Districts	†Large variations between districts
	Jessop (1988)	Towns	**74 (W Mersea)—124 (Brightlingsea); standardised discharge ratios
	McPherson and others (1981)	Regions	**8.5 (Mersey)—14.5 (Oxford) per 10,000 population
	McPherson and others (1982)	Districts	**10–20 per 10,000 population
Haemorrhoidectomy	McPherson and others (1981)	Regions	**1.3 (W Midlands)—3.0 (Yorkshire) per 10,000 population
	McPherson and others (1982)	Districts	**1–4.6 per 10,000 population
Varicose vein operations	Coulter and McPherson (1985)	Social class	Higher rate in lower social classes
Cataract operations	Sanderson (1980)	Regions	**Northern = 140%, W Midlands = 70% of national rate
Lens and eye operations	McPherson and others (1981)	Regions	**4.6 (W Midlands)—9.6 (Northern) per 10,000 population

continued

ADMISSION	STUDY	POPULATION AGGREGATION	RANGE REPORTED
Lens and eye operations	Jessop (1988)	Towns	**Lens: 55 (Halstead)—173 (Harwich); **Eyelid: 146 (Halstead) 511 (Brightlingsea); standardised discharge ratios
Myringotomy	Black (1978, 1985d)	Regions	**35 (S Western)—70 (Oxford) per 10,000 population age 0–9 years
		Districts	**Lowest range between districts in Oxford RHA (30), highest in SW Thames RHA (65)
Breast operations	Coulter and McPherson (1985)	Social class	Higher rate in higher social class
	Holland (1986)	Districts	†Large variations between districts
D and C	Coulter and McPherson (1985)	Social class	No social class gradient
	Jessop (1988)	Towns	**100 (Halstead)—185 (Clacton); standardised discharge ratios
Sterilisation	Coulter and McPherson (1985)	Social class	Little social class gradient
	Savage (1983)	Regions	*13.3 (SW Thames—42.2 (Mersey) per 100,000 population
Caesarean section	Macfarlane (1986)	Regions	*7.9% (Yorks)—10.2% (NW Thames and Mersey) deliveries by caesarean section (1980)
	Macfarlane and Mugford (1986)	Regions	*8.6% (W Midlands)—11.5% (Mersey) deliveries by caesarean section (1983)
		Health boards	7% (Fife)—15% (Argyll and Clyde, and Lanarkshire)
	Mugford and Stilwell (1986)	Regions	*8.4% (W Midlands)—11.3% (Mersey) (1982)
Circumcision	Coulter and McPherson (1985)	Social class	Higher rate in higher social class
Cardiovascular surgery	English and others (1984)	Regions	*83 (S Western)—429 (NW Thames) cardiac operations per million population per year
Renal surgery	Barker and Donnan (1978)	Regions	*14.6 (Sheffield)—26.6 (Leeds) per 100,000 population
	Jones and others (1984)	Regions	*14 (SW Thames)—142 (SE Thames) transplant operations
Skeletal and joint surgery (including hip operations)	Holland (1986)	Districts	†Large variations in hip operations
	Jessop (1988)	Towns	**Arthroplasty: 69 (Clacton)—140 (Halstead); Other joint: 47 (Clacton)—105 (Halstead); standardised discharge ratios

continued

The Evidence for Geographical Variations in Admission Rates

ADMISSION	STUDY	POPULATION AGGREGATION	RANGE REPORTED
Skeletal and joint surgery (including hip operations)	Office of Health Economics (1982)	Regions	*164 (Mersey)—448 (S Western) hip operations per million population
General medical	Beresford (1982)	Regions	*105 (E Anglia)—224 (SE Thames) per 10,000 population
	DHSS (1981)	Regions	*114.7–226.9 Discharges and deaths per 10,000 population (general medicine)
	Logan and others (1972)	Regions	*150 (E Anglia)—228 (Liverpool) per 10,000 population
	Winyard (1982)	Districts	**50–189 standardised admission ratios (general medicine); large variations for specialties
Renal and dialysis	Barker and Donnan (1978)	Regions	*Renal and uteric colic: 20.3 (Sheffield)—39.9 (Wales) per 100,000 population
	Dalziel and Garrett (1987)	Districts	**8–73 per million population (acceptance rate); 134–357 per million population (treatment rate)
	Dowie (1984)	Regions	Patients receiving treatment: *95 (Wessex)—226 (NE Thames) per million population
Diabetes	Holland (1986)	Districts	†Small variation in discharge rates
Cardiology	Holland (1986)	Districts	†Large variation in admission for acute myocardial infarction
Outpatient activity	Fowkes and McPake (1986)	Regions	*6020 (S Western)—9480 (NE Thames) attendances per 10,000 population

* Data unstandardised (or no information on standardisation given in text).
** Data standardised for age and sex of population.
† No detailed information given in text.

surgical procedures, there is significant range between the highest and lowest rate. There also seems to be a wide variation between studies in the highest and lowest rates reported. For example, Beresford (1982) reported a range from a low of 730 to a high of 910 over all surgical and medical admissions per 10,000 population, whereas the rates reported by the London Health Planning Consortium (1979) ranged from an average of 861 (Thames) to 1,153 (Inner London) medical and surgical admissions per 10,000 population. Black (1985d) reports a range of 45–60 tonsillectomies per 10,000 population between regional health authorities; in contrast, McPherson and others (1981) note an inter-regional range of 14–25 tonsillectomies per 10,000 population. Similar discrepancies in the data are reported for many other procedures, as can be seen from Table 3. Such discrepancies are probably caused partly by researchers using different definitions of the procedures being studied or different population estimates. Very often the information given in the publication is insufficient to make reasonable comparisons between studies.

The most popular level of aggregation used has been regional health authorities in England or health boards in Scotland. At this level significant variations have been observed in both medical and surgical admissions. Logan and others (1972) reported that Liverpool's admission rates in 1967 were conspicuously higher than those of other

regions. Liverpool came top of the table for admission rates in medical and next to the top in surgical specialties; in medical specialties, Liverpool's rate was 35 per cent above the national average while in the surgical specialties it exceeded the national average by only 17 per cent. Marked variations in hospital admission rates for all acute specialties were shown between the 14 regional health authorities in England by the London Health Planning Consortium (1979). For example, there was a 25 per cent difference in admission rates between Trent and Yorkshire. The residents of Inner London are more likely to be admitted to an acute hospital than those living in other parts of the country. Within the four Thames regions there was considerable variation, with 115 admissions per 1,000 residents in Inner London, 100 per 1,000 in Outer London and 86 per 1,000 in the remainder of the four Thames regions. This compared with a figure of 91 per 1,000 in England as a whole. Large regional variations in general medical and surgical admissions were reported by Beresford (1982), and Haynes (1985) noted considerable regional variations in bed use rates.

There have been a number of analyses of selected surgical procedures. These include: an examination of regional variations in rates of tonsillectomy and adenoidectomy (Bloor and Venters 1978, Wilson 1978); the rate at which caesarean section is performed (Macfarlane 1986, Macfarlane and Mugford 1986, Mugford and Stilwell 1986); rates of cardiovascular surgery (English and others 1984); rates of renal surgery (Barker and Donnan 1978, Jones and others 1984); the rate at which women are sterilised (Savage 1983) or undergo hysterectomy (Teo 1988, Coulter, McPherson and Vessey 1988). In its report on hip replacement and the NHS, the Office of Health Economics (1982) details large variations between regions in surgical rates. Using data from 1967 to 1978, the rates per million population range from 164 in Mersey to 448 in the South Western region, indicating that the rate could be substantially increased in many cases. For people over 75, there were particularly marked disparities, the highest and lowest regions differing by a factor of 721. Cullis and others (1981) noted that the coefficient of variation for a specific specialty was larger than for all acute specialties taken together, suggesting that global data can mask the extent of true variation.

As discussed in Appendix A section 5, variations in the private sector have to be taken into account in examining geographical variations in admission rates. Private hospital activity is not included in routine hospital statistics, but Nicholl and others (1984) reported significant regional variations in the use of private practice for common elective operations. In 1981, 13.2 per cent of the total case load in domestic inpatient elective surgery was treated in the private sector. Regionally, the private sector contribution varied from five per cent to over 20 per cent. People in social classes IV and V have one-twentieth the rate of private surgery than those in social class I (McPherson, Coulter and Stratton 1985).

General medical admissions also show substantial variations between regions (DHSS 1981, Beresford 1982, Logan and others 1972). Admission rates for renal failure and dialysis, ENT, injuries and geriatric services all show wide variations between regions (Dowie 1984, Barker and Donnan 1978, Jones and others 1984, Beresford 1982). Regional variations in standardised admission rates in general medicine are substantially greater than those for general surgery (Winyard 1982). Treatment rates for end stage renal failure and diabetes vary between regions (Dalziel and Garrett 1987, Holland 1986); and there are large variations in rates of admission for acute myocardial infarction (Holland 1986).

The above studies, while indicating significant regional variations, have used data that has not been standardised for age and sex characteristics of the population, which limits its value in pointing to the causes of such variations. Several studies have standardised data for age and sex characteristics. McPherson and others (1981) demonstrated up to

two-fold variations in the standardised rate of common surgical procedures between regions, and general surgical admissions were found to vary from 753 in Wessex to 988 in North East Thames per 10,000 population by Winyard (1982). Standardised rates for tonsillectomy, hysterectomy, cholecystectomy, cataract operations and surgery for glue ear have been shown to vary significantly between regional health authorities.

In its study of the acute hospital sector, the DHSS (1981) demonstrated wide disparities in rates of activity and resource use between health authorities. However, the report discusses the limitations of comparisons at regional level and concluded that studying variations at district level is likely to be much more informative: 'any serious attempt to evaluate variations in activity and resource usage must get down to at least the district level where factors affecting variation can be better identified, with a view to identifying better and more efficient ways of providing a particular service'.

For many causes of admission, variation between districts is significantly greater than inter-regional variation. For example, Cullis and others (1981) studied variations in admission rates for all acute specialties and general surgery and observed that the coefficients of variation were higher in Trent region than between the English regions; Black (1985d) describes greater variation between districts in admissions for tonsillectomy than between regions. As can be seen from Table 3, several studies have examined variations at district level. Rates of general medical and surgical admissions varied from 671 per 10,000 population in the district of Walsall to 1,181 in City and Hackney (Winyard 1982); the amount of intra-regional variations also varies between regions (Beresford 1982). Winyard (1982) reported large variations in standardised admission rates for general surgery, with even greater variations for the specialties, comparing rates across district health authorities. McPherson and others (1982) studied the incidence of common surgical procedures in West Midlands Health Authority and found that tonsillectomy, haemorrhoidectomy, hysterectomy and prostatectomy varied more from district to district than appendicectomy, hernia repair or cholecystectomy. Admissions for appendicitis varied widely between districts in Wales (West and Carey 1978), and Holland (1986) showed large variation between districts in rates of hernia operations, breast operations, skeletal and joint surgery.

Other studies have used towns as units of population aggregation, and reported variations between towns in rates of tonsillectomy and adenoidectomy (Bloor and Venters 1978, Jessop 1988), appendicectomy (Barker and Liggins 1981), hysterectomy, cholecystectomy, hernia operations, lens and eye operations, dilatation and curretage, and skeletal and joint surgery (Jessop 1988). Coulter and McPherson (1985) studied variations between social classes in the use of common elective surgical operations, and although people in more advantaged groups had higher mean numbers of operations than those in the less advantaged groups, the difference was mainly accounted for by operations carried out before the establishment of the NHS and by those performed in the private sector.

Finally, variations between doctors have been documented in relation to hospital care and general practice. One example is the study by Buttery and Snaith (1980) which reported wide differences between surgeons in the number of operations performed. In six surgical specialties, the regional average number of operations per surgeon varied from 662 to 1,288. The extent of variation was found to be even greater in individual specialties. Heasman and Carstairs (1971) have shown considerable variations in certain aspects of practice by Scottish consultants. The likelihood that an operation is performed, once a person is admitted to hospital, varies significantly between consultants: two-thirds of people discharged from surgical units have had an operation but the range between consultants varies from 50 per cent to 86 per cent. For hernia operations, some consultants operate on all patients but a few operate on less than

three-quarters. In a detailed analysis of the content of ENT consultations, Bloor and Venters (1978) document considerable variations between consultants' assessment practices, particularly in their examination of children and the questions asked prior to a decision to perform tonsillectomy and adenoidectomy. The authors examine how such different assessment practices might contribute to variations between regions in surgical rates.

Variations in rates of referral by general practitioners to hospital consultants have long been known to exist. A paper presented by Dr Donald Acheson highlighted the extent of variation and expressed a sense of frustration that '. . . a phenomenon so gross can continue to defy analysis' (Acheson 1985). His concerns were with the cost implications of variations as well as the extent to which patients are receiving too much or too little care. The literature on variations between GPs is reviewed by Wilkin and Smith (1986, 1987b). Research findings relating to variations in referral rates have been appearing in the literature over a period of at least 25 years. The studies which report ranges for doctors all show substantial variations between GPs, a finding which is true even for those based on single practices. Studies which include doctors from many practices report a wider range, the most extreme being the one found by Wilkin and Smith (1987a) with a range between one and 24 referrals per 100 consultations. Crombie and Fleming (1988) found that variability in referral rates between general practices to outpatient departments greatly exceeded variability which can be associated with different practice locations (urban/rural) or characteristics of patients (sex, age or social group).

Although the literature provides a fairly comprehensive account of the extent of variation in referral rates, it is far from complete in addressing the problem of identifying the sources of this variation or the possible consequences. Although studies have examined how characteristics of patients or characteristics of doctors and their practices might contribute to variations, 'The conclusion that must be drawn from the existing literature on referral rates and the causes of variation between General Practitioners is that most of the variation between General Practitioners remains unexplained' (Wilkin and Smith 1987a). Dowie (1983) analysed GP referrals to medical outpatient departments in the light of 25-fold differences between general practitioners and identified factors relevant to the referral decision, including professional attributes, personal characteristics and the GP's knowledge of the medical system. Although the published literature demonstrates significant variations between GPs in referrals to consultants, what is unclear is how this might contribute, directly or indirectly, to variations in admission rates.

SUMMARY

The above overview indicates that there is a large and growing literature on geographical variations between countries and within countries. Most of the literature so far has arisen from North America, although a significant number of papers have been published referring to variations in the United Kingdom. An examination of the literature merits the following conclusions.

1 Many studies have examined variations in surgical procedures but relatively few have looked at medical admissions. A few procedures, such as tonsillectomy, adenoidectomy, hysterectomy, cholecystectomy and other common elective operations have been examined more than others, such as renal surgery and cardiac surgery. These common procedures have been relatively neglected.

2 Although less attention has been paid to medical admissions, the evidence is that there is much more variation in rates of admission for medical causes than for surgery.

3 The amount of variation for specific specialties is much greater than the variation for all specialties combined, such as measures of all general acute admissions used in some studies. Global data can mask the extent of true variation.

4 In the UK, most studies have concentrated on variations between regional health authorities, although there is evidence that intra-regional variation exceeds inter-regional and that more information can be gained by analysis at the district or unit level (see Appendix A).

5 Certain patterns of variation have been identified indicating that while some procedures have a high level of variation others have a low level, regardless of where the procedure is performed. Such differences appear to remain constant over time, at least for those procedures that have been studied at several points over time.

6 Finally, a key point arising from an analysis of literature on geographical variations is that the existence of such large variations indicates that there is little agreement on what the correct or appropriate level of use of service should be. One theme running throughout the literature is that of the continuing debate on whether high rates signify unnecessary usage or low rates signify under provision. This issue, which has been less addressed in the literature from the UK than in the work from North America, will be discussed further.

2 EXPLANATIONS FOR VARIATIONS IN ADMISSION RATES

Explaining observed variations in admission rates is no easy task. Clearly, many factors can and do contribute to the hospitalisation of an individual, and variation in such factors must contribute to the observed variations in admission rates. The challenge is to assess which factors are of significance, and which are a natural consequence of acceptable variation between people and within the health care system. Causes of variations have been reviewed by Coulter (1986), Morgan and others (1987), Paul-Shaheen and others (1987) and Ham (1988).

There is no shortage of theories proposed to explain variations in hospitalisation rates. McPherson and others (1981) list 11 possible sources of variation; in their review article, Paul-Shaheen and others identify over 40 characteristics of individuals, the community or the health care system which had been associated with variations in admission rates. Some possible sources of variations, such as differences in the age and sex composition of the population studied, can be dealt with statistically by standardisation (as discussed in Appendix A). The extent to which people are treated as outpatients or have day care rather than being admitted as inpatients must also be taken into account. McPherson and others (1981) assessed the extent of random variation in their study and eliminated it as a major factor in the observed differences. Other factors which might cause 'false' variations include sources of data inaccuracy, incomplete data files, different coding procedures, or errors in recording information. But in general such factors cannot be held responsible for large variations and can be eliminated through appropriate study design.

Although it is tempting to be simplistic and look for a single cause which can explain observed variations in all admissions, different procedures vary because of different causes. For example, the observed variations in appendicectomy rates may simply relate to differences in the morbidity of the population; large variations in tonsillectomy rates may however be totally unrelated to morbidity and have completely different causes. As discussed in Appendix A, causes may vary according to the population aggregation studied.

Causes of variations in admission rates have been evaluated in terms of the following categories: demand factors, including morbidity differences between populations and characteristics of patients; differences in supply of health care resources; and clinical factors, including decision-making on the need for hospitalisation. The evidence for causes of variations is reviewed under these three headings.

NEED AND DEMAND FACTORS

For many conditions, variations in overall hospitalisation rates appear to be too large to be accounted for by differences in morbidity alone. Morbidity is extremely difficult to measure, uncontaminated by the supply of health care resources or effect of clinical opinion, and it relies on indirect measures such as mortality or expensive and infrequently conducted surveys of a population's health status. Many people's symptoms

go unreported; the complaints brought to the attention of the medical profession are the tip of the 'symptom iceberg'. Mortality indices are too crude to assess the quality of life of an individual. Therefore, it is difficult to relate independent measures of disease incidence to admission rates. However, available evidence suggests that the relationship for widely varying causes of admission is low.

In the UK, no relationship between standardised mortality ratio and admission rates has been observed by Cullis and others (1981) and Winyard (1982). Self-reported health status could not explain geographical variation in surgical rates in Manitoba (Roos and Roos 1982), and little difference has been found between respiratory morbidity and tonsillectomy rates in Canada (Roos and others 1977b). Similarly, mortality rates or other morbidity data could not explain the observed differences in hospitalisation rates for peptic ulcer between Denmark and Sweden (Joensson and Silverberg 1982). Blumberg (1982) found that differences in hospital use across regions of the United States did not parallel regional morbidity differences, and Mitchell and Cromwell (1982) report that although health status could explain some observed variation across small areas in the US, supply factors were far more important. Also, no relationship between admission rates and mortality was found by Brewer and Freedman (1982).

While for many common discretionary procedures admission rates are not solely related to morbidity, the contribution of morbidity varies depending on the condition. For example, although some suggest that the rising rates of cholecystectomy and variations across areas cannot be accounted for by morbidity factors (Milner and Hewitt 1972, Opit and Greenhall 1974, Bateson 1984), McPherson and others (1985) correlated cholecystectomy rates in seven districts where prevalence of gallstones had been determined at necropsy and found a positive association. However, cholecystectomy is not a highly variable procedure (at least within countries) and the available evidence suggests that the large observed variations in admission rates for many more discretionary procedures are unlikely to be accounted for by variations in morbidity (Wennberg 1985b, 1987b).

Socioeconomic and demographic factors may also be associated with utilisation rates. However, socioeconomic factors, including income and educational level, were found to have surprisingly little effect on hospital utilisation in the US in some studies, although the type of health insurance held, itself dependent on income and social class, would be expected to influence utilisation rates (Anderson 1973, Brewer and Freedman 1982, Knickman and Foltz 1985, Wennberg and Fowler 1977, Connell and others 1981, Roos and Roos 1981). In comparison, socioeconomic differentials were found in rates of surgical procedures such as tonsillectomy, haemorrhoidectomy, cataract operations and circumcision in the US (Denman Scott and Mackie 1975) and the UK (Coulter and McPherson 1985). In another study, income was found to have an effect on utilisation in the US, with less influence of social class (Bombardier and others 1977). The influence of occupation was reported by Bunker and Brown (1974): surgical rates for physicians and their spouses were higher than rates for other groups; people in professional occupations had higher overall utilisation rates than in the US as a whole.

Ethnic group may influence utilisation. Studies in the US found that, in comparison with black people, white people have more elective surgical operations (Mitchell and Cromwell 1982), but black women have slightly more hysterectomies than white women (Dicker and others 1982) and, overall, black people may use more hospital care than white (Wilson and others 1985). Any effect of race on utilisation rates could be secondary to the effects of income or socioeconomic status. In the UK, unmarried people have higher utilisation rates than married (Butler and Morgan 1977) although in the US, married people were more likely to have surgery for lung cancer, as opposed to non-surgical treatments, than unmarried (Greenberg and others 1988).

People's behaviour is assumed to play a fairly limited role in contributing to differences in hospitalisation rates. Coulter (1986) stated:

> The prevailing view is that the patient is a passive partner in the consultation, lacking knowledge about his or her condition and the possible treatment options, and exerting little influence on decision. There is some supporting evidence for this view, but also some which would also suggest that, at least in relation to some procedures, patients may play a more active role than is generally accepted.

Coulter goes on to review the influence of demand on utilisation, and discusses the notion that certain people might be 'surgery prone', exerting higher demands on the medical services than others for surgical intervention. Bolande (1969) argues that tonsillectomy, adenoidectomy and circumcision are performed, not for medical need, but for 'non-rational ritualistic' reasons, responding to a perceived emotional need of parents to help their children. Further evidence for the view that consumers play an active role in affecting utilisation comes from the research by Domenighetti and others (1986) who report that the rates of hysterectomy in a Swiss canton decreased significantly following a media campaign to publicise the increasing rates in previous years. This suggests some effect of demand, at least on hysterectomy rates, although an alternative explanation might be that clinicians altered their rates of performing hysterectomy once they knew that their decisions were under scrutiny by the public. The influence of demand factors is under-researched, and patients' attitudes and behaviour may be a greater influence on utilisation rates than is generally recognised.

THE INFLUENCE OF SUPPLY

A key factor identified as contributing to geographical variations in hospital use both between and within countries is the influence of health service provision, in terms of the supply of hospital beds, medical staffing and resources. The association between surgical rates and various resource measures in Kansas was reported by Lewis (1969) who found that while the rates of haemorrhoidectomy and varicose veins operations were not associated significantly with any of the independent variables measured, almost 50 per cent of the variation in rates for herniorrhaphy and tonsillectomy could be accounted for by variations in operating physicians. By adding rates of beds per 1,000 population to numbers of surgeons, resource variables could account for 66 per cent of the variation in cholecystectomy rates and 70 per cent of the appendicectomy variation. Lewis coined a phrase, representing a new version of Parkinson's law: 'Patient admissions for surgery expand to fill beds, operating suites and surgeons time'. Following the acquisition of a new hospital in New York State, Roemer (1961a) observed that the hospital utilisation rate rose sharply from 1957 to 1959. 'Roemer's law' was observed to follow the supply of physicians (Roemer 1961b). Bunker (1970) also reported on the relationship between resource supply and surgical rates in his observation that there were twice as many surgeons in proportion to population in the United States as in England and Wales and that the population underwent twice as many operations. The correlation between the supply of surgeons and rates for nearly all surgical procedures in different hospital areas in Vermont was commented on by Wennberg and Gittlesohn (1973). Vayda (1973) concluded that the main cause of different surgical rates between Canada and England and Wales related to the higher proportion of surgeons and hospital beds in Canada. In their review of the North American literature, Paul-Shaheen and others (1987) examine studies that have correlated a number of factors with utilisation rates and conclude that the strongest positive associations were found between utilisation and resource supply.

Studies using multiple regression also found that the supply of beds, doctors and surgeons explains the greatest amount of variation observed.

In the UK, some relationships have been observed between supply of resources and utilisation. Logan and others (1972), reporting on the higher level of use of beds in Liverpool than in other regions, concluded that the high use reflects not a higher need for beds but greater availability. Liverpool inherited a large number of hospital beds in 1948 and consequently appeared to use more acute beds than any other region. They found a low level of efficiency in the use made of beds, and concluded that the study fulfilled the expectations of 'Roemer's law'—that admissions expanded to fit the number of beds available. Also, at a regional level, the London Health Planning Consortium identified the supply of beds as the major determinant of variations in hospital admission rates for acute specialties. The LHPC noted that the same relationship occurs within regions, with a correlation co-efficient of +0.85 between hospital admission rates and available beds per 1,000 resident population in health districts within the four Thames regions. Winyard (1982), looking at variations between area health authorities in England, found that bed supply was the most powerful predictor of admission rates, but the socioeconomic status of an area could explain a significant proportion of the variation. A large proportion of observed variation in admission rates between regions and districts was explained in terms of bed supply by Cullis and others (1981): bed use rate could be predicted most accurately in terms of the five-sevenths rule—that is, if a National Health Service bed is made available for an additional week then for five out of seven days it will be occupied. In other words, it is bed supply which strongly influences the demand for hospital care.

A few studies have examined the relationship between resource variables and admission rates for particular specialties. Black (1985a) reports that the greater availability of otolaryngologists contributed to the epidemic of surgery for glue ear in children. Chamberlain and others (1983) noted considerable regional variations in staffing levels in cardiology between regions in England and Wales, with corresponding regional variations in treatment. Variations in cholecystectomy rates between Scottish health boards correlated with certain measures of availability and use of surgical resources (Fowkes 1980). Variations in staffing levels are reported to contribute to varying treatment levels in renal medicine (Jones and others 1984) and for child health services (West and Lowe 1976). Sanderson (1980) comments on the relationship between availability of ophthalmic beds and rates of cataract extraction, although he questions whether bed supply determines operation rates or vice versa.

Despite much evidence that there is some relationship between supply variables and admission rates, resource factors do not explain all the observed variation (Coulter 1986). For example, Roos and others (1977b) found no consistent relationship between tonsillectomy rates and number of active physicians, throwing further doubt on the applicability of a Parkinson's law of surgery. McPherson and others (1981) examined relationships between rates for specific surgical procedures in regional health authorities and resource variables such as staffing, numbers of beds, level of funding and waiting lists. Although different combinations of supply accounted for more than 50 per cent of the inter-regional variation for each procedure, the pattern was complex and the relationship between surgical rates and numbers of surgeons was much weaker than that described in the North American studies.

As discussed by Coulter (1986), although supply factors are clearly important, other aspects of the process in deciding to admit people to hospital must be examined in order to arrive at some clear understanding of why variations exist.

Alternative provision and outpatient care

A further influence on the utilisation of hospital beds in the NHS is the availability of alternative forms of inpatient care, such as convalescent hospitals and nursing homes. Availability varies between regions and districts, private nursing home provision being particularly concentrated in the south west, along the south coast and on the North Wales coast. For example, in the Mid-Downs and Chichester districts private nursing homes and bed provision is approximately three times greater than NHS geriatric bed provision. There is not sufficient information on the use of these facilities to determine their precise impact on rates of hospital utilisation, but hospital activity analysis data for the South East Thames region in 1982 showed that 5 per cent of surgical discharges in the region were transferred to another hospital or convalescent unit, the transfer rate for individual districts ranging from 2.4 per cent to 10.1 per cent (Morgan and others 1987). As previously discussed, the private acute sector plays an increasing role in the provision of hospital care and varies markedly between regions. In 1986, 9 per cent of the population held some form of private medical insurance (Social Trends 1988), most of it by the higher social classes: over 20 per cent of men and women in socioeconomic group I held medical insurance compared with under 2 per cent in unskilled manual groups (General Household Survey 1983). There is also a notable north–south divide in the provision of private acute beds. The distribution of alternative forms of care is bound to have some impact on geographical variations.

A second influence is the extent to which care, particularly surgery, is provided on an outpatient rather than inpatient basis. In studies from North America, varying provision of ambulatory care accounts for some, but not all, of the observed differences in admission rates (Blumberg 1982, Brewer and Freedman 1982, Connell and others 1981, Knickman and Foltz 1985, Mitchell and Cromwell 1982). Outpatient surgery has increased notably in recent years, accounting for 18 per cent of all surgery in the US in 1985 and 28 per cent of all surgery in Canada in 1983–1984. Large differences exist between hospitals and physicians within hospitals in rates of outpatient procedures (Roos 1988). Variations in outpatient activity also exist in the UK (Fowkes and McPake 1986).

CLINICAL FACTORS AND THE INFLUENCE OF DECISION MAKING AND UNCERTAINTY

Alternative explanations for observed variations in admission rates lie with doctors and clinicians themselves, and in the decision-making process. A growing quantity of literature is devoted to discussing, firstly, how the judgment and preferences of individual clinicians affect admission rates and, secondly, how professional uncertainty contributes to variations between specific procedures or diagnoses.

In seeking to explain why the surgical rate in the US is twice that in England and Wales, Bunker (1970) explores the links between the number of surgeons and their practice, and suggests that, 'A more aggressive therapeutic approach appears to contribute to the greater number of operations in the United States'. Several studies in the UK point to the importance of physician behaviour in influencing variations. Accounting for variations between ENT specialists and their likelihood of recommending a child to be seen in outpatients for adenoid/tonsillectomy, Bloor and others (1978) describe variations between specialists in five parameters of assessment practices regarding examination and history taking. Specialists could be described as 'low acceptor—low operators' who accepted fewer children for operations than did the 'high acceptor—high operators'. Sanderson (1978) reports that people accepted for cataract surgery in Newcastle were significantly more disabled than those in Bristol and Bath,

which shows that clinicians are using different criteria for acceptance for surgery. Admissions for appendicitis in Wales may well vary because of different hospital admission policies (West and Carey 1978), and Smiddy (1977) reports a wide range of variation between doctors in the way that clinical data is recorded from women presenting with breast lesions. The significant variations between general practitioners in their referral rates to hospital outpatient departments have already been commented on and reviewed by Wilkin and Smith (1986, 1987b). Patterns of referral depend not on the particular medical condition but on a variety of other factors, including characteristics of the general practitioners: causes of variations in general practitioner referral rates are complex and explanations vary between studies.

In the UK, the effect of clinical judgment is usually only considered in the context of variations between district health authorities: individual clinicians, it is argued, may affect a district's surgical rate but not the regional rate where there are too many surgeons for the activity of one to be noticeable. However, as discussed by Black (1978) in his examination of variations in surgical rates for glue ear, this fails to take into account 'group' clinical judgment: it seems plausible that surgeons in any region will share similar clinical views, arising from regional meetings, postgraduate teaching and the movement of surgeons in training between districts. Thus, in regions with low variance, there is a consensus among surgeons concerning the clinical indications for the use of surgery, whereas in the high variance regions operating for glue ear remains controversial. 'When a high rate of surgery is established, variance between districts decreases as a result of consensus on the use of the operation' (pages 142–145).

Jack Wennberg is a leading proponent of the view that practice styles and professional uncertainty influence variations in hospital admission rates. Wennberg has written prolifically on the notion of practice style variation, and the reader is referred to his reviews (Wennberg, Bunker and Barnes 1980, Wennberg, Barnes and Zubkoff 1982, Wennberg 1984 and 1988) for complete details of his arguments and evidence. Wennberg and Gittlesohn (1982) reviewed small area variations in six New England states, and although they identified the importance of supply factors in accounting for such variations, the availability of beds and surgeons could not give a complete explanation of all the variations that existed. Rather, the judgment and preferences of doctors were a key factor. Wennberg and Gittlesohn coined the phrase 'surgical signature' to describe the phenomenon of high surgical rates for particular operations in individual areas.

The notion that physicians have their own unique surgical signature (or perhaps, more appropriately, clinical signature, since the phenomenon seems to exist for both medical and surgical causes) has much evidence to support it. Glover (1938) describes the effects on tonsillectomy rates of the appointment of Dr Garrow who, in his first year as school medical officer in Hornsey, reduced the number of operations from 186 to 12 per year. When a surgically active physician moved into an area in rural Manitoba, population utilisation rates increased by 17 per cent; when similar physicians left an area the surgical rate decreased correspondingly, indicating that the physician brought his or her unique surgical signature to the area and removed it on leaving (Roos 1983). Roos (1984a) identifies 'hysterectomy prone surgeons' in areas with high rates of hysterectomy who are more likely to 'label' conditions as gynaecological in origin and recommend hysterectomy than surgeons in low rate areas.

There is much evidence to suggest that doctors use different assessment practices. Panels of experts in the UK and US were asked to judge the appropriateness of coronary angiography and coronary artery bypass operations on possible indications. The US panel judged more indications appropriate than the UK panel, although agreement among the US panel was greater than in the UK (Brook and others 1988). However,

Chassin and others (1987a) found differences in appropriateness of use of procedures (defined as 'present to the extent that the expected health benefits of a procedure exceeded its expected negative consequences by a sufficiently wide margin that the procedure is worth doing') could not account for geographical variations in rates of coronary angiography, carotid endarterectomy and upper gastrointestinal endoscopy. Hospitals in counties with high admission rates for diabetes tend to admit proportionately more patients who were mildly ill, while hospitals in low-rate counties admitted proportionately more patients who were severely ill (Connell and others 1984). Roos, Roos and Henteleff (1977a and b) described large variations among individual physicians in standards of selection for tonsillectomy and adenoidectomy. Variations in rates for eight common elective operations in Ontario could not be explained by resource differentials between the counties, but was due to lack of agreement on indications for surgery (Vayda and others 1984). Variations in elderly surgical discharge rates between counties in New York were related not only to the supply of resources but also to surgical practice styles (Pasley and others 1987); and variations between areas in hospitalisation of children for gastroenteritis, lower and upper respiratory tract infections and ENT surgery reflect differences in propensity of physicians in Washington state to hospitalise (Connell and others 1981). The influence of physicians' practice styles on propensity to operate for glue ear is discussed by Black (1985d). Different clinical policies between teaching and community hospitals in Ontario account for wide variations in the use of caesarean section (Anderson and Lomas 1985).

Wennberg argues that 'the type of medical service provided is often found to be as strongly influenced by subjective factors related to the attitudes of individual physicians as by science', and the above studies provide evidence for the effect of subjective factors. Further support for the view comes from studies which have shown that practice patterns can be changed by either feedback of information to clinicians or introduction of peer review and second opinion programmes (see Chapter 4).

One of the key factors leading to practice variations is the uncertainty of clinicians about how to approach a particular medical problem. As stated by Eddy (1984), 'uncertainty creeps into medical practice through every pore', and the existence of considerable professional uncertainty and the lack of evaluation of common medical procedures makes variation in treatment styles an inevitable part of the clinical process (Wennberg and others 1982). The necessary scientific basis for rational decisions on clinical treatment is frequently missing (Cochrane 1973) and leads to considerable uncertainty within much of clinical medicine. For more than 80 per cent of medical conditions, and for a large number of surgical procedures, the need for hospitalisation is not clearly defined and there is no professional consensus as to appropriate management (Morgan and others 1987). Any critical appraisal of the medical literature uncovers a large number of controversies concerning the use of most common operations (Wennberg, Bunker and Barnes 1980). There is also much evidence for the unreliability of clinical decisions. Second opinion programmes in the United States are built on the assumption that clinicians examining the same person may recommend differing treatments, and opinions as to the need for surgery can vary over time (Rutkow 1982d). Moreover, when presented with the same set of facts in the form of standardised hypothetical cases, equally well-qualified surgeons commonly diverge in their opinions on the need for surgery (Rutkow 1982a).

Efforts to obtain consensus on appropriate indications for surgery or diagnostic tests among experts also show fundamental disagreements about the interpretation of the facts or the use of procedures. The Rand Corporation has developed a series of appropriateness criteria for the use of several common procedures, including cholecystectomy, carotid endartectomy and coronary artery bypass surgery, and during their

consensus conferences uncovered a substantial lack of agreement among the panelists. After reviewing an extensive summary of the literature and openly debating their initial conclusions concerning appropriateness, the nine members of the panel reached agreement less than half the time (Park and others 1986a and b).

The process of decision making by clinicians in the face of considerable uncertainty regarding appropriate treatment is reviewed by Eisenberg (1986), Rutkow (1982d) and Eddy (1986). As discussed by Eddy (1982), clinical care is influenced by the collection of clinical policies that guide physicians' actions, and although well-designed policies can be a tremendous aid to physicians in deciding on appropriate care, there is reason to believe that there are flaws in the process by which the profession generates clinical policies. There is evidence to suggest that the decision-making process differs between different professional groups. For example, Young and others (1987) studied physicians' recommendations for a coronary artiography in hypothetical patients with chest pain by analysing responses of cardiologists and family physicians. They found that cardiologists compared with family practitioners had significantly higher decision thresholds, and recommended coronary artiography in fewer patients. Wood and others (1972) described differences of opinions between paediatricians and otorhinolaryngological surgeons as to what constituted normal tonsillar appearances which therefore influenced decisions to operate for tonsillectomy.

Medical interventions and innovations have not generally been subjected to rigorous evaluations before widespread acceptance and use by the medical community. Wennberg, Bunker and Barnes (1980) list current controversies regarding the value of nine common surgical procedures: hysterectomy for sterilisation; hernia repair in the elderly; tonsillectomy; cholecystectomy; caesarean section; appendicectomy in the absence of an inflamed appendix; prostatectomy for prostatic hypertrophy; haemorrhoidectomy; and lens extraction. For most common surgical and medical procedures, there is a significant lack of randomised control trials or other evaluations to assess their effectiveness and to assess the effects of alternative forms of treatment (McPherson 1982). *Costs, Risks and Benefits of Surgery* (Bunker and others 1977) highlights controversies and uncertainties surrounding common surgical procedures.

It is clear that the degree of small area variation exhibited by a procedure is related to the degree of controversy or uncertainty concerning the indications for the procedure: procedures can be ranked according to the amount of variation leading to a 'hierarchy of implied uncertainty' (McPherson and others 1981, 1982). Morgan and others (1987) concluded:

> ... hospital admission rates bear a close relationship to the incidence of morbidity only for a fairly small number of conditions which can be diagnosed with reasonable certainty, *and* for which a consensus exists within the medical profession on the need to treat the illness on an in-patient basis.

It is important to emphasise a crucial distinction in the notion of clinical uncertainty which has implications for understanding the development of research into variations. Uncertainty has two distinct roots. The first is to do with ignorance and lack of knowledge; the second has nothing to do with these pejorative terms but is based on the incomplete development of scientific understanding. Since there is usually a confusion as to which is being referred to, the use of 'uncertainty' inevitably carries a pejorative component and therefore can ruffle professional sensitivities. The meaning of uncertainty used in the study of variations is derived entirely from its second root, and has nothing to do with an individual's lack of knowledge.

CONCLUSIONS

There is little consensus on what causes variations between geographical areas in hospital admission rates, although the research points to two factors: supply variables and the importance of practice style factors. The provision of beds, staffing, technology for management and other supply variables will invariably have an effect, and there are clear geographical variations in resource distribution. However, of greater significance is the fact that there is a large degree of uncertainty concerning appropriate management of many common medical conditions, and this uncertainty leads to great variations between individual clinicians and groups of clinicians in the way they practice medicine. In combination with the influence of supply factors, practice style factors affect geographical variations in admission rates.

3 CONSEQUENCES OF GEOGRAPHICAL VARIATIONS IN ADMISSION RATES

It is certain that there are considerable geographical variations in admission rates for many common surgical and medical procedures; it is less clear what causes variations. It is also difficult to ascertain the impact of such variations on the health care system and on consumers of health care. The influence of variations has been examined in terms of financial effects, their implications for equitable allocation of resources, and whether high or low rates of hospitalisation have any concomitant side effects or mortality: in particular much debate has centred on the issue of what is the 'correct' rate of hospitalisation.

FINANCIAL IMPLICATIONS

Variations, particularly the observation of high rates in certain areas, are of great financial concern in the US (Barnes and others 1985, Caper 1984, Wennberg, Barnes and Zubkoff 1982, Payne 1987, Shah and Carr 1974). There is considerable interest in calculating implications of different admission rates across countries. Wennberg, Bunker and Barnes (1980) estimated the costs associated with different frequencies of nine surgical procedures: hysterectomy for sterilisation; hernia repair in the elderly; tonsillectomy; cholecystectomy; caesarean section; appendicectomy in the absence of an inflamed appendix; prostatectomy for prostatic hypertrophy; haemorrhoidectomy; and lens extraction. They looked at costs in terms of dollars and per capita death rates under various rates of use in the UK, US and Canada. They concluded that if the surgical rate of the lower rate region in the UK were the norm for the US, the dollar investment in 1975 would have been $1.5 billion compared with $6.6 billion at the high rates of use in Canada and Vermont and $2.4 at the low rate in Vermont. Rates of hysterectomy, cholecystectomy and prostatectomy result in the greatest net differences in expenditure. In terms of surgery-associated deaths, the UK low rate is equivalent to a death-rate of 0.21 per cent of all deaths in the US; the high rate in Canada is equivalent to an annual death rate of 1.07 per cent of all US deaths. The estimates indicate a five-fold difference in the probability of death associated with surgery under different surgical rates, with cholecystectomy and prostatectomy as the most significant contributors to the death rate (Wennberg and others 1980, Table 2). Other studies have calculated the financial implications of different rates across countries: for example, if obstetricians in England and Wales had performed caesareans at the same rate as their American colleagues in 1981 there would have been an additional 115,000 operations in England and Wales at an additional cost of £88 million (Chalmers 1985). McPherson (1988, in Ham 1988) showed the cost implications for the NHS at 1986 prices for eight common surgical operations (hysterectomy, cholecystectomy, prostatectomy, tonsillectomy, inguinal hernia repair, lens operations, appendicectomy and haemorrhoidectomy). His findings were that whereas the total cost to the NHS at the UK rate was £176 million, if surgeons in the UK performed these operations at the same rate as Norway, Canada or the US,

the total costs would be £160 million, £455 million or £447 million respectively, the extent of the financial difference varying according to the procedure.

Precisely what the financial implications are of variations in hospital admission rates in the UK is unclear. Crombie and Fleming (1988) estimated the cost implications of large variations between general practices in referral rates to emergency and outpatient departments and inpatient referrals. Some general practitioners initiated referrals to an extent which could result in a yearly hospital-based expenditure of approximately £365,000; other GPs' referral patterns would cost only £195,000. The equivalent estimated hospital expenditures for the highest and lowest rates of referral were £408,000 and £40,000—a 12-fold difference. Other cost implications in the UK may well be an important area for further research.

IMPLICATIONS FOR EQUITABLE ALLOCATION OF RESOURCES

As discussed by Bevan and Ingram (1987), for the purposes of the Resource Allocation Working Party, increases in hospital admissions, and hence high rates, are taken to be an indication of increased output: hospitals in Inner London and the North Western Region have increased admissions at reduced cost per case and are therefore deemed more 'efficient'. But little work has been done to establish whether high admission rates are justified in terms of their outcomes and whether increases in admission rates are indeed genuine increases in efficiency. The implications of variations in admission rates for RAWP are discussed in more detail in the paper (Bevan and Ingram 1987).

HEALTH IMPLICATIONS OF VARIATIONS: WHICH RATE IS RIGHT?

The fact that much hospitalisation appears to be governed not only by rates of illness raises questions about the therapeutic value of hospitalisation, particularly ñ high rate areas. There is much evidence that high rates may carry excess morbidity and mortality (Vayda and others 1977). Roos and Danzinger (1986) assessed surgical outcome following cholecystectomy and reported a high rate of postoperative readmissions, psychological problems, abdominal symptoms and death. The authors concluded that most published data underestimate the risk associated with cholecystectomy, as with other common surgical procedures (Roos 1984c). Similar risks following prostatectomy (Wennberg and others 1987b, 1988) and appendicectomy (Lembcke 1952, Lichtner and Pflanz 1971) have been reported. Mortality costs associated with nine common surgical procedures have been described by Wennberg, Barnes and Bunker (1980, cited above). Bunker and Wennberg (1973) comment on how some operations designed to decrease mortality may, when performed in excess, increase it. Higher rates of caesarean section for dystocia appear to have little effect on perinatal mortality (Sheehan 1987) and there is much debate as to the procedure's value (Chalmers 1985). Evidence that high surgical rates raise mortality rates may be, in part, because any surgical intervention in itself carries associated risks and because areas with high surgical rates will accept for surgery more people at high risk compared with low rate areas (Roos and Roos 1981, Peterson 1981).

In the US there is much concern over the issue of unnecessary hospitalisation, particularly that many surgical operations are 'unnecessary'. The issue has been reviewed by Pauly (1979), Rutkow (1982e) and Payne (1987). Pauly (1979) argues that there is little consensus on what constitutes unnecessary surgery, and medicine as a discipline '... cannot generate either the conceptual apparatus or the complete information set needed to arrive at a general definition'. Given the large degree of uncertainty surrounding many common medical and surgical procedures, it is hardly surprising that whether hospitalisation is necessary or unnecessary is unclear.

As well as concerns over utilisation, there is also debate about whether low-use areas are not admitting sufficient patients. One implication of variability may be that in low rate areas, people who need treatment are not receiving it. Roos, Roos and Henteleff (1977a) studied all people treated for respiratory illness, including those receiving tonsillectomies and adenoidectomies in Manitoba for one year, and found that a sizeable group of people not selected for surgery perhaps should have been.

The debate over variations led Wennberg (1986) to write a short paper entitled 'Which rate is right?' in which he argues that with the current levels of uncertainty regarding the necessity of medical and surgical interventions it is hardly surprising that physicians do not know which is the correct rate for hospitalisation. For medical conditions associated with highly variable rates of admission, the differences in hospitalisation largely reflect different opinions concerning safety. When is it safe and in the patient's interest to provide treatment on an outpatient basis and when is it necessary to hospitalise? For surgical procedures the outcome question is the efficacy of one treatment versus another. Unfortunately, in many cases there is little consensus on questions of safety and efficacy.

The question of which rate is right leads to many questions regarding whether high or low rates are appropriate. Smits (1986) discusses three settings in which variations in the use of medical services would be appropriate:

> (1) When uncertainties in medicine leads to acceptable alternative practice patterns; (2) when an innovation in diagnostic or treatment modality is in a phase of active dissemination; and (3) where the variation reflects underlying differences in the population's health status.

It is also important, in the face of concern about the existence of variation, not to automatically assume that variation is bad *per se*. Patient's opinions on the rate of intervention in their community should be taken into account in assessing the consequences of variations. In some areas, people might opt for medical intervention and hospitalisation; in others, people might prefer no or low rates of intervention. In the first case a high hospitalisation rate would be acceptable and a low rate less acceptable but *vice versa* for the second case. If these are valid cases variation would be legitimate.

There is continuing debate in the literature on whether high rates signify unnecessary usage or low rates signify under-provision. In general, the literature raises more questions than answers. Chassin and others (1986a) conclude their assessment of geographical differences in the use of medical and surgical services between 13 large areas in the US by Medicare beneficiaries by saying:

> The available data do not allow us to explain the wide variations we have observed. In addition, we cannot establish the 'correct' use rates from this data. For any given procedure, geographical differences may reflect substantial inappropriate overuse in the high use areas with very little inappropriate use in the low use areas. On the other hand, variations may have occurred because physicians in the low use areas were not providing enough services to those who needed them, whereas those in the high use areas were meeting legitimate medical needs in an appropriate manner. A third possibility is that the rates of use of procedures were appropriate in both high and low use areas and that the differences in rates resulted from differences in the incidence of diseases. Finally, some combination of all three possibilities may have been responsible for our findings.

Until answers are found to the 'which rate is right' question, any of these three possibilities could reflect the implications of variations in admission rates.

CONCLUSIONS

The fact that admission rates vary markedly between areas within the UK, as well as within other countries, inevitably has financial implications, although the precise effects are unclear. No doubt if those districts with high overall admission rates altered their rates to those of the lowest-rate district, the financial effects would be considerable. However, the lowest rate of admissions cannot be held to be the most appropriate rate. Of major importance is the fact that the existence of variations highlights the considerable uncertainty as to what constitutes a 'correct' (in terms of therapeutic value) level of admission for many common medical and surgical procedures. The question remains as to whether high rate areas are admitting too many patients, or whether low rate areas are not admitting people who would benefit from hospitalisation? In the absence of data on the outcomes associated with different levels of admission, it is difficult to determine correct rates of hospitalisation.

4 INTERVENTIONS TO ALTER VARIATIONS IN ADMISSION RATES

Geographical variations in hospitalisation rates for many causes of admission are of concern not only because of their financial implications but also because they raise the question of what is the correct rate of hospitalisation for different procedures; they point to a large degree of uncertainty in the practice of medicine. For these reasons, much work is being done to alter variations, in particular to establish correct use rates for medical and surgical procedures. Such interventions can be categorised as feedback, audit and educational programmes, consensus conferences and outcome studies to establish appropriate rate of use, second opinion programmes, outpatient activity as an alternative to inpatient admissions, influences on general practitioner referral rates, increasing consumer participation in decisions over care, and other strategies.

FEEDBACK AND EDUCATIONAL PROGRAMMES

Several studies have reported changes in surgical practice following feedback on incidence rates. Lembcke reported changes in rates of pelvic surgery following initiation of a peer review process in which feedback on population incidence played a role (Lembcke 1956). Rates of hysterectomy dropped by 50 per cent in one city in Saskatchewan, and an overall reduction of 33 per cent was observed in the province following a review of criteria for 'justified' and 'unjustified' hysterectomy (Dyke and others 1977). Over a five-year period following feedback on data on geographical variations in tonsillectomy rates to the Vermont State Medical Society, rates decreased significantly (Wennberg and others 1977). In the UK, feedback of information from clinical audit appears to have resulted in changes in surgical practices (Gruer and others 1986). Other effects of feedback have been reviewed by Eisenberg (1986) and Wennberg (1984). Wennberg proposed a comprehensive plan for dealing with practice variations, including monitoring of high-rate and low-rate areas and ensuring that physicians within such areas are aware of their individual rates and are motivated to effect changes where appropriate.

Feedback to consumers has been shown to influence utilisation rates: following publicity of the high rate of hysterectomy in the Canton Ticino in Switzerland the numbers of hysterectomies dropped significantly, suggesting that demand for the operation changed once women were aware of the excessive rates (Domenighetti and others 1986). Williams and Chen (1983) suggest that caesarean section rates could be controlled in the same way.

The effect of feedback on clinical practice has been reviewed by Mugford (1987), who concluded that the cicumstances, form, quantity and quality of feedback may strongly affect the way information is accepted, interpreted and used. The review examined studies which have shown that simple feedback of information alone is insufficient to change behaviour. Mitchell and Fowkes (1985) distinguished 'passive' feedback—consisting of information without overtly evaluative material or suggestions for

improvement—and 'active' feedback—which includes some judgment of the behaviour being studied and educational factors. From reviewing studies on the effect of feedback, it appears that simply feeding back information on performance has less effect on changing clinical behaviour than feedback combined with other educational measures.

One of the most comprehensive studies to review variation rates in the utilisation of inpatient services is the ongoing Maine Medical Assessment Programme (MMAP) initiated in 1981 by the Maine Medical Association in the United States. MMAP comprises an advisory committee, which includes physicians, to review hospital discharge data and identify variations in surgical practice. In addition, specialty-specific study groups of physicians look closely at the data prepared for their own specialty and decide themselves upon a course of action in order to alter significant variations and to educate the physicians with extreme rates. The specialty groups involved are in orthopaedics, gynaecology and urology. The authors conclude that one of the most important purposes of the programme is the educational process of bringing practice variation to the attention of physicians (American Medical Association 1986).

In the UK, the need for surgeons to be actively involved in the process of altering variations, where necessary, is discussed by Jennett (1988a and b). Several audits have been performed on surgical practice, as reviewed by Jennett (1988a), who concludes:

> ... evidence about variations in surgical practice should arouse the curiosity of surgeons and stimulate them to find out more about what they are doing. Surgeons would do well to collect more data themselves rather than responding defensively to inadequate data from others. Surgeons are more likely to react constructively to data that has been produced by other surgeons and that deal with matters that both seem clinically relevant and could be altered by their own actions.

The importance of physicians continually monitoring their own performance using audit has been discussed by Shaw (1980a–e), indicating that far more can be done in monitoring performance at a local level. The effectiveness of surgical audit in changing performance has been described by Gruer and others (1986), Gillmore and others (1980) and Irving and Temple (1976). Flint (1985) discusses the need for midwives to carefully monitor practice within their wards in order to continually improve midwifery practice.

CONSENSUS CONFERENCES AND OUTCOME STUDIES

Consensus conferences

A major theme in the literature which examines interventions to alter variations is the need to fully evaluate procedures and to establish correct rates prior to dissemination of information to both providers and consumers of health care. In the US and UK 'consensus conferences' bring together groups of 'experts' to decide on what constitutes 'good practice'. The RAND corporation in the US has reviewed literature and established guidelines for good practice for coronary angiography, coronary artery by-pass surgery, colonoscopy, diagnostic gastrointestinal endoscopy, carotid endarterectomy, and cholecystectomy (Chassin and others 1986b and c, Kahn and others 1986a and b, Merrick and others 1986, Solomon and others 1986). Consensus conferences have been held in North America to develop guidelines for, among other topics, caesarean section (Gleicher 1984, National Consensus Conference 1986, US Department of Health and Human Services 1981) and coronary artery bypass surgery (National Institute of Health 1981). Consensus methods are increasingly being used to solve problems in medicine and health, their purpose being to define levels of agreement on controversial subjects. The characteristics of several major methods on consensus are reviewed by Fink and others (1984).

Although in theory the method would appear to be successful, there is evidence that such conferences do not always change clinical practice. A consensus development conference in 1980 formulated recommendations which were expected to lead to a decrease in national caesarean section rates. A review of caesarean patterns for the five years following the conference in many representative states in the US revealed, contrary to expectations, a continuing increase in caesarean section delivery rates even after the conference (Gleicher 1984). In 1986, the National Cancer Institute held a consensus conference on prostate cancer; however, the consensus panel were unable to decide on clear cut recommendations for the treatment for early prostate cancer because the necessary data simply did not exist (Kolata 1987). The panel requested that future research should address the profound lack of good available data and wanted patients to have more information on the effectiveness of different methods of treatment. Following a National Institute of Health consensus development programme on the surgical management of primary breast cancer, the use of steroid receptors in breast cancer, caesarean childbirth and coronary artery bypass surgery, a survey showed that it mostly failed to stimulate change in physician practice, despite moderate success in reaching the appropriate target audience (Kosecoff and others 1987b).

Several consensus development conferences have been held in the UK, with varying degrees of success. During an audit of caesarean section in a district in Scotland, the rate of sections began to fall and has continued to decrease in the months since (Rosenberg and others 1982). Consensus development conferences have been held to examine the treatment of primary breast cancer (Consensus Development Conference 1986) and coronary artery bypass surgery (Stocking and Jennett 1984).

One problem associated with consensus conferences is the lack of information on which participants can base their debates, given the paucity of data concerning outcomes. An attempt has been made to rectify this in the US by Wennberg and others, who have evaluated common surgical procedures in the context of the Maine Medical Assessment Programme. Several studies have looked at prostatectomy. The work commenced with detailed reviews of the surgical literature. It involved consultations with urologists practising in high and low rate areas to achieve a detailed understanding of the theoretical reasons for using prostatectomy and to obtain the best available estimates for the probabilities of the various outcomes associated with either watchful waiting or surgical strategies for treating benign prostatic hypertrophy. Using Medicare claims data, post-operative death rates and the incidence of complications following the operation were assessed. The results indicated that life expectancy was actually a little longer for those who did not undergo early operation, indicating that the choice between surgery and watchful waiting should rely far more on patients' preferences rather than on routine surgical preferences. The study also looked at symptoms, functional status and quality of life following prostatectomy by in-depth interviews with patients (Wennberg and others 1987b, Fowler and others 1988, Wennberg and others 1988, Barry and others 1988). Roos and Ramsey (1987) have also assessed outcomes associated with different surgical approaches for prostatectomy.

Outcome studies and 'good practice'

In view of the large amount of uncertainty regarding much clinical practice, there is a clear need for studies of the outcome of common surgical and medical procedures. Several studies have been included in the bibliography and are briefly described here. Some common elective procedures have undergone scrutiny as to the appropriateness of the procedure. Bouchier (1983) reviewed evidence on indications for cholecystectomy and concluded that cholecystectomy may not be necessary for 'silent' gallstones. Gracie

and Ransohoff (1982) also concluded that routine prophylactic operations for silent gallstones are neither necessary or advisable; the risks associated with the operation are generally underestimated (Roos and Danzinger 1986). Tonsillectomy is a highly variable and commonly used procedure; however, outcome studies indicate that it might be inappropriately used. Roos (1979) has explored the value of tonsillectomy using large databases, comparing the outcome of the operation in patients under the care of physicians with 'a high propensity to operate' with those people going to low operators. In a randomised controlled trial of adenoidectomy for glue ear (Black and others 1986) the result showed that, six months after the operation, improvement in hearing was of only small clinical significance; despite this a high proportion of patients were satisfied with the operation, indicating that the outcome must take into account patients' preferences as well as clinical criteria. In another randomised controlled trial of tonsillectomy and adenoidectomy, the authors concluded that non-surgical management may be more appropriate for indiviual children (Paradise and others 1984). Findings of the major evaluative studies into adeno-tonsillectomy are reviewed by Venters and Bloor (1974); McKee (1963) details appropriate indications for the procedure.

Although haemorrhoidectomy is routinely used, it has been suggested that it should be reserved for people with severe third degree piles or for those in whom other methods have failed (*The Lancet* 1975). Sandberg and others (1985) evaluated the effects of hysterectomy in comparison with alternative medical management upon life expectancy, quality of life and direct medical cost. They concluded that although the operation may be effective in preventing reproductive tract cancers in women aged 30–60 with a low operative risk, the operation may result in losses of life expectancy in women with higher operative risk or low expected cancer risk. Roos (1984b) followed up women two years before and two years after hysterectomy and, despite a low mortality rate, indicated that there is a significant risk of complications requiring hospital readmission during the two years after hysterectomy and associated repair procedures. Other outcome studies include the Manitoba study of common surgical procedures (Roos and Roos 1983) and those detailed by Bunker and others (1977).

Several new operative procedures have been evaluated to some degree to establish outcomes. Allen and Preziosi (1981) described the pre-operative evaluation for carotid endarterectomy, with careful initial selection of patients to ensure that their symptoms were caused by atherosclerosis at the carotid bifurcation, and postoperative evaluation to assess the incidence of stroke following the operation. Winslow and others (1988b) followed up patients after carotid endarterectomy and found that 9.8 per cent had a major complication within 30 days of surgery, concluding that the procedure was substantially overused; the author made recommendations for the appropriate uses of CA. In a follow-up study of people in the Medicare end stage renal disease programme in the US, Eggers (1988) concluded that renal transplantation offers the best clinical and economic outcomes for people with end stage renal disease. Thus, transplantation may be a viable alternative to dialysis. In comparison, Earlam (1984) followed up people treated for oesophageal cancer, and found that many people with terminal illness were being treated unnecessarily in hospital where hospice or community care would be more appropriate. Indication for coronary artery bypass surgery are reviewed in an editorial in *The Lancet* (1980). Although the procedure has been evaluated, there is evidence of inappropriate use and limitations of the procedure may not always be fully acknowledged.

Clearly much outcome work is being done, although there seems to be little overall coordination of the considerable research effort. Brook and others (1977) described a methodology for evaluating the outcome of medical care, detailing the approach taken to select outcome criteria and develop short-term, disease specific outcome standards against which medical care delivered to patients can be evaluated; they gave as examples

methods of assessing appropriate procedures for asthma, treatment of breast mass and breast cancer, cholecystectomy, diarrhoea and dehydration in children, ischaemic heart disease, osteoarthrosis, otitis media in children and tonsillectomy and adenoidectomy.

Randomised controlled clinical trials continue to be the most scientifically valid method of evaluating the risks and benefits of medical innovations. In 1987, a consensus conference on clinical trials was held in Lugano, Switzerland which concluded that RCTs are still misunderstood and underused and are certainly not accepted as an integral part of professional practice (Bracken 1987). Although some randomised trials immediately affect medical practice, many of them have little immediate impact, partly because of the equivocal results of many small trials. Bunker and others (1978) called for the centralisation of studies to evaluate new surgical procedures, describing an Institute of Health Care assessment with implementation and regulation of evaluation conducted at local and regional level using existing research agencies. Bracken (1987) discussed the importance of centres conducting trials using multi-centre protocols.

Although there have been many other outcome studies to assess the effectiveness of different procedures (for example Bunker and others 1977), there still remains a great deal of work to be done on establishing outcomes of common procedures and in disseminating information so that clinical practice is affected, specifically in the UK.

A further aspect of studying outcome of procedures is to look at alternative treatments, in particular the examination of alternatives to surgery. As cited above, non-surgical treatment for benign prostatic hyperplasia may be just as effective as surgery and in some cases may be a safer alternative; other examples include the use of shock wave lithotripsy for gallstones as an alternative to cholecystectomy (Sackmann and others 1988) and truss versus hernia repair operations in the elderly (Neuhauser 1977).

SECOND OPINION PROGRAMMES

In North America, particularly as a response to concern over rising costs of medical care, second opinion programmes have been introduced to attempt to reduce the quantity of 'unnecessary' hospitalisation and to ensure that all medical treatment is appropriate. Several studies have shown that, on second opinion, many people previously referred for surgical intervention were not operated on and this appeared to have no adverse effects on outcome (Gertman and others 1980, Graboys and others 1987, McCarthy and Finkel 1980b and 1981, McCarthy and others 1981 and 1982, McCarthy and Widmer 1974). However, Brook and Lohr (1982) offer words of caution on the use of second opinion programmes—that one cannot yet describe the consequences of these programmes for the health status of the population to which they are applied. The so called 'sentinel' effect of these programmes undoubtedly results in the deterrence of both necessary and unnecessary procedures, especially true for persons covered by public programmes such as Medicaid.

Second opinions automatically occur in the UK: general practitioners screen people prior to referral to a consultant and possible hospital admission. It is unusual to find a third opinion instituted in the NHS. A consultant's recommendation for hospitalisation for surgery is most often accepted by a consumer and acted on; it is rare for a consumer to seek a further opinion on the need for the intervention.

OUTPATIENT CARE AS AN ALTERNATIVE TO HOSPITAL ADMISSION

A further intervention to alter variations may be to increase the provision of day care, particularly surgery done on an outpatient basis. No major differences in functional outcome could be observed between patients undergoing hernia or varicose vein

operations in either day care or inpatient units. Day care, in fact, was found to be a safe and widely acceptable alternative to inpatient care and resulted in more rapid improvements in health and return to work (Prescott and others 1979). In the US, dilatation and curettage may be just as safe done on an outpatient as an inpatient basis (Goldrath and Sherman 1985). Roos (1988) discussed the potential for outpatient surgery in Canada, although cautions that there is little outcome data to assess its effectiveness and safety relative to inpatient care.

STRATEGIES TO INFLUENCE GP REFERRAL RATES

The considerable variation in rates of referral to hospital in general practice have led to the formulation of strategies to aim to alter such variations. In a recent paper in the *British Medical Journal*, Marinker and others (1988) proposed four broad strategies which could be envisaged to influence referral rates: adopting norms, rationing, management incentives and performance review. Although in theory the idea is to present GPs with a norm for referral and ask them to conform to such a norm, in practice it is unclear whether the present average represents a professional consensus about what is desirable or whether average rates should be higher or lower. In order to assess what is the desirable rate, it is necessary to look at the appropriateness of referrals in terms of their actual or expected outcomes. The second strategy, that of rationing referral rates, also appears to be unrealistic. Although no firm proposals have been put forward, some health authorities have examined the possibility of imposing referral quotas on general practitioners. But how such quotas could be arrived at was not made clear. In particular, the impositions of quotas leave unanswered the question of how doctors should respond to clinical need when their quotas have been filled. The last two proposed strategies, management incentives and performance review, meet more favourable discussion in the paper. It might be possible to change the referral behaviour of GPs by restructuring their contract so as to provide the appropriate incentives—the practice would be penalised financially by high rates of referral, expensive referrals, and loss of unsatisfied patients. Although there are several difficulties in such a model proposed, in general it might be an appropriate means of influencing GP referral rates. Performance review is also crucial within general practice and the authors put forward several proposals to influence GP referral rates through regular peer review.

INCREASING CONSUMERS' PARTICIPATION

Another intervention which influences variations can be seen in terms of increasing consumers' participation in the decision to hospitalise. The work described above by Barry and others (1988) on prostatectomy has highlighted the need for consumers' views in deciding on the appropriateness or otherwise of prostatectomy; the need for greater consumer participation in hysterectomy is discussed by the *British Medical Journal* (1977) and by Coulter, McPherson and Vessey (1988).

However, increasing consumers' participation raises an important question as to whether the existing evidence regarding the efficacy, safety or value of a particular medical intervention is sufficient for patients to make informed decisions regarding their care. Given the amount of uncertainty surrounding much of medical practice, the available evidence may not be sufficient for patients to decide on the appropriateness of procedures offered; however, consumers should be aware of the uncertainty surrounding the various options available and take this into account in their decisions regarding treatment.

OTHER STRATEGIES

Wickings and others (1983) reviewed one method of altering clinical practice—namely, clinical budgeting and costing experiments. The authors concluded that an improved capacity to review the relative priority of various different spending options would be beneficial, particularly in influencing those regions and districts which are high spending and have very high utilisation rates.

Interventions to alter physician practices have been reviewed by Eisenberg (1986). He describes, in his last chapter, several other approaches to altering physician practice styles, including participation in efforts to alter practice, administrative rules, financial incentives and penalties.

SUMMARY

Many studies have demonstrated that hospitalisation rates alter once clinicians are aware of practice variations (Wennberg 1984, Eisenberg 1986); the active involvement of clinicians in data collection and evaluation has a greater, and more sustained, effect than simple feedback of information alone. Similarly, once consumers are aware of variations they may play some role in altering admission rates, particularly in high-rate areas. However, any strategy that seeks to alter variations in admission rates must take into account the fact that for many common medical and surgical procedures what constitutes a correct rate, and hence what is the norm to aim for in altering admission rates, is unknown. Although work is being done to establish correct utilisation rates, by means of consensus conferences and outcome studies, it is clear from the literature that most of the relevant work is from North America: few studies in the UK have directly addressed the question of altering variations in admission rates.

5 RECOMMENDATIONS FOR FURTHER WORK ON GEOGRAPHICAL VARIATIONS

In the literature many researchers have recommended further work that needs to be done in order to establish the evidence for geographical variations, the causes of such variations and what needs to be done. Several reviews have made comprehensive recommendations, including Paul-Shaheen and others (1987), Ham (1988), Wennberg (1988) and Coulter (1986), and the following conclusions draw substantially upon these reports. We also add our own views.

It is clear that considerably less is known about variations in the UK in comparison with North America and other countries. The US is far ahead of Britain in the quality and quantity of health services research, particularly in the area of geographical variations. Although data are readily available from Hospital Activity Analysis and other routinely collected statistics, much of the variation remains unknown and more research needs to be done to document the extent of geographical variations in the UK. Available information varies considerably between procedures: while a small number of surgical procedures have been looked at in some detail, a large number of common causes of admission, in particular admissions for medical procedures, have been relatively neglected. This is particularly true for areas such as psychiatry and geriatrics where few, if any, studies have been done. It is proposed that the appropriate research is conducted to fully document the extent of variations in all hospital admissions in the UK.

More attention should be given to the units of population aggregation used. Study of population-based admission rates at different levels of aggregation will enable far more to be said than at present about the causes of variation. Although regional health authorities have been mainly studied, evidence suggests that even larger variations are seen at smaller levels of aggregation, including districts, general practices or individual doctors. Ham (1988) suggested that collecting evidence about variations between and within districts should be a task for managers and clinicians making use of performance indicators.

More information needs to be collected on the relative contribution of the private sector to variations in admissions. Private hospitals should be required to provide routine data on their activity so that more accurate utilisation rates can be calculated.

More research needs to be done on how variations in general practitioners' referral rates influence variations in admission rates. Although it is well known that GP referral rates vary considerably, why this should happen and how this influences variations in admission rates is less clear.

Paul-Shaheen and others (1987) made several useful recommendations about the methodology to use to examine the extent and causes of variations between small areas. One particularly relevant point is that admission rates should always be standardised for age and sex, and publications should clearly state whether rates are standardised: in many of the studies reviewed in the UK it was unclear whether data was standardised or not. In addition, the extent of inaccuracy in the data should be established. Limitations

to routine health statistics are discussed in Appendix A (section 4) and the contribution of measurement error must be established in order to make meaningful comparisons between studies.

Although it is often assumed that consumers play little part in determining utilisation rates, there is evidence to suggest that demand factors do play a role (Coulter 1986). Far more research is needed on people's attitudes to hospitalisation and on doctors' attitudes to the incorporation of patients' views in the decision-making process.

In the US there is considerable concern about the financial implications of variations and whether a significant proportion of hospitalisation is unnecessary. In the UK, more research is needed on the impact of variations to establish the implications of high or low rates.

A priority for future research is to establish correct rates of use of those procedures which vary and fully evaluate outcomes. A dominant theme in the literature is that much variation arises because of uncertainty as to correct procedures and is influenced by clinicians' practice styles. It is often assumed that areas with low rates are optimal and that, therefore, high rate areas are over-utilising resources, but this may be completely incorrect. Given that it is very unclear as to what is the correct rate of use, there is a need to find out whether unmet need or over-utilisation exist.

The only way to do this is to establish what the outcomes of different procedures are—in terms of the morbidity, mortality and the quality of life of consumers. The need for outcome studies to establish the correct rates of use has been mentioned in many papers reviewed. Wennberg (1988) stated that some 25 high variations surgical procedures and 40 medical conditions can be identified as priorities for outcome assessment. 'Systematic studies to evaluate outcomes, similar in purpose to those we now routinely apply to the evaluation of new drugs, are needed to test the various reasons for doing surgery, for performing diagnostic tests and for using expensive modalities of care such as hospitals and intensive care units.' (page 32). It is a priority to establish the safety and efficacy of procedures, and to establish whether residents of high-rate areas are healthier or more at risk than those in low-rate areas.

Evaluation should operate on several levels: it should examine the clinical outcomes of procedures; it should assess the effect of the procedures on consumers' quality of life; it should assess the value of alternative procedures; and it should assess the value of the procedure in relation to other priorities for health care spending.

In the US, the government is considering an assessment programme run by research and clinical scientists with long-term responsibility for evaluating appropriate practice in priority areas. The programme will assess alternative treatments for specific conditions, assess current practice patterns, evaluate new developments and design clinical trials. The Maine Medical Asessment Programme (American Medical Association 1986) is one such model; the assessment of prostatectomy described by Wennberg and others (1988), Fowler and others (1988) and Barry and others (1988) also provides a model. The work of RAND is also relevant in this context.

In the UK, there is a clear need to draw together information on outcomes of selected procedures and conduct considerably more research and clinical trials to establish efficacy and outcomes. As suggested by Ham (1988), laboratories should be established in selected health districts to tackle problems in utilisation and undertake research into outcomes. Wennberg (1988) adds to this the need to perform such research in an international context, given that work from other countries is of relevance. The Copenhagen Collaborating Centre has established an international network among clinicians and research scientists to study clinical uncertainties and to undertake outcome studies. Researchers and clinicians in the UK should be involved in such work.

Information on outcome studies needs to be pooled in a more rational and

comprehensive manner. Several centres provide models for such data collection: the National Perinatal Epidemiology Unit in Oxford has compiled a database on clinical trials in perinatal medicine; and the Oxford Record Linkage Study could be used to its full potential to provide the necessary evaluative data to establish correct rates of use of many common medical and sugical procedures. In addition, given that a substantial proportion of discretionary surgical procedures are performed in private hospitals, it would be of value for the private sector to play a more active role in evaluation.

Patients' subjective responses to therapy should be an important part of the assessment of outcomes, and there is a need to include standardised quality of life measures in outcome studies. Patient satisfaction is, or should be, an important aspect of any evaluation, especially for the many common elective operations which are carried out to improve quality of life rather than as life-saving procedures. The tools for measuring quality of life outcomes of medical and surgical procedures are in the process of development (Katz 1987), and such measures should be integral to any assessments of therapeutic outcomes.

In addition, patients' expectations of treatment and whether they are met should be examined. While clinicians may hold one set of views as to what are the important outcomes of treatment, what the consumers want may be very different, as demonstrated by the trials on prostatectomy (Wennberg and others 1988).

Further research needs to be conducted on alternatives to hospitalisation—for example, the evaluation of safe and non-intrusive alternatives to surgical intervention, and the evaluation of day care surgery versus admissions.

Clinicians should play a more active role in reviewing their practice and acting on the results, as discussed by Wennberg (1984) and Jennett (1988a and b). Guidelines on appropriate clinical practice should be established, to encourage explicit discussion and declaration of treatment goals and the methods best suited to achieving these. Guidelines may well be best thought of as ranges within which a norm for practice can be established rather than an absolute rate (as discussed by Paul-Shaheen and others 1987).

Consensus conferences, properly constituted, on areas where uncertainty exists in medical practice have a great deal to offer. Several consensus conferences have been described above. Such conferences have two important roles: to influence professional opinion and to inform the public on the debate regarding their health care. In the UK, conferences have been held on the treatment of primary breast cancer, coronary artery bypass grafting, the role of asylums in the treatment of mentally ill people and genetic screening; no doubt there is a need for more consensus on high variation procedures.

It is proposed that consumers need to become much more active participants in the decision-making process, given the uncertainties that surround much of clinical medicine. There are many suggestions that patients' preferences should be taken into account far more than at present for procedures such as prostatectomy and hysterectomy. There is some evidence that once consumers know of variations in clinical practice their demands will alter. As with other areas of health education, consumers' active participation in decisions about their health produces far more significant behavioural changes than information alone. Studies of clinical practice have underlined the pressure on doctors to act decisively and suppress any doubts or uncertainties they may feel, and this uncertainty is frequently concealed from patients. Traditionally, medical training tends to emphasise certainty and decisiveness and the scientific rigor of medicine, rather than ambiguity and doubt. It is therefore not surprising that clinicians present their patients with decisions on optimal health care as though there is little debate or uncertainty regarding the procedures, rather than giving patients a range of alternatives from which to choose.

Involvement of consumers in decision-making requires changes by both the medical

profession and consumers. More honesty from clinicians is required about the uncertainty that exists between and within members of the medical profession; in addition, consumers need to be more aware of the existence of uncertainty and more willing to accept it. The work by Wennberg and his colleagues on prostatectomy has clearly called for involvement of patient preferences in decision making. Although consumers' knowledge about variations in admission rates has not been evaluated, it is probable that few members of the general public are aware of the substantial variations in practice or of the implications. We would propose that information on variations should be more actively disseminated to consumers of health care.

Asking consumers to accept the existence of uncertainty in medicine means that they need to alter their view that 'medicine knows'. Consumers usually cannot distinguish between the two possible roots of uncertainty discussed earlier (pages 30–33)—that is, uncertainty because of ignorance and uncertainty because of the incomplete development of scientific knowledge. If uncertainty is a reflection of ignorance, it would be extremely worrying and disconcerting to patients; if it is a reflection of undeveloped scientific knowledge, then it may be disconcerting but the rational response would be very different. The knowledge that the doctor does not have all the answers has two implications: firstly, the chances of recovery may diminish and, secondly, the thought that someone else does have the answers is suggested. Patients are therefore unwilling to accept uncertainty because they are brought up to believe that medicine has the answers to their health problems and they therefore want to believe that their doctor knows everything. Thus, patients cannot be expected to easily accept uncertainty unless they jettison, to some degree, the placebo effect arising from trusting their doctors and unless the perceived role of medicine is changed.

Involvement of consumers in their health care also means that information on which to base their decisions must be available. This, again, leads to the need for outcome research and proper evaluative studies. People faced with the prospect of having an operation or other medical intervention need more information about the likely consequences of choosing not to have the operation or procedure, the natural history of the condition and the likely effects of alternative procedures on quality of life. For many procedures, such information is not available.

In conclusion, the existence of significant geographical variations in hospital admission rates in the UK (and in other countries), the fact that they point clearly to considerable uncertainty in the practice of medicine, and their implications for a rational and equitable health service in this country, calls for action on the part of the Department of Health. We propose that a unit is set up to monitor and study variations and to instigate and coordinate the necessary outcome studies. Such a unit could cost approximately 0.001 per cent of the total expenditure of the Department of Health, a spending well justified in this area so crucial to health care delivery.

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APPENDIX A
METHODOLOGICAL ISSUES

The methodology used in the study of geographical variations in health care utilisation is reviewed by Paul-Shaheen and others (1987), Barnes (1982), Breckenridge and others (1988) and Diehr (1984); other papers in the references also discuss issues of methodology. Several points will be discussed here: first, the use of standardised, population-based admission rates in order to measure the extent of variation; second, the definition of small area analysis and population aggregations; third, the use of different levels of aggregation in order to determine different causes of variations; fourth, the source of data for analysing geographic variations and limitations of such data; and, fifth, the need to include the contribution of the private sector in analysis of geographical variations in the UK.

1 STANDARDISED, POPULATION-BASED ADMISSION RATES AS A METRIC TO ASSESS VARIATION

The basic technique for studying geographical variations is to examine rates of admission in defined areas and to either document such variation or to relate variations to other defined factors in order to arrive at some understanding of the causes.

The first requirement is to be able to measure the phenomenon. A metric is required, therefore, which has known characteristics and uses. In order to develop a metric for measurement the first and most simple step is to use population-based rates for particular medical or surgical procedures. Such a measure has advantages as well as disadvantages. The advantages are that the population for which such rates might apply is known, in an epidemiological sense: the age, sex and prevailing illness patterns will be understood to some degree. Also the availability of health services for such populations will be known. Thus in any year the rate of cholecystectomy among a population may be 250 per 100,000. Such a metric may be the outcome of many thousands of decisions taken on many thousands of patients over the course of that year and, therefore, it clearly measures something to do with medical decisions. On the other hand, it does not necessarily provide insight into any individual clinical decisions. But the problem with observing individual decisions is that it is never clear that they are entirely comparable—with respect to the nature or severity of the illness or the preferences of the patient, for example. Thus population-based rates have characteristics similar to those of any average measure.

Obviously several factors can affect the rates of admission, the most obvious being the age and sex structure of the population. Although some early studies did not make any attempt to standardise, it is now routine practice for studies in this area to standardise the data for age and sex in order to reduce this factor of variation. In addition, some researchers have standardised for migration and race; a select few use other variables such as socioeconomic status and wages.

2 THE DEFINITION OF POPULATION AGGREGATIONS

Many studies have looked at variations between countries and between large areas within countries—states, provinces, or counties, for example. However, many concerns have been raised regarding the true causes of variation based upon studies employing very large areas as the unit of analysis. For this reason, much recent attention has been given to defining what are known as small areas for analysis, and comparing admission rates between such defined small areas. Paul-Shaheen and others (1988) stated:

> Small area analysis is a method used to describe the way individuals in a community utilise the community's health care resources. The approach is analogous to that used in epidemiology, where the number of disease occurrences during a defined time period in a specific area is divided by the population at risk for contracting the disease in that area to create an incidence rate for the disease. In small area analysis, the number of occurrences of a health care event in an area and within a defined time frame is divided by that area's population at risk. The result is a use rate standardised to a given population or sub population at risk.

The specific value of small area analysis is that it permits the examination of data for populations which tend to be more homogeneous in character and in their environmental circumstances than the larger or more widely spread populations which are diluted by the diversity which occurs at this level. For this reason, as described by

Table 4 Population aggregations used to study geographical variations

COUNTRIES, REGIONS AND SMALL AREAS WITHIN COUNTRIES

Canada and United States of America

Provinces
Regions within provinces
States
Large geographical areas in US
US census regions

Small areas:
Hospital market areas
Counties
Cities
Professional standards review organisation areas
Health planning regions
Primary sampling units (from Health Interview Survey, National Centre for Health Statistics)
Small geographical regions
Metropolitan areas
Sub areas used for MAP analysis

Type of hospital (teaching/non-teaching; pre-paid/fee-for-service)
Physicians

Australia

States
Local authority areas
Statistical divisions

Other countries

States
Counties
Cities/towns
Regions
Districts
Health boards
Hospital market areas

UK

Regional health authorities
District health authorities
Health boards
General practices
Counties
Cities/towns
Local education authorities

OTHER AGGREGATIONS

Consultants
General practitioners
Social class
Occupational group
Marital status
Method of payment

Carstairs (1981), small area analysis has developed as a research tool in the UK over the last two decades.

Although in theory small area analysis offers a tool to compare studies across different areas, in practice the service areas used have been defined at many and varying geographical levels. One often used in studies in the US and Canada is the 'hospital service area'. Two definitions of hospital service areas appear in literature. Wennberg and Gittelsohn (1973) define it by assigning population and patients in a given postcode to the hospital service area where the greatest number of patients from that postcode have historically received care. A more complex method, the relevance index, described by Paul-Shaheen and others (1987), has been used less because of the serious technical problems experienced in calculating such an index. In the US, apart from hospital market areas, other small areas used for analysis have been defined as cities, health planning regions, metropolitan areas and other defined small geographic regions (see Table 4). For this reason it may be hard to make any comparisons between studies in the United States, given the wide diversity of population aggregations used.

Population aggregations used in studies in the UK are comparatively simpler, given the existence of the NHS and the fact that people can be allocated into different regions and districts. Therefore, the small area categories used include regional health authorities, health boards, district health authorities and general practices. As well as these categories, variations have been examined between towns and counties, or between consultants; early papers by Glover examine variations between local education authorities. Carstairs (1981) and Carstairs and Lowe (1986) discuss small area analysis in the context of health service research.

3 DIFFERENT LEVELS OF AGGREGATION DETERMINE DIFFERENT CAUSES OF VARIATION

The level of aggregation is important to the interpretation of the observed variation in rates and is an essential part of the process of understanding causes. It is important to assume that catchment populations are well-defined so that denominators of people at risk of hospitalisation are known and relatively unambiguous.

As discussed in Chapter 2, there are five main plausible causes of variation between defined areas for standardised admission rates: morbidity, random, supply, clinical opinion or demand, but such causes may well overlap. Most of them are not directly measurable or are extremely difficult to measure, and it is not generally possible to investigate correlations between rates of hospitalisation and, for example, morbidity, clinical opinion or demand. Therefore the usual epidemiological scheme for inferring causation from carefully measured associations is not readily accomplished in this area.

An important methodological point is that plausible causes of variation in rates change according to the level of aggregation used, and so different levels of aggregation give indirect insights into their causes. Possible levels of aggregation in the UK are: between GPs within districts; between districts within regions; between regions within countries; between countries. When examining variation between regional health authorities it is clear that supply, demand and morbidity are in principle plausible causes of this variation. This is because the population of regions could exhibit specific regional characteristics and they could suffer different levels of morbidity because of characteristic lifestyles or exposure to risk factors. Also, the supply of medical services is largely historically determined, and supply is known to vary between regions. Since regional health authorities involve large populations and rates will be based on large numbers, random variation will be negligible except for very rare procedures. Also, because the admission rates will be the consequence of averaging many clinical

Figure Plausible sources of variation in standardised rates at different levels of aggregation

VARIATION BETWEEN	MORBIDITY	CLINICAL	AVAILABILITY	PATIENT DEMAND	ERRORS IN DATA SOURCES	RANDOM
GPs in one district	S	L	O	S	M	L
Districts in one region	S	L	M	S	S	M
Regions in one country	M	S	L	M	S	S
Countries	L	L	L	L	S	O

L = Large effect
M = Medium effect
S = Small effect
O = No effect

} Relative to others in same row

Source: McPherson K. Variations in hospitalisation rates: why and how to study them. In: Ham (1988), page 19.

opinions, such a source of variation is an implausible dominant cause of variation between regions.

The examination of variation becomes more straightforward if the population aggregational level is changed. If variation between districts in a single region or between GPs in a single district is examined, then the plausible causes of variation are more restricted. Large differences in morbidity rates are less likely between these populations. On the other hand since these communities are each served by relatively few specialists, clinical opinion could have a more significant impact on the rates of hospitalisation. However, since the level of aggregation is lower, the number of events are fewer and the random component in the variation of rates is larger. Also, at this level of aggregation the supply component is standardised since all GPs are referring patients to the same consultant within the same hospital. Figure 1 summarises the important sources of variation at different levels of aggregation, indicating that there are no simple explanations for variations between regions or between countries since there are too many possible but unmeasurable causes.

A method is proposed to measure and compare the systematic variation in standardised rates of events between defined populations adopting a simple development of proportional hazard or multiplicative relationships which enables comparisons that take account of the effect of different population denominators and numerators on the estimate of variance. The method, which gives a measure of systematic variation, is described in McPherson and others (1982). Hence, the amount of variation can be compared between samples in a way which is not biased by sample size. Variation in high rate regions will exhibit less random variation than in low rate regions because of the consequent statistical stability associated with larger numbers. The comparison of

the amount of variation is a statistically complex matter simply because random variation is a function of the number of admissions recorded and the size of the population being studied. The exact nature of this function is not easily known.

4 SOURCES OF DATA FOR ANALYSING GEOGRAPHICAL VARIATIONS

There are two broad categories of data used to analyse geographical variations, in particular to analyse the causes of such variations: published statistics (generally government information) and specially commissioned surveys. Most of the research has relied on the former, the latter being extremely expensive and difficult to obtain. In the US, information from insurance companies is a valuable source, particularly claims forms. In the UK, possible sources of data are reviewed by Ashley (1972), Charlton and others (1984) and Lewis (1979). Most studies in the UK have used data derived from the Hospital Activity Analysis (HAA), such as Hospital In-Patient Enquiry (HIPE) (or, more recently, from the district and regional information systems), and athough they provide useful sources for research, such information must be interpreted with caution (as discussed by Goldacre, 1981). When investigators are able to collect information for themselves the definitions and coding used are specific to that study, and any unusual or unexpected findings can be seen and dealt with as they arise during the course of the study. At the time of analysis or interpretation the investigator is usually alert to any problematic aspects of the data. In comparison, large and remotely organised information systems, such as HAA, present many problems of design and interpretation and the investigator must use caution. For example, the specialty given in HAA is usually the main contractual specialty of the consultant responsible for a patient. But the designation of a specialty can vary from place to place (for example, the extent to which geriatrics and general medicine are separated). Some consultants have more than one contractual specialty (such as general medicine and cardiology) and some specialist departments may take a share of the general medical or surgical workload. Diagnostic information is coded in HAA using the International Classification of Diseases, and each ICD term can cover a range of conditions. It is therefore important to be alert to synonymous or closely similar terms used to describe a diagnosis or operation (for example, hysterectomy can be coded in different ways depending on the exact operation performed). Incompleteness and errors in the data set must be known: systematic errors in any information system are always likely to give misleading results, and although there should be built-in edit checks to identify probable errors, in practice the complexity of medicine is such that there is a limit to which uncommon events can be queried, or queries can be followed up. Thus, interpretation of discharge rates between health districts using routinely collected data must take into account possible errors in the numerator, the denominator, demographic factors, determinations of whether the statistics refer to episodes or to people, how consistent the findings are and variations in clinical practice. Such cautions in the use of published data have not always been fully discussed in the studies published in the field of geographical variations.

5 THE CONTRIBUTION OF THE PRIVATE SECTOR

Finally, studies of geographical variations in Britain need to take into account private sector admissions, which are not included in routinely collected statistics. The contribution of the private sector has been comparatively under-researched, despite the fact that private medical care represents a significant proportion of overall admissions. There has been a general increase in the number of operations performed privately—from 3.8 per cent in 1950–1954 to 18.7 per cent in 1980–1983 (McPherson, Coulter and

Stratton 1985). The present contribution is about 23 per cent. As discussed in Chapter 1 (pages 14–24), there are significant variations between regions in the extent of use of private practice. For example, in 1981, 21 per cent of hysterectomies took place in the private sector, with a range of 10–34 per cent in the 15 health regions of England and Wales; this makes the total number of hysterectomies greater than the HIPE estimate by between 1.11 and 1.52 regionally (Williams and others, 1988). Therefore, when assessing the evidence for variations and causes of such variations in the UK, private sector activity must be taken into account.

APPENDIX B
DESCRIPTION OF THE DATABASE ON GEOGRAPHICAL VARIATIONS

In order to manage the large amount of literature on geographical variations, we created a database using Cardbox-Plus (version 3.5, Business Simulations Ltd), compatible with IBM microcomputers. References were entered on electronic 'cards', containing the author, title and reference of the paper, its abstract or an extract written by us or taken from the CCC bibliographies (Copenhagen Collaborating Centre 1985 and 1987), and categories for sorting and selecting references. The full list of the categories is given below. In brief, the categories selected were as follows:

> The country covered by the paper, or international if several countries are studied; the main topic and other topics included in the paper; medical and surgical causes of admission; source of data; causes of variations, categorised in terms of supply factors, clinical judgment factors and demand factors; implications of variations; interventions suggested to alter variations; and notes of recommendations for further investigations or research.

The database can be used to select references on any of the categories defined: for example, all papers describing variations in Norway (concerned with tonsillectomy, adenoidectomy and hysterectomy) which give information on the effects of bed supply on rates and which suggest interventions to alter variations can be selected. The database also includes studies which have evaluated outcomes of procedures and those which are concerned with 'good practice'—that is, papers suggesting what the appropriate level of a procedure should be.

The database is similar to that produced by the Copenhagen Collaborating Centre, but includes more studies from the UK; it includes outcome studies, which the CCC is planning to incorporate in future reviews. It is hoped that the database will be of value to researchers examining geographical variations in admission rates and that it can be regularly updated.

CLASSIFICATION SYSTEM USED IN THE DATABASE

CO/Country

International
England and Wales
Scotland
UK
England
Wales
Q = category for UK (all countries)
US
Canada

Sweden
Denmark
Norway
Australia
New Zealand
Netherlands
Germany

TO/Topic (describes main category of paper) and OT/Other (describes other categories)

A Documenting, describing variations
B Explaining variations
C Interventions to reduce variations
E Consequences or policy implications of variations
F GP referral patterns
G Reviews of literature
H Commentary, letters, editorials
I Methodology papers
J Morbidity variations
K Decision making
D 'Good practice': recommended treatment for specified cause of admission
L Outcome or follow-up studies
M Unnecessary surgery or hospitalisation
(N Private practice)

AD/Admissions

A Describes one cause of admission only (single topic)
B Describes two to ten causes (most common admissions)
C Describes more than ten causes: many admissions and general papers
D Outpatient activity

PA/Population aggregations

Canada and United States of America:

P Provinces
Z Regions within provinces
S States
GA Large geographical areas in US

Small areas:

SA1 Hospital market areas
SA2 Counties
SA3 Cities
SA4 US census regions (north, east, north central, south and west)
SA5 Professional standards review organisation areas
SA6 Health planning regions
SA7 Primary sampling units (from Health Interview Survey, National Centre for Health Statistics)
SA8 Small geographical regions

SA9 Metropolitan areas
SA10 Sub areas used for MAP analysis

H Type of hospital (teaching versus non-teaching; pre-paid or fee for service)
PH Physicians

Australia:

S States
LAA Local authority areas
SD Statistical divisions

Other Countries:

OS States
OD Counties
OT Cities/towns
OR Regions
OD Districts
OB Health boards
OH Hospital market areas

UK:

R Regional health authorities
D District health authorities
B Health boards
CON Consultants
G General practitioners
C Counties
TW Cities/towns
LEA Local education authorities

Other aggregations:

SC Social class
OCP Occupational group
MS Marital status

DS/Data source

A Routine health statistics
B Ad hoc surveys
C Claims data: insurance companies

CA/Causes

A Supply-general supply factors
AA Staffing or 'manpower' levels
AB Hospital bed provision
AC Funding of medical services (GNP spent on health care)
AD Method of payment (salaried versus fee-for-service)
AE System (differences between countries)
AF Outpatient (use of ambulatory/outpatient/GP services rather than hospital admissions)

AG Use of private practice
AH Waiting lists
AI Different technology for management
AJ Teaching versus non-teaching centre
AK Availability of nursing home/convalescent care
AL Extent of health insurance coverage (US)
AM Access to health care services

B General clinical judgment factors
BA Practice style
BB Uncertainty regarding appropriate treatment
BC Characteristics of physicians/surgeons
BD Characteristics of GPs
BE Referral patterns of GPs
BF Varying indications for procedure
BG Unnecessary surgery
BH Litigation fears
BI Different assessment practices used by specialists
BJ Ritualistic/placebo aspects of surgery

C General demand factors
CA Age/sex of population (when not controlled for)
CB Race/ethnicity
CC Income
CD SEG/Social class
CE Occupation
CF Urban versus rural
CH Morbidity/health status
CI Life satisfaction scores
CJ Education
CK Expectation of treatment
CL Population size
CM Religion
CN Use of treatment for sterilisation/attitudes to sterility
CO Marital status
CP Housing

Other causes:
R Random variation
O Rate of organ removal in previous years
Q Associated operations (for example, previous caesarean)

IM/Implications

A Financial
B Outcome 1: is treatment effective?
C Outcome 2: side-effects or mortality
D Inequality of access to care
E Efficiency

IN/Interventions

A Feedback to physicians
B Feedback to consumers
C Consensus conferences, committees
D Outcome studies
E Utilisation review
F Increase day care surgery
G Review of budgeting
H Second opinion programmes
I Audit
J Educational programmes (active form of feedback)
K Include consumers' participation in decision to operate
L Other (reviewed by Eisenberg)

RE/Recommendations

Notes of any suggested recommendations for further investigations or research

**/* Extra text field: abstract (either journal abstract or summary of paper indicated at end—see CCC Bibliography)

Principal causes of admission: surgical

1 = Most common
2 = Oncology
3 = Cardiovascular/circulatory
4 = Respiratory
5 = Alimentary tract and pancreas
6 = Liver and biliary tract
7 = Kidney/genito-urinary
8 = Reproductive
9 = Endocrine and metabolic
10 = Blood
11 = CT, joints and bones
12 = Nervous system
13 = Eye
14 = Ear
15 = Skin
16 = Infection
17 = Injuries
18 = Psychiatry

1.0 All surgical admissions (unspecified or numerous categories)
1.1 Elective surgery (unspecified or numerous categories)
1.2 Non-elective procedures
1.3 Tonsillectomy
1.4 Adenoidectomy
1.5 Tonsillectomy and adenoidectomy (T & A)
1.6 Appendicectomy
1.7 Hysterectomy
1.8 Cholecystectomy

1.9 Prostatectomy
1.10 Hernia repair
1.11 Haemorrhoidectomy
1.12 Varicose veins
1.13 Cataract
1.14 Lens extraction/operations
1.15 Myringotomy
1.16 Breast operations
1.17 Dilatation and curretage (D & C)
1.18 Caesarean section
1.19 Thyroidectomy
1.20 Circumcision
1.21 Surgery of soft tissue mass

2.0 Oncology: general or unspecified
2.1 Breast ca
2.2 Oesophageal ca
2.3 Prostate ca
2.4 Cytoscopy
2.5 Lung ca

3.0 Cardiovascular/circulatory: general/unspecified
3.1 Heart valve
3.2 Cardiac catheterisation/coronary arteriography
3.3 Coronary bypass
3.4 Carotid endarterectomy
3.5 Pacemaker implantation
3.6 Shunt for portal hypertension

4.0 Respiratory: general/unspecified
4.1 Lobectomy/pneumectomy

5.0 Alimentary tract/pancreas/digestive: general/unspecified
5.1 Gastric resection
5.2 Splenectomy
5.3 Ulcer operations
5.4 Colectomy
5.5 Upper gastrointestinal endoscopy
5.6 Colonoscopy
5.7 Partial gastrectomy
5.8 Small intestinal bypass
5.9 Partial excision of large intestine

6.0 Liver and biliary tract: general/unspecified
6.1 Bile duct exploration

7.0 Kidney/genito-urinary: general/unspecified
7.1 Nephrectomy
7.2 Kidney transplantation
7.3 Cystocele and rectocele
7.4 Kidney stone removal

8.0 Reproductive: general/unspecified
8.1 Sterilisation (M & F)

8.2 Oophorectomy
8.3 Termination of pregnancy
8.4 Orchidopexy

9.0 Endocrine and metabolic: general/unspecified

10.0 Blood: general/unspecified

11.0 Skeletal, CT, joints: general/unspecified
11.1 Hip operations
11.2 Fracture reduction
11.3 Disc/spinal fusion
11.4 Excision of semilunar cartilage
11.5 Joint arthrodosis
11.6 Limb amputation
11.7 Excision/destruction of intervertebral cartilage
11.8 Meniscectomy
11.9 Laminescopy

12.0 Nervous system: general/unspecified
12.1 Craniotomy

13.0 Eye: general/unspecified
13.1 Operations on eyelid

14.0 ENT: general/unspecified
14.1 Rhinoplasty
14.2 Submucous resection
14.3 Incision of eardrum

15.0 Skin: general/unspecified

16.0 Infections: general/unspecified

17.0 Injuries: general/unspecified

18.0 Psychiatry: general/unspecified

Principal causes of admission: medical

1 = Most common
2 = Oncology
3 = Cardiovascular/circulatory
4 = Respiratory
5 = Alimentary tract and pancreas
6 = Liver and biliary tract
7 = Kidney/genito-urinary
8 = Reproductive
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13 = Eye
14 = Ear
15 = Skin
16 = Infection

17 = Injuries
18 = Psychiatry
19 = Intensive care
20 = Geriatrics

1.0 All medical admissions (unspecified or numerous categories)
1.1 Ill-defined
1.12 Varicose veins
1.6 Appendicitis
1.8 Cholelithiasis and cholecystitis
1.10 Hernia

2.0 Oncology: general or unspecified
2.1 Breast ca
2.2 Oesophageal ca
2.3 Prostate ca
2.4 Lung ca

3.0 Cardiovascular/circulatory: general/unspecified
3.1 MI
3.2 CVA
3.3 Hypertension
3.4 Angina
3.5 Atherosclerosis
3.6 Ischaemic heart disease

4.0 Respiratory: general/unspecified
4.1 Upper and lower RTIs
4.2 Pneumonia
4.3 Chronic diseases (bronchitis, emphysema)
4.4 Chronic lung disorders
4.5 Asthma

5.0 Alimentary tract/pancreas/digestive: general/unspecified
5.1 Gastroenteritis
5.2 Diarrhoea and dehydration (children)
5.3 Peptic ulcer
5.4 Total parenteral nutrition

6.0 Liver and biliary tract: general/unspecified

7.0 Kidney/genito-urinary: general/unspecified
7.1 Dialysis
7.2 Urinary tract infection
7.3 Upper UT stones/renal and ureteric colic

8.0 Reproductive: general/unspecified
8.1 Congenital/perinatal
8.2 Pregnancy and childbirth

9.0 Endocrine and metabolic: general/unspecified
9.1 Diabetes

10.0 Blood: general/unspecified
10.1 Bone marrow transplantation

11.0 Skeletal, CT, joints: general/unspecified
11.1 Fracture of neck of femur
11.2 Osteoarthrosis

12.0 Nervous system: general/unspecified

13.0 Eye: general/unspecified

14.0 ENT: general/unspecified
14.1 Otitis media

15.0 Skin: general/unspecified

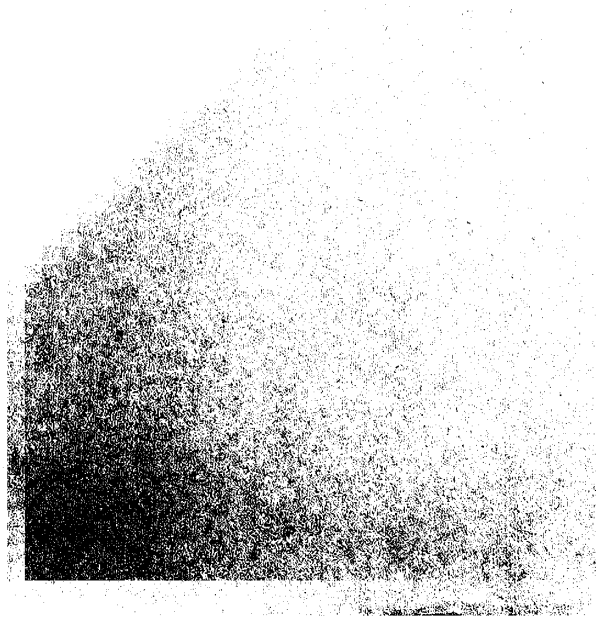
16.0 Infections: general/unspecified

17.0 Injuries: general/unspecified

18.0 Psychiatry: general/unspecified

19.0 Intensive care

20.0 Geriatrics



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