

**AUSTRALIAN INSTITUTE OF HEALTH
HEALTH SERVICES SERIES, NO. 2**

Variations in surgery rates

**Manoa Renwick
Krystian Sadkowsky**



Australian Institute of Health

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Contents

List of tables	iv
List of figures	v
Acknowledgements	vi
1. Introduction	1
Health status	1
Access and equity	2
Quality of care	2
Small area analysis	3
Australian studies of variation	4
Purposes of this study	6
2. Method	7
Development of the mappings	7
Data collection	8
Public patients	8
Private patients	8
Merging public and private data	9
Data analysis	9
Insurance status	10
Statistical tests	10
Cesarean section	11
Limitations of the data	11
3. Results	12
Rates for mainland Australia	12
Cesarean section	27
4. Discussion	34
National rates	34
Variability at State/Territory level	35
Variability within States at statistical division (SD) level	37
Variability within SDs at statistical subdivision (SSD) level	38
Variability across capital cities	39
Variability between metropolitan/non-metropolitan areas	40
Cesarean section	41
Variability at SD level	42
Variability at SSD level	43
Variability between metropolitan/non-metropolitan areas	43
Summary	43
Possible causal factors	44
5. References	47
Appendixes	
A. Mappings for selected surgical procedures	51
B. Area of usual residence conversions	52
C. Notes on statistical procedures and tests for analysing surgery rates ..	53
D. Other limitations of the data	55

List of tables

Table 1:	Rates per 1000 population for selected surgical procedures, reported in various studies	5
Table 2:	Cesarean section rates per 100 live births, reported in various studies	6
Table 3:	Summary of small geographic areas for States and Territories	9
Table 4:	Age groups selected for discretionary standardised ratios	10
Table 5:	Crude rates of selected surgical procedures per 1000 population by sex, mainland Australia, 1986	12
Table 6:	Percentage of private patients for surgical procedures, States and Territories and mainland Australia, 1986	14
Table 7:	Age and sex standardised ratios for surgical procedures, States and Territories, 1986	14
Table 8:	Age and sex standardised ratios for surgical procedures, NSW statistical divisions, 1986	15
Table 9:	Age and sex standardised ratios for surgical procedures, Victorian statistical divisions, 1986	17
Table 10:	Age and sex standardised ratios for surgical procedures, Queensland statistical divisions, 1986	18
Table 11:	Age and sex standardised ratios for surgical procedures, South Australian statistical divisions, 1986	18
Table 12:	Age and sex standardised ratios for surgical procedures, Sydney metropolitan area, 1986	20
Table 13:	Age and sex standardised ratios for surgical procedures, Melbourne metropolitan area, 1986	21
Table 14:	Age and sex standardised ratios for surgical procedures, State capital cities, 1986	23
Table 15:	Age and sex standardised ratios for surgical procedures, State metropolitan and non-metropolitan regions, 1986	26
Table 16:	Cesarean section rates per 100 live births, mainland Australia, States and Territories, 1986	28
Table 17:	Cesarean section rates per 100 live births, New South Wales statistical divisions, 1986	28
Table 18:	Cesarean section rates per 100 live births, Victorian statistical divisions, 1986	29
Table 19:	Cesarean section rates per 100 live births, Queensland statistical divisions, 1986	29
Table 20:	Cesarean section rates per 100 live births, South Australian statistical divisions, 1986	30

Table 21: Cesarean section rates per 100 live births, Sydney metropolitan area, 1986	30
Table 22: Cesarean section rates per 100 live births, Melbourne metropolitan area, 1986	30
Table 23: Cesarean section rates per 100 live births, Brisbane metropolitan area, 1986	31
Table 24: Cesarean section rates per 100 live births, Adelaide metropolitan area, 1986	31
Table 25: Cesarean section rates per 100 live births, State/Territory capital cities, 1986	31
Table 26: Cesarean section rates per 100 live births, State metropolitan/non-metropolitan areas, 1986	33
Table 27: Cesarean section rates per 100 births for insured and uninsured women, mainland Australia, States and Territories 1986	33
Table 28: Percentage of private patients among cesarean sections and all births for States and Territories and mainland Australia, 1986	33
Table 29: Prevalence of surgical procedures in OECD countries (rate per 1,000 population)	35
Table 30: Extent of variation in State/Territory standardised ratios for nine surgical procedures	36
Table 31: Cesarean sections (per cent of all deliveries in clinics or maternity wards) in OECD countries, around 1986*	41

List of figures

Figure 1: Range of standardised ratios of surgical procedures across States/Territories (excluding Tasmania), 1986	16
Figure 2: Range of standardised ratios of surgical procedures across State statistical divisions (SDs), 1986	19
Figure 3: Range of standardised ratios of surgical procedures across Sydney and Melbourne metropolitan areas, 1986	22
Figure 4: Range of standardised ratios of surgical procedures across five mainland State capital cities, 1986	24
Figure 5: Range of standardised ratios across statistical subdivisions (SSDs) of Sydney, Melbourne and Adelaide, 1986	25
Figure 6: Cesarean section rate (% livebirths)—range across State statistical divisions (SDs), metropolitan areas, States/Territories and capital cities, 1986	32

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1 Introduction

International variations in the rate of use of hospital facilities have been noted for many years, but cultural factors and differences in definitions and health care systems make it very difficult to interpret these comparisons. Far more useful, although not necessarily easy, is comparison between like populations with the same health system and similar definitions. Such comparisons during the last 20 years, using small area studies, have consistently revealed variations in the USA, Canada and a number of European countries. These variations have been in the order of three- or four-fold (Wennberg & Gittelsohn 1982; Roos & Roos 1983; Muller 1986; Chassin et al. 1987; Shepard & Cooper 1987).

Variation may be the result of differences in health status and in access to, and availability of, health services—all matters of concern to governments that aim to redress inequities in the health system. Other factors less subject to government control play an important part—personal health habits, and the values and attitudes of both the users and providers of health care.

Extensive research abroad has also found that a significant component of the variation stems from differences in doctors' practice styles resulting in disparities in the way they use hospitals and other health services for the care of their patients (Eisenberg 1986; Wennberg 1988; Brook 1989).

Small area studies make it possible to compare the experience of residents of a specific geographic area with residents of another geographic area, regardless of where the health services are provided. Statistical techniques are employed to measure variation after adjusting for age and sex, and other techniques can be used to distinguish between the systematic and random components of variation (see, for example, McPherson et al. 1982).

The patterns of variation revealed by this type of analysis raise questions about:

- the health status of defined populations
- their access to health services
- the equity of the health system
- the quality of services.

These questions can then be investigated by other means.

Health status

The simplest explanation for variations in the rates of use of health services is to ascribe them to variations in health status—sicker people need, and therefore use, more services, whereas people in good health do not need services to the same extent and therefore do not use them. This model assumes that there are no barriers to gaining access to the health care system.

If this direct relation between health status and the use of health services operates, then it could be expected that small area analysis would reveal that areas with high consumption are those with a low health status—areas where, for example, there is a high mortality rate, high prevalence of risk factors, and a high proportion of socioeconomically disadvantaged people.

This type of analysis could also be expected to identify areas where the reverse applies: where comparatively healthy and affluent populations have low use rates. This could be a matter of concern if the medical practitioners in those areas have few other opportunities to retain their clinical skills—in relatively remote areas for example.

Access and equity

The health status model is too simple for the complex interactions that occur in health care. Roemer (1961) suggested another model: that, under conditions of widespread economic support for hospitalisation (such as insurance), bed supply is the greatest and most consistent determinant of hospital utilisation rates through its influence on the practice of doctors, i.e. consumption of services follows supply of resources.

Under this model (also regarded as simplistic by some), geographic areas with an abundance of health resources—general and specialist medical practitioners, well-staffed and equipped hospitals—will have very high use rates, while under-resourced areas will have low rates. With that scenario, remote rural areas would yield much lower use rates than metropolitan areas, and blue collar outer suburbs would have lower use rates than white collar well-to-do suburbs.

Access and equity are not the only issues raised here. Because resources are limited, opportunity costs are also involved (i.e. the concept of what could have been done for others with the same resources). Once we begin to talk about affluent groups of people consuming more of a limited resource than the less affluent, we cannot avoid discussing 'need' and the controversial subject of the provision and use of unnecessary services.

Quality of care

Leape (1989) has defined an unnecessary service as one that is useless or ineffective, with 'useless' meaning that 'the patient is no better off'. If service use is not directly related to need, then it follows that services are provided inappropriately—that there is a degree of under- or over-servicing. As Donabedian (1980, p. 7) has pointed out,

'whenever a judgment is made about the necessity or suitability of the quantity of care a judgment of quality is implied'.

Some of the factors that contribute to the provision of inappropriate services are the supply and distribution of doctors and the fee-for-service incentive, but whatever the reason, the quality of care is in jeopardy.

There now seems to be general agreement in North America and Europe that doctors' practice patterns are the principal underlying cause of variations in medical and surgical admissions to hospital, and recent North American research has focused on finding 'which rate is right' (Wennberg 1988). This search is apparently motivated by a concern for the quality of medical care and a wish to curb expenditure, two closely related issues. Clinicians would like to know which rate is 'right' so they can possibly improve the quality of their care, and third party payers would like to know the 'right' rate so they can constrain costs by controlling the variation (Berwick 1989).

The debate hinges on clinical decision-making. While there is consensus about the effectiveness of treatment options in some clinical areas, such as heart attacks and gastrointestinal hemorrhages, many other clinical decisions have to be made where there is little agreement between equally competent doctors. These decisions, and the ser-

vices that flow from them, are called 'discretionary'. The quest for the 'right' rate in the USA has begun with a concerted attack on defining standards of practice, and clinical guidelines to achieve them (Lehmann 1987). Similar programs, motivated by concern for quality of care, have begun in Australia with the Care Evaluation Program of the Australian Council on Healthcare Standards (Collopy 1989) and the Quality Assurance Program of the Royal Australian College of General Practitioners (Steven 1990).

Small area analysis

If there is to be an understanding of the relations between quantity and quality (and, inevitably, cost, but this study has not addressed that issue), it is essential to have information about the patterns of service use. This information should be clinically relevant and specific to the geographic areas where doctors practise and their patients reside. If it is appropriate to modify the differences in medical practice between areas, the practitioners concerned must be able to see where the differences exist and how their actions contribute to the observed patterns. Similarly, where access to health care is the issue, knowledge of local circumstances gives policy makers the information they need to allocate resources more appropriately.

The delineation of small rather than large geographic units has distinct advantages for the measurement and comparison of health services, although it is the *population* of the area that is important rather than its size. In more populous countries it has been observed that small areas are more homogeneous than large areas and the range of variations between them greater than that between large areas (Carstairs 1981). The per capita use rate for a given procedure in a large State, for example, represents a weighted average of the decisions of many doctors practising in many different parts of that State. This weighted average may obscure significant differences among small areas where relatively few doctors determine utilisation. Thus the use of large geographic areas 'averages out' the variations in local use rates.

The use of small area analysis has been found especially valuable in regional rates where the insurance status of the patient and the referral patterns of doctors may interact with bed supply to determine rates of hospital use (Spitzer & Caper 1989).

Another advantage of small area analysis is that it allows localised pockets of under-use to be identified on a service-specific basis. For example, extremely low rates for a specialty or a low variation procedure (i.e. one about which there is general accord among doctors regarding the best course of action), may reveal difficulties of access to hospitals or bottlenecks in referral patterns.

The extent of variation is an important factor to be considered in small area analysis and, to interpret the findings, an understanding of the sources of variability is needed.

It is in this context that comparisons have been drawn with quality control techniques used in manufacturing industry. Deming (1986) pioneered statistical methods to improve industrial quality control in production processes by determining the sources of variability. To improve quality, appropriate outcome measures have to be established and used to determine whether variation has arisen from 'common' (statistical) causes—when a system is said to be 'in control'. If not, then 'special' causes can be identified and, where possible, eliminated. When the system is in control, the common causes are investigated in order to reduce the variation systematically, using controlled trials and experiments. The two sources of variability have to be carefully distin-

guished because, as Deming has shown, over-correction in a system that is in control will actually increase the variation, not reduce it.

Deming's techniques have been applied to the quality of hospital care as well as to industrial production. In the context of hospital utilisation, Gibberd (1990) has suggested that systems with more than two-fold variation may be 'out of control'. Hence, it is important to identify variations of this magnitude and to seek out their special causes.

It is worth noting that there is not necessarily an implication of high quality care because a procedure has low variability. It means only that there is a consensus among doctors in the population about surgical intervention. In other populations, doctors may reach an entirely different consensus, or fail to reach one at all.

Australian studies of variation

The Hospital Utilisation and Costs Study (HUCS) 1985-86 (Harvey & Mathers 1989) found that acute hospital admission rates varied across the States and Territories of Australia, with Victoria having the lowest rate and South Australia the highest. (HUCS 1987-88 indicates that, although the rank order remained the same, the disparity between the extremes was reduced.)

Rates also varied between metropolitan and non-metropolitan regions. Analysis of the HUCS 1985-86 data showed that much of the variation in overall admission rates arose from medical rather than surgical cases, and that metropolitan admission rates were higher than non-metropolitan rates for surgical admissions, but lower for medical admissions.

In their analysis of New South Wales admissions, Gibberd and his colleagues have also found greater variability in medical than in surgical admissions, but they found both were higher in non-metropolitan than metropolitan areas. They attributed this difference to lack of alternative health facilities in rural areas (Gibberd 1990).

In the absence of national inpatient statistics for both public and private hospitals, there have been no studies using population-based methods to investigate national variations. There have, however, been several population-based studies examining variations in rates of surgery at regional and State level (McEwin 1978; Opit & Hobbs 1979; Schacht 1979; Taylor 1979; Learoyd & Taylor 1983; Eckstein 1984; Gibberd 1990). Of these, only that by Gibberd included non-surgical admissions.

Table 1 summarises some of the surgical rates reported in these studies.

Taylor (1979) reported a greater than three-fold variation across New South Wales for 1973-74 for appendectomy and cholecystectomy, and five-fold variations for hysterectomy and tonsillectomy (these were age-standardised only).

Schacht (1979) ranked procedures in Queensland during the early 1970s according to the extent of variation in the following descending order: tonsillectomy, appendectomy, cesarean section, hysterectomy, lens insertion and hip replacement. He also found that high rates were generally found in coastal areas and the south-east of the State.

Table 1: Rates per 1000 population for selected surgical procedures, reported in various studies

Procedure	¹ WA		² Qld	³ WA	⁴ NSW	⁵ NSW	⁶ SA	⁷ NSW
	1971		1973	1977	1978	1979	1982	1983
	M	F						
Appendectomy	3.6	4.7	2.83	—	5.2	3.58	2.69	2.64
Cholecystectomy	0.6	2.2	—	1.77	1.4	1.54	1.71	1.60
Tonsillectomy*	—	—	4.88	—	5.7	3.65	2.53	4.28
Hysterectomy	—	3.5	4.41	4.69	4.4	2.27	2.00	3.78
Cesarean section	—	—	1.93	—	—	1.83	2.51	3.38
Hip replacement	—	—	0.31	—	—	—	—	0.59
Lens insertion	—	—	—	1.03	—	—	—	1.48
Thyroidectomy	—	—	—	—	—	—	0.00	—

* with/without adenoidectomy

¹ Lugg 1975

² Schacht 1979

³ Opit & Hobbs 1979

⁴ McEwin 1978

⁵ Learoyd 1985a

⁶ O'Connor 1983

⁷ Eckstein 1984

In South Australia, O'Connor (1983) found State-wide rates fairly stable over four years with the exception of tonsillectomy, which peaked in 1980 at 4 per 1000 population and then declined to 2.5 per 1000 in 1982.

Eckstein (1984) reported variations in age and sex standardised ratios of from one-and-a-half- to two-and-a-half-fold across New South Wales Health Regions.

In the early 1980s, allegations of unnecessary surgery by the Doctors' Reform Society (Learoyd & Taylor 1983) reflected widespread concern about the practice of surgery by general practitioners. Pressure applied by the Royal Australasian College of Surgeons, the Australian Medical Association and the Doctors' Reform Society to reduce rates of elective surgery was such that, by 1985, significant declines in rates of tonsillectomy, appendectomy and hysterectomy were apparent (Learoyd 1985b).

More recent studies comparing differences in hospital admission rates have used diagnosis-related groups (DRGs) to control for casemix. Gibberd (1990) was able to list surgical procedures in rank order to show their variability across New South Wales. The procedures of interest here were ranked in the following descending order: hysterectomy, cholecystectomy, lens insertion, appendectomy, tonsillectomy and cesarean section.

Because rates for cesarean section, expressed as a proportion of the population, do not take account of fertility patterns, they are better expressed per 100 live births. There has been a progressive rise in cesarean births in many Western countries, including Australia, over the last 20 years, with considerable controversy over the reasons for the variations that exist, as well as controversy over the indications for cesarean section. Investigative reports on the subject by the National Health and Medical Research Council (1984) and several State health authorities (see, for example, New South Wales Department of Health 1988; Health Department Victoria 1989; South Australian Health

Commission 1990) have reflected the concern felt by some leading obstetricians and administrators, but 'holding back the tide of cesareans' has proven to be no easy task (Lomas 1988). Many recent Australian studies reporting State rates have used a hospital-based rather than a population-based analysis. Table 2 lists some of the rates found and indicates the general upward trend.

Table 2: *Cesarean section rates per 100 live births, reported in various studies*

State	Year	Rate
¹ NSW	1979-83	12.3
² WA	1984-86	14.9
³ NSW	1986	15.3
⁴ SA	1986	19.0
⁵ Vic	1987	16.4
⁶ WA	1987	16.9
⁷ SA	1988	20.6

¹ Gibberd et al. 1990

² Read et al. 1990

³ NSW Department of Health 1988

⁴ Jonas et al. 1989

⁵ Health Department of Victoria 1989

⁶ Read et al. 1990

⁷ South Australian Health Commission 1990

Purposes of this study

This study had its origin in the unnecessary surgery debate which occurred in the early 1980s. With the recent growth in interest in the quality of health services and current concerns for access and equity of health care, the opportunity was taken to pick up earlier work in the area. The time also seemed propitious to take advantage of interest shown by the Royal Australasian College of Surgeons in surgery statistics.

The intention of this investigation of surgical rates was to determine the patterns of variations at as many levels of disaggregation as possible, consistent with requirements for confidentiality and statistical reliability. Since this had not been done before on a national scale, the study offered an opportunity to explore the value of small area analysis in this country, with its unique combination of population distribution and health care system.

It was expected that the information provided by such a study would be useful to policy makers, planners, providers of health services and others interested in an equitable health system.

The extent and patterns of variations have been analysed to reveal issues of access, equity and quality, but no attempt has been made to seek causal explanations. The limited scope of the data collected dictated that this would be an exploratory study leading, perhaps, to further investigations by other interested parties.

2 Method

Because this investigation evolved from an earlier one, the method is more clearly described by explaining the circumstances that led up to the first study.

Development of the mappings

In 1985 there was considerable public discussion about the rates of surgery in Australia, following evidence presented to the Enquiry into Fraud and Overservicing by the Joint Parliamentary Committee of Public Accounts (see, for example, Learoyd 1985a; Thompson 1985a). The possibility that unnecessary surgery was being performed was a matter of concern to the Australian Health Services Council (predecessor of the Australian Health Ministers' Advisory Council) which asked the Australian Institute of Health to investigate. At that time, the sources of data were seriously fragmented and incomplete. There was only partial coverage of both public and private hospital inpatient morbidity, and little uniformity across States and Territories.

However, almost total cover of inpatient morbidity could be obtained if those State/Territory collections that did not include private hospitals could be supplemented by Medicare data. Hence the Institute undertook to establish a set of mappings to find equivalence between the International Classification of Procedures in Medicine (ICPM) and the Commonwealth Medical Benefits Schedule (CMBS).¹

The Victorian Health Department's District Health Councils Program had already produced a 'book mapping' of the two coding systems and a start was made by validating this list empirically. It contained 48 procedures that together comprised a substantial proportion (in the order of 80 per cent) of hospital admissions.

A sample of hospital inpatient data for private patients in public hospitals was requested from the Health Department of Victoria and CMBS item numbers were appended to each record by the Health Insurance Commission. It took some time for the data to be made available to the AIH and some useful progress was made before the project had to be set aside owing to lack of resources.

In 1988 the Institute was approached by the Royal Australasian College of Surgeons for advice on the collection of statistics on surgery and it was agreed that members of the College would assist the Institute with the project by clinically validating the preliminary mappings.

Because of developments in hospital statistics—progress with casemix measures and the National Minimum Data Set for institutional health care—the utility of the mappings was expected to be somewhat short-lived. It was decided, therefore, with the cooperation of the College, to use them on a small number of surgical procedures to investigate variations in the rates of performance.

The following procedures were chosen: appendectomy, cholecystectomy, tonsillectomy (with or without adenoidectomy), hysterectomy, cesarean section, hip replacement, lens insertion, thyroidectomy, and bowel resection.

1. At the time, the Clinical Modification of the 9th revision of ICD (ICD-9-CM) was being introduced so it was decided that the ICPM should be the classification system used.

The reasons for this selection were:

- the mappings were relatively uncomplicated
- the extent of variation between them was expected to vary because consensus on the clinical indications for surgery was varied too
- most surgical specialties were included
- they were few in number and the available resources were limited.

Data collection

Data were collected for the 1986 calendar year because:

- most hospital collections had used the ICPM for the coding of 1986 morbidity
- the Australian Bureau of Statistics (ABS) Census of Population and Housing data could be used for the reference populations
- the mappings had been derived from statistics for the last quarter of 1985
- the CMBS item numbers used for the mappings, which came into operation in November 1984, were unchanged.

Appendix A lists the mappings for the selected procedures.

Public patients

The State and Territory Health Authorities provided the number of separations, for all public patients in recognised hospitals, for each of the nine procedures (principal and other). The separations were broken down by sex, four age groups (0–14, 15–44, 45–64, 65 plus) and geographic area of usual residence of the patient, with the following exceptions:

- Tasmania, for which no hospital inpatient statistics were available
- Western Australia, for which statistics were coded to either metropolitan or non-metropolitan
- Northern Territory, for which statistics could not be disaggregated geographically.

The area of usual residence of the patient was coded to statistical local area (SLA) for Victoria and South Australia, and to local government area (LGA) for New South Wales and the Australian Capital Territory. In order to include secondary and tertiary procedures as well as the principal procedure, the Queensland data had to be obtained from two sources, each with a different coding system for area of usual residence—metropolitan separations were coded to postcode and non-metropolitan to statistical area code (SAC).

All morbidity collections included repatriation hospitals, with the exception of South Australia. The Department of Veterans' Affairs supplied data directly for entitled persons in that State.

The data from Victoria, which had been coded to ICD–9–CM, were recoded to ICPM to conform with the other collections.

Private patients

Although by 1989 coverage of private hospitals by State/Territory inpatient morbidity collections had improved, it was still incomplete. It was decided therefore to collect all the data relating to private patients (from both public and private hospitals) from the Medicare database.

The Commonwealth Department of Community Services and Health (CDCSH) made available the number of services for the CMBS item numbers for which benefits

had been paid for all private patients. These Medicare data came from the date of service files and related to the 1986 calendar year. They were broken down by sex and the same age groups, but by postcode of usual residence rather than SLA/LGA.

Because the CMBS items corresponding to hip replacement were not specific to hip joints, it was necessary to adjust the Medicare data. New South Wales and Victoria public hospital morbidity statistics (held by the AIH) were analysed to find the proportion of joint replacements of the lower extremity that related to the hip joint for the target age groups (45–64 years: 60.4%; 65+ years: 73.5%). The Medicare data were reduced proportionally.

The ABS provided a revised postcode to SLA conversion that mapped postcodes to corresponding SLAs on a proportional basis. This conversion file also matched other ABS geographic areas and aggregated them to statistical subdivisions (SSDs) and statistical divisions (SDs). This ABS file was used to map postcodes to SLAs. Appendix B explains the small area coding systems that had to be matched.

Merging public and private data

Once the Medicare data were recoded to SLA, they were merged with the hospital morbidity data for each procedure and the combined data were, in turn, merged with the respective populations from the 1986 Census file to produce rates per 1000 population for each of the eight age/sex groups. The lowest levels of disaggregation for each of the States and Territories are shown in Table 3. Although ACT data could have been analysed at SLA level, the populations would have been very small and so they were aggregated to Territory level.

Table 3: *Summary of small geographic areas for States and Territories*

State	Level of disaggregation
NSW, Vic, Qld, SA	SLA (or equivalent)
WA	Metropolitan/other
ACT, NT	Territory

Data analysis

Crude rates for SSDs, SDs, States and Territories, and for mainland Australia, were produced. These rates were then standardised, using the indirect method, against the mainland Australian population (see Section 3).

The procedures chosen for investigation in this study are likely to be less 'discretionary' when performed on certain age groups. For example, for persons aged over 64 years, when serious complications are common, the chances of appendectomy being 'discretionary' are much lower than at lower ages. Following advice from the College, a second set of standardised ratios was produced for age groups selected to reflect this discretionary component. The age groups selected are shown in Table 4.

Table 4: *Age groups selected for discretionary standardised ratios*

Procedure	Ages included	Ages excluded
Appendectomy	0-64	65+
Cholecystectomy	15+	0-14
Tonsillectomy	0-14	15+
Hysterectomy	15+	0-14
Cesarean section	15-44	0-14, 45+
Hip replacement	45+	0-44
Thyroidectomy	15+	0-14
Bowel resection	15+	0-14
Lens insertion	45+	0-44

Insurance status

Insurance status has been significantly correlated with variations in surgical rates (Opit & Selwood 1979; Learoyd & Taylor 1983) but it was not possible to examine the association directly for all the procedures in this study. Although the insurance status of the patient undergoing surgery was known, the reference populations could not be quantified.

It was possible, however, to obtain Australian and State/Territory totals of all deliveries billed to Medicare so that cesarean section rates as a percentage of births could be calculated for insured and uninsured women.

For the other procedures, the proportion of patients for whom Medicare claims were made has been used to explore the relationship with insurance status.

Statistical tests

Because the incidence of surgery varies according to age and sex, State/Territory and other regional rates were standardised for age and sex, i.e. to take account of different age and sex population structures so that comparisons could be made. The total Australian population was taken as the standard and used to calculate the expected number of events for each procedure.

The POISSON function in the SAS software package was used to test whether the difference between the observed number of events and the expected number for each of the procedures was likely to be due to chance (i.e. whether the standardised ratios were significantly different from 100). The 0.05 level of significance and a two-tailed test were used.

Non-significant results that had less than an 80 per cent chance of detecting a difference of 15 per cent or more between the observed and expected numbers were regarded as inconclusive. Differences of less than 15 per cent were considered to have no practical significance. For small populations or for relatively rare procedures, tests often had a low power and hence a low probability of detecting underlying differences.

Appendix C contains a full account of the statistical procedures and the tests performed on the data.

Cesarean section

These standardised ratios were adjusted only for age and sex and are therefore not satisfactory for the derivation of cesarean section rates, which may be significantly affected by fertility. Hence, cesarean section rates per 100 live births were also calculated by using registered births per SLA for 1986, obtained from ABS. Upper and lower confidence intervals were calculated (see Appendix C).

Limitations of the data

The results that follow are affected by some difficulties inherent in the sources of the data and the methods used to analyse them. The limitations caused by most of these weaknesses are not likely to affect the results in any significant way. The limitations imposed by a once-only study and small populations are more important, however, and should be borne in mind when interpreting the findings. Many of the population units are relatively small, even at SD level, as are the observed numbers of procedures. In these circumstances, the observed ratios may show large annual fluctuations and, as a result, a once-only study may yield misleading results. Only longitudinal studies could ascertain whether or not this had occurred.

The other special causes of unreliability in this study are listed in Appendix D.

3 Results

Rates for mainland Australia

The crude rates for the selected procedures for mainland Australia are presented in Table 5.

Table 5: *Crude rates of selected surgical procedures per 1000 population by sex, mainland Australia, 1986*

Procedure	Males	Females	Persons
Appendectomy	1.92	2.40	2.16
Cholecystectomy	0.88	2.36	1.62
Tonsillectomy	1.51	1.95	1.73
Hysterectomy		3.97	
Cesarean section		5.12	
Hip replacement	0.42	0.72	0.57
Lens insertion	1.65	2.63	2.14
Thyroidectomy	0.09	0.49	0.29
Bowel resection	0.56	0.64	0.60

As it was not possible to produce rates according to insurance status, Table 6 (page 14) shows the proportion of patients for whom the surgeon claimed reimbursement from Medicare, for all States and Territories and mainland Australia.

The standardised ratios for States and Territories (other than Tasmania), indirectly standardised for sex and selected age groups, are shown in Table 7.

Direct comparison of rates using DRGs instead of four-digit ICD codes is not without problems, but admissions data for New South Wales for 1986 (Gibberd 1990) vary by less than 12 per cent from those found in this study. The main reasons for this are that DRG groupings only include principal procedures and no out-of-State admissions.

The extent of variation in standardised ratios for the selected procedures between States and Territories is illustrated in Figure 1.

Tables 8 to 11 show the standardised ratios at a smaller geographic area—the statistical divisions of the States for which they are available—viz. New South Wales, Victoria, Queensland and South Australia respectively. For the lesser-performed procedures and the less populated rural areas, the problem of small numbers becomes apparent.

Figure 2 illustrates the extent of variation shown in Tables 8 to 11.

The larger populations in the metropolitan areas of Sydney and Melbourne give an opportunity to examine variation at the statistical subdivision level or equivalent (statistical regional sectors in Melbourne). Tables 12 and 13 show the standardised ratios of the SSDs and SRSs in the Sydney and Melbourne metropolitan areas respectively. Figure 3 shows the range of variation.

Table 14 allows comparison of the ratios for the mainland State capitals and Figure 4 shows the extent of variation between them. The range of variation across mainland State capital cities was examined on the basis that residents of any of Australia's State capitals could expect the same access to quality health care. Figure 5 illustrates the variability across the three capitals (Sydney, Melbourne and Adelaide) for which SSD/SRS-level data were available, taking the highest and lowest ratios in the three cities as the extremes.

Table 15 gives the standardised ratios of the eight procedures for metropolitan and non-metropolitan regions of the mainland States.

(TABLES 6-15 AND FIGURES 1-5 FOLLOW, COMMENCING ON PAGE 14)

Table 6: Percentage of private patients for surgical procedures, States and Territories and mainland Australia, 1986

State/Territory	Appendix	Cholecyst	Tonsillectomy	Hysterectomy	C section	Hip replt	Lens ins	Thyroidity	Bowel res
New South Wales	58.0	54.6	71.6	69.2	65.3	66.9	78.6	62.1	53.7
Victoria	53.9	55.8	68.9	70.0	65.2	60.3	72.8	65.6	57.0
Queensland	48.5	49.0	71.8	68.1	58.8	70.5	83.2	59.3	53.2
Western Australia	53.2	46.6	65.3	63.3	59.5	61.9	58.5	59.6	49.8
South Australia	56.2	53.9	69.5	70.5	65.6	40.5	94.8	65.0	50.0
Australian Capital Territory	64.0	68.3	85.4	82.9	78.8	74.4	71.7	66.5	56.0
Northern Territory	17.6	29.8	35.0	28.2	28.4	81.6	30.0	45.6	32.2
Mainland Australia	54.5	53.2	70.1	68.5	63.3	62.1	77.6	62.4	53.7

Table 7: Age and sex standardised ratios for surgical procedures, States and Territories, 1986

State/Territory	Appendix	Cholecyst	Tonsillectomy	Hysterectomy	C section	Hip replt	Lens ins	Thyroidity	Bowel res
New South Wales	*108.2	*104.6	98.7	99.8	*97.5	*94.4	*111.8	*109.3	97.7
Victoria	*94.8	*87.2	*87.7	*87.9	*92.5	*95.6	*74.4	98.1	100.3
Queensland	*95.6	*103.6	*90.3	*107.8	*110.8	*87.9	*116.0	*107.4	103.1
Western Australia	*110.0	*91.8	*107.4	*116.9	*95.4	*121.7	*109.6	*80.9	105.3
South Australia	*83.8	*120.2	*159.0	100.1	102.1	*129.1	*87.2	*70.8	100.9
Australian Capital Territory	*98.9	*110.7	*108.6	*115.0	*143.2	*108.0	*158.3	*121.2	*86.8
Northern Territory	*75.4	*92.7	*59.5	*129.6	*144.5	*256.1	*68.0	*123.4	*72.8

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

Table 8: Age and sex standardised ratios for surgical procedures, NSW statistical divisions, 1986

Statistical division	Appendix	Cholecyst	Tonsillity	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Sydney	*109.2	102.4	*93.4	*92.2	*90.2	*122.8	*113.9	97.5
Hunter	*92.9	*121.3	*97.7	*134.6	*87.4	*110.4	*87.9	*114.3
Illawarra	95.0	*110.7	*114.4	106.1	*77.9	*97.1	*90.7	*97.0
Richmond-Tweed	*115.6	*106.7	*98.3	*85.0	*81.4	*88.9	*117.8	*88.3
Mid-North Coast	*120.9	*111.2	*117.5	*123.2	*109.5	*77.7	*123.8	*99.1
Northern	98.7	*103.9	*88.4	94.7	*116.7	*107.6	*122.2	*82.7
North Western	*82.7	*88.7	*100.7	*91.2	*117.6	*127.2	*71.1	*89.9
Central West	*147.0	*125.2	*161.7	*127.7	*174.9	94.6	*147.9	*107.9
South Eastern	*112.3	*79.3	*101.6	*104.0	*108.2	*87.7	*96.0	*60.7
Murrumbidgee	*122.1	*104.2	*114.7	*96.0	*115.5	*53.0	*100.3	*94.3
Murray	*97.5	*95.0	*80.1	*119.8	*92.0	*58.0	*120.2	*106.6
Far West	*154.4	*72.2	*118.0	*118.9	*36.5	*68.1	*0.3	*125.8

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

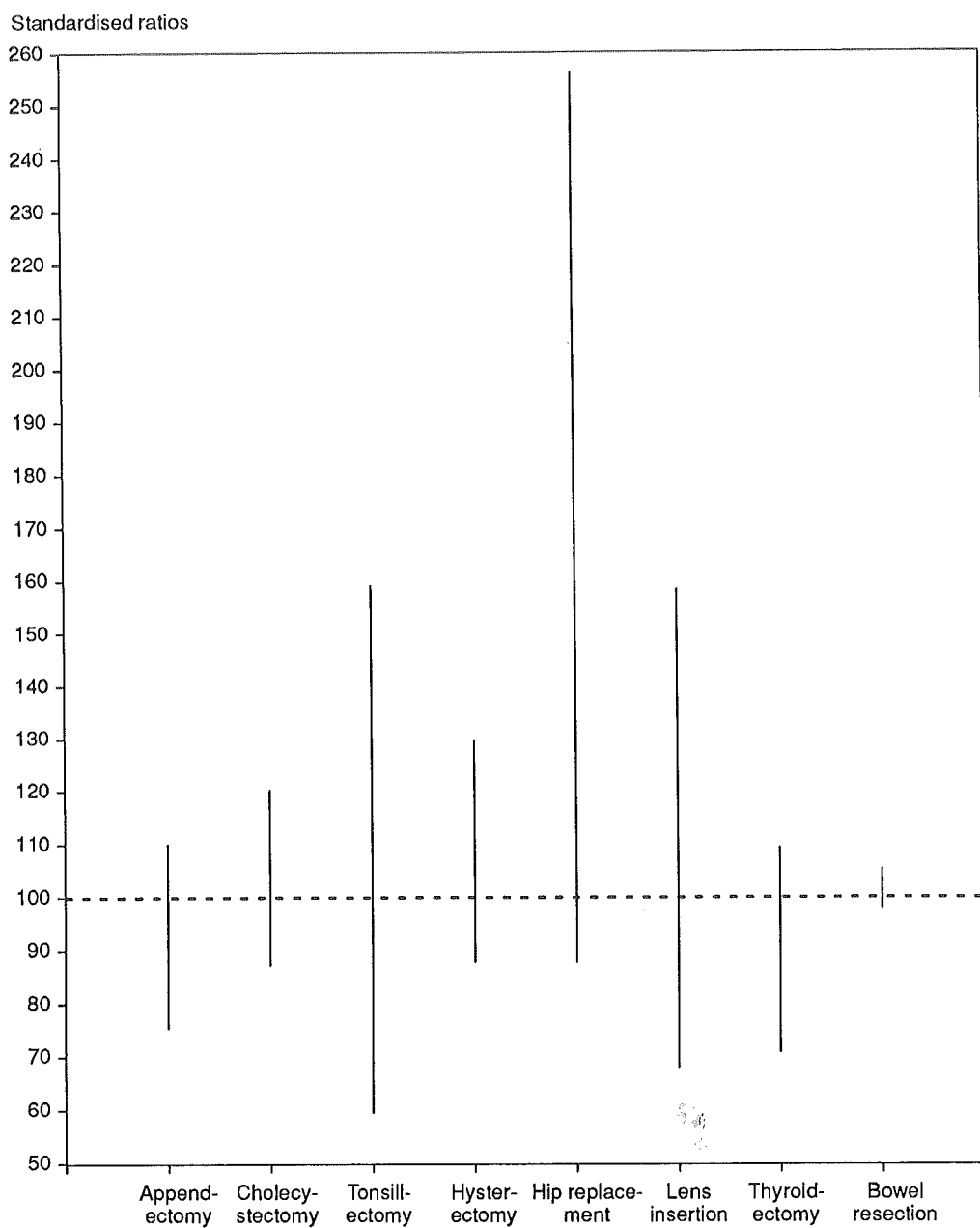


Figure 1: *Range of standardised ratios of surgical procedures, across States/Territories (excluding Tasmania), 1986*

Table 9: Age and sex standardised ratios for surgical procedures, Victorian statistical divisions, 1986

Statistical division	Appendix	Cholecyst	Tonsillity	Hystercty	Hip replt	Lens ins	Thyroidity	Bowel res
Melbourne	*90.7	*85.1	*87.9	*88.0	*93.5	*81.1	100.2	104.1
Barwon	102.7	95.5	*62.8	92.9	*77.8	*50.9	#86.2	#101.2
South Western	*123.7	*82.9	*75.8	#86.7	#101.8	*65.8	#100.9	#115.9
Central Highlands	*118.3	#105.1	*114.6	#88.8	#90.3	*73.5	#84.0	*76.9
Wimmera	#104.1	#87.3	*65.1	*59.5	#118.3	*72.3	#93.2	#89.5
North Mallee	*123.6	#94.4	*129.2	*73.6	#100.3	#101.7	#117.3	*71.4
Loddon-Campaspe	91.3	#91.0	*111.5	*86.9	*136.4	*52.0	#100.3	#90.1
Goulburn	*116.5	#95.7	#103.8	#95.2	#97.3	*50.0	#100.9	#93.3
North Eastern	*79.2	#86.2	*49.6	*83.3	#109.7	*54.4	*157.7	#95.8
East Gippsland	*130.5	#85.6	*65.5	*147.9	390.0	*69.8	#120.2	#107.9
Central Gippsland	89.5	#95.1	*86.1	*70.9	#101.9	*46.8	#88.2	#91.7
East Central	*76.0	*70.6	*69.8	*74.0	#77.0	*52.1	#49.0	*61.4

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

Table 10: Age and sex standardised ratios for surgical procedures, Queensland statistical divisions, 1986

Statistical division	Appendix	Cholecyst	Tonsility	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Brisbane	*95.9	*109.8	*108.8	*105.3	*80.3	*110.4	*113.1	*112.5
Moreton	103.4	*97.6	*77.5	103.3	*92.2	*109.7	*100.3	*104.3
Wide Bay - Burnett	*107.3	*102.7	*84.5	*113.8	*87.5	*84.6	*94.1	*76.3
Darling Downs	*115.8	*108.2	*82.8	*132.2	*138.5	*132.2	*121.9	*109.4
South West	*114.1	*74.6	*84.0	*117.6	*104.0	*114.9	*148.4	*72.6
Fitzroy	*101.8	*115.8	*75.2	*88.7	*71.0	*66.2	*117.3	*120.9
Central West	*108.9	*65.4	*66.2	*79.9	*89.1	*47.8	*69.7	*138.8
Mackay	*93.1	*105.5	*117.1	*106.1	*83.4	*113.1	*109.3	*75.8
Northern	*82.0	*99.6	*73.1	*138.1	*77.5	*225.9	*110.5	*85.1
Far North	*53.3	*71.1	*27.7	96.0	*95.6	*154.9	*83.3	*84.0
North West	*80.2	*82.8	*71.6	*98.3	*82.9	*118.0	*82.8	*60.1

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

Table 11: Age and sex standardised ratios for surgical procedures, South Australian statistical divisions, 1986

Statistical division	Appendix	Cholecyst	Tonsility	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Adelaide	*84.1	*123.3	*164.2	99.0	*131.2	*93.0	*68.2	105.1
Outer Adelaide	*99.8	*104.9	*143.3	*101.6	*130.1	*78.0	*52.2	*91.6
Yorke-Lower North	*76.2	*104.9	*131.9	*80.0	*112.1	*105.0	*44.2	*110.4
Murray Lands	*73.9	*121.9	*169.8	*91.2	*119.2	*54.7	*112.8	*81.3
South East	*67.6	*84.3	*98.4	*97.4	*121.8	*39.2	*131.8	*92.5
Eyre	*78.3	*94.6	*127.1	*98.2	*115.0	*65.4	*51.4	*80.0
Northern	*91.2	*139.2	*181.0	*133.0	*130.3	*68.2	*79.1	*79.7

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

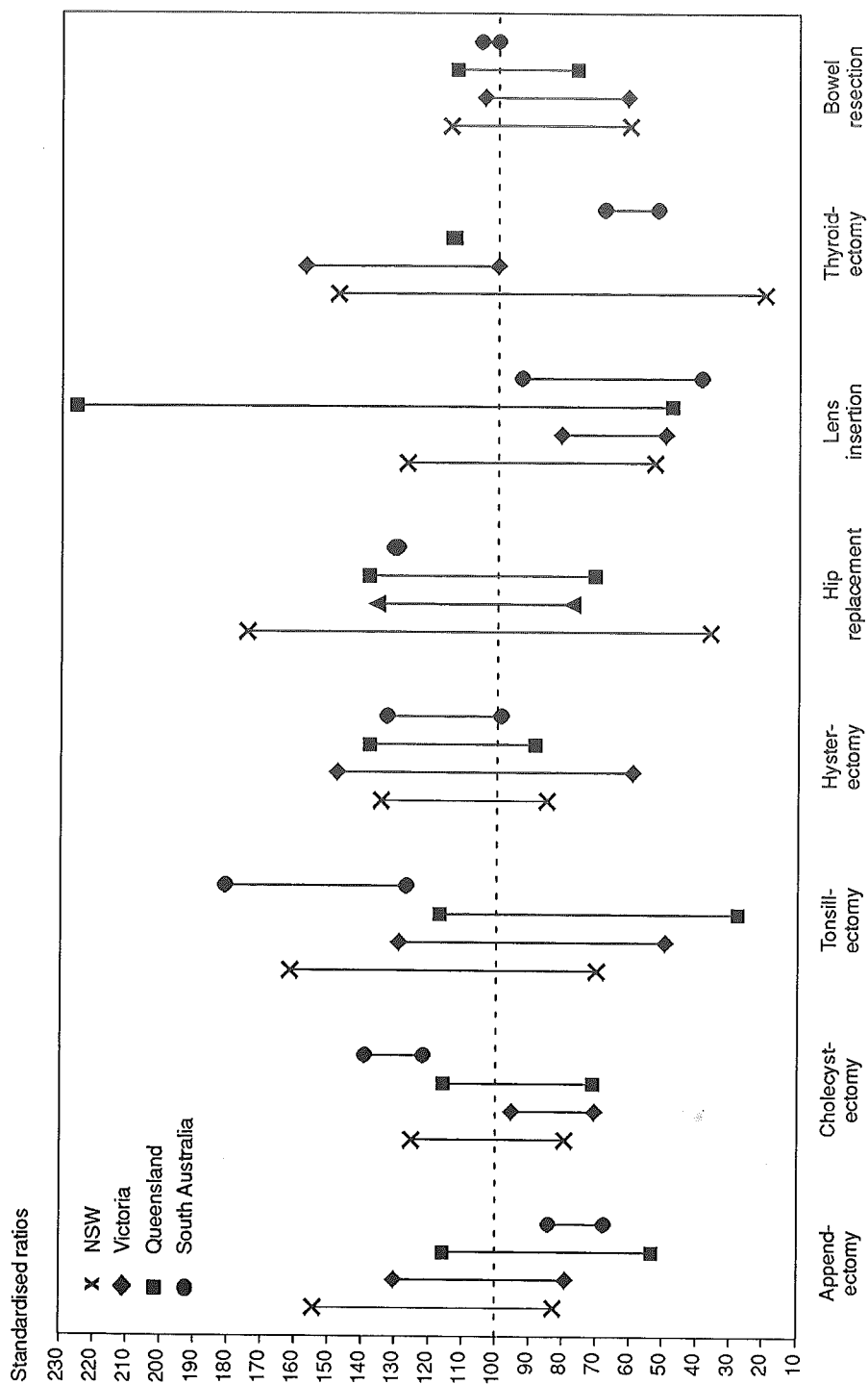


Figure 2: Range of standardised ratios of surgical procedures across State statistical divisions (SDs), 1986

Table 12: Age and sex standardised ratios for surgical procedures, Sydney metropolitan area, 1986

Statistical subdivision	Appendix	Cholecyst	Tonsillity	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Inner Sydney	97.1	95.0	*74.3	*63.3	*74.0	*114.9	*128.9	*83.3
Eastern Sydney	*87.3	*77.8	*63.3	*69.6	*84.8	*133.4	*69.0	*120.0
St George-Sutherland	*136.0	93.9	94.5	*76.9	*96.9	*130.6	#103.3	#110.4
Canterbury-Bankstown	*123.6	*123.7	105.5	*86.5	*87.0	*110.4	#113.5	#88.6
Fairfield-Liverpool	*136.4	*151.1	*130.5	104.1	*51.3	*162.1	*140.0	#88.3
Outer South West	*113.7	*148.6	*143.3	*124.3	*96.1	*79.0	#95.0	#98.1
Inner West	96.7	*72.5	#100.1	*81.0	*71.5	*111.8	*101.5	*67.3
Central West	100.3	*110.0	*83.4	93.6	*80.4	*144.6	*159.3	#100.3
Outer West	*125.1	*116.2	*90.1	*113.4	*124.1	95.1	#119.4	*74.5
Blacktown-Baulkham Hills	103.3	*121.6	*78.4	*125.6	*95.7	*146.9	*123.0	*83.9
Lower North	*85.4	*84.1	*68.7	*73.4	#103.0	*127.2	#115.4	#92.4
Hornsby-Kuringai	*112.9	*85.2	*73.4	*88.3	#111.9	*114.4	#120.9	#106.3
Manly-Warringah	93.8	*76.3	*74.0	*89.0	*99.7	*124.7	#116.8	*134.2
Gosford-Wyong	*88.0	100.9	*124.0	*135.2	*82.8	101.5	#77.5	#94.3

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

Table 13: Age and sex standardised ratios for surgical procedures, Melbourne metropolitan area, 1986

Statistical region sector ¹	Appendix	Cholecyst	Tonsil	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Western Melbourne	*84.9	101.0	*80.4	105.8	*79.8	*78.7	#103.5	90.2
Inner Melbourne	*65.4	*66.8	*58.7	*57.7	*77.6	*77.9	*79.7	#100.0
North East	*85.6	*81.1	*79.1	*82.1	#92.7	*62.1	#111.9	#101.6
Inner East	98.6	*72.7	*83.3	*88.3	*112.1	102.3	#102.6	#110.4
Southern Melbourne	*87.0	*77.7	96.3	*74.6	#93.4	*85.9	#86.8	*113.9
Outer East	101.6	*88.8	107.1	93.5	#100.4	*70.3	#107.2	#106.8
Mornington Peninsula	106.4	*105.5	105.4	103.7	#95.0	*72.2	#107.5	#106.0

¹ Melbourne is divided into statistical region sectors (SRSs) not statistical subdivisions (SSDs) (see Appendix B).

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

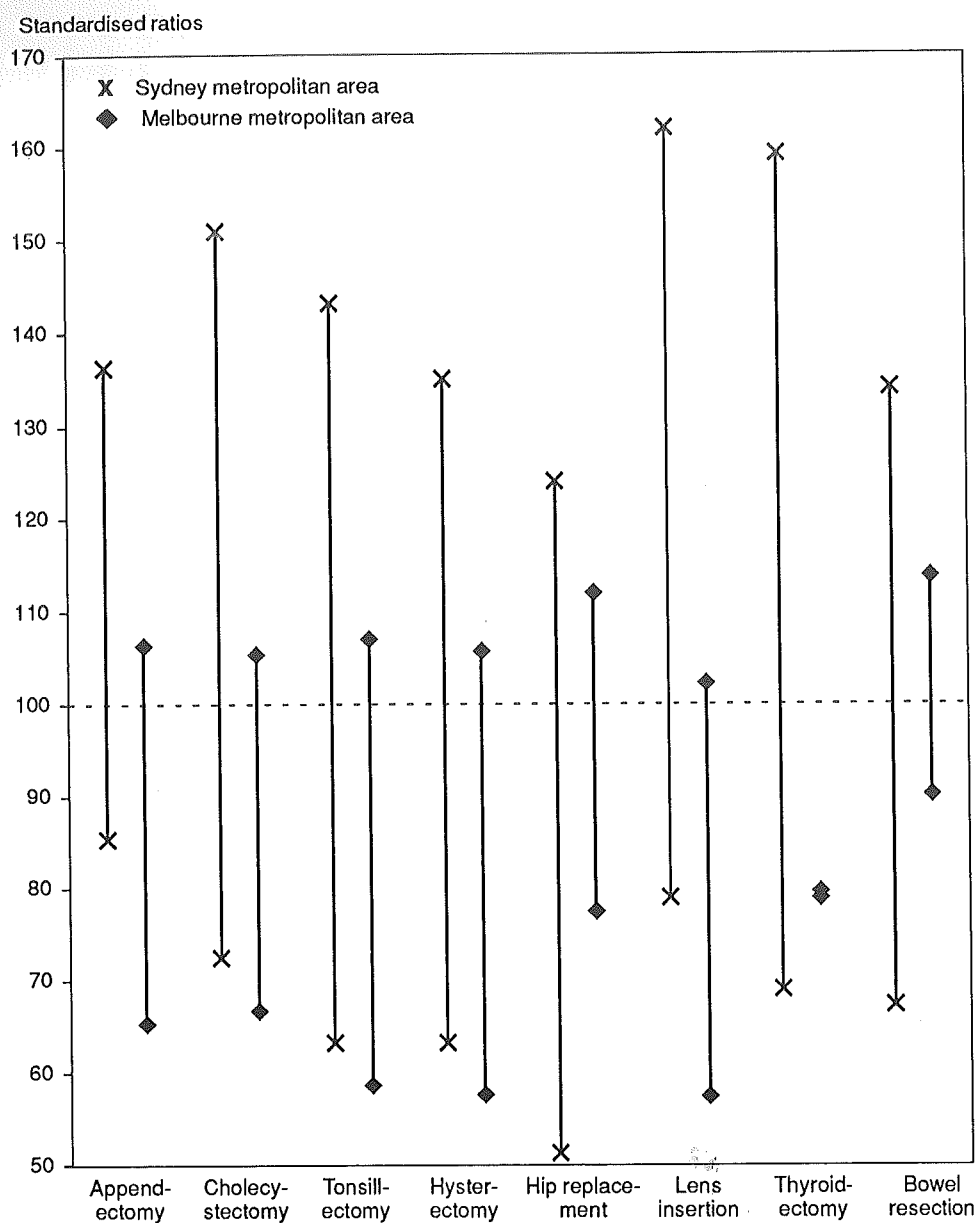


Figure 3: Range of standardised ratios of surgical procedures across Sydney and Melbourne metropolitan areas, 1986

Table 14: Age and sex standardised ratios for surgical procedures, State capital cities, 1986

City	Appendix	Cholecyst	Tonsillity	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
Sydney	*109.2	102.4	*93.4	*92.2	*90.2	*122.8	113.9	97.5
Melbourne	*90.7	*85.1	*87.9	*88.0	*93.5	*81.1	100.2	104.1
Brisbane	*95.9	*109.8	*108.8	*105.3	*80.3	*110.4	*113.1	*112.5
Adelaide	*84.1	*123.3	*164.2	99.0	*131.2	*93.0	*68.2	105.1
Perth	*105.0	*92.2	*110.7	*109.0	*112.7	*107.7	*81.6	105.3

* The difference from the national rate is statistically significant at ≤ 0.05 .

Standardised ratios

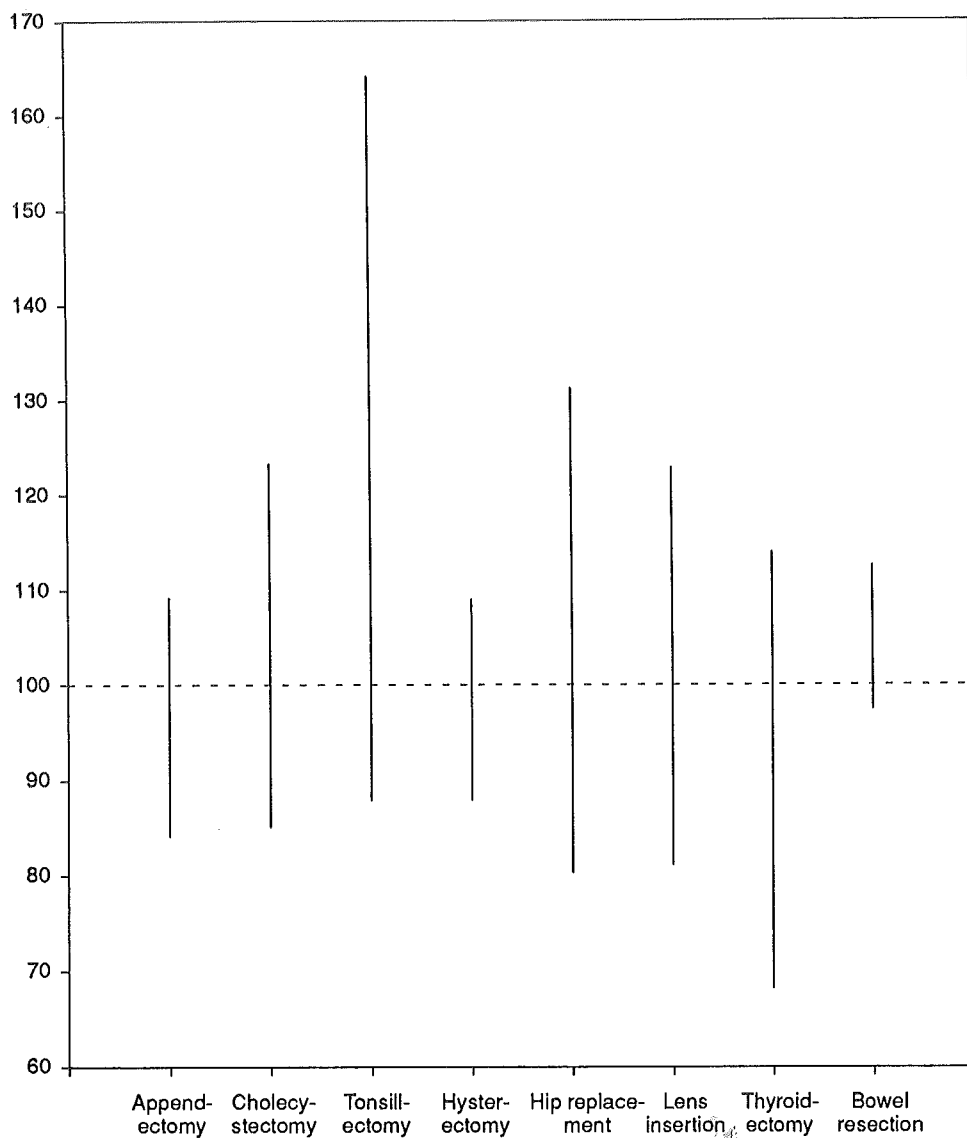


Figure 4: *Range of standardised ratios of surgical procedures across five mainland State capital cities, 1986*

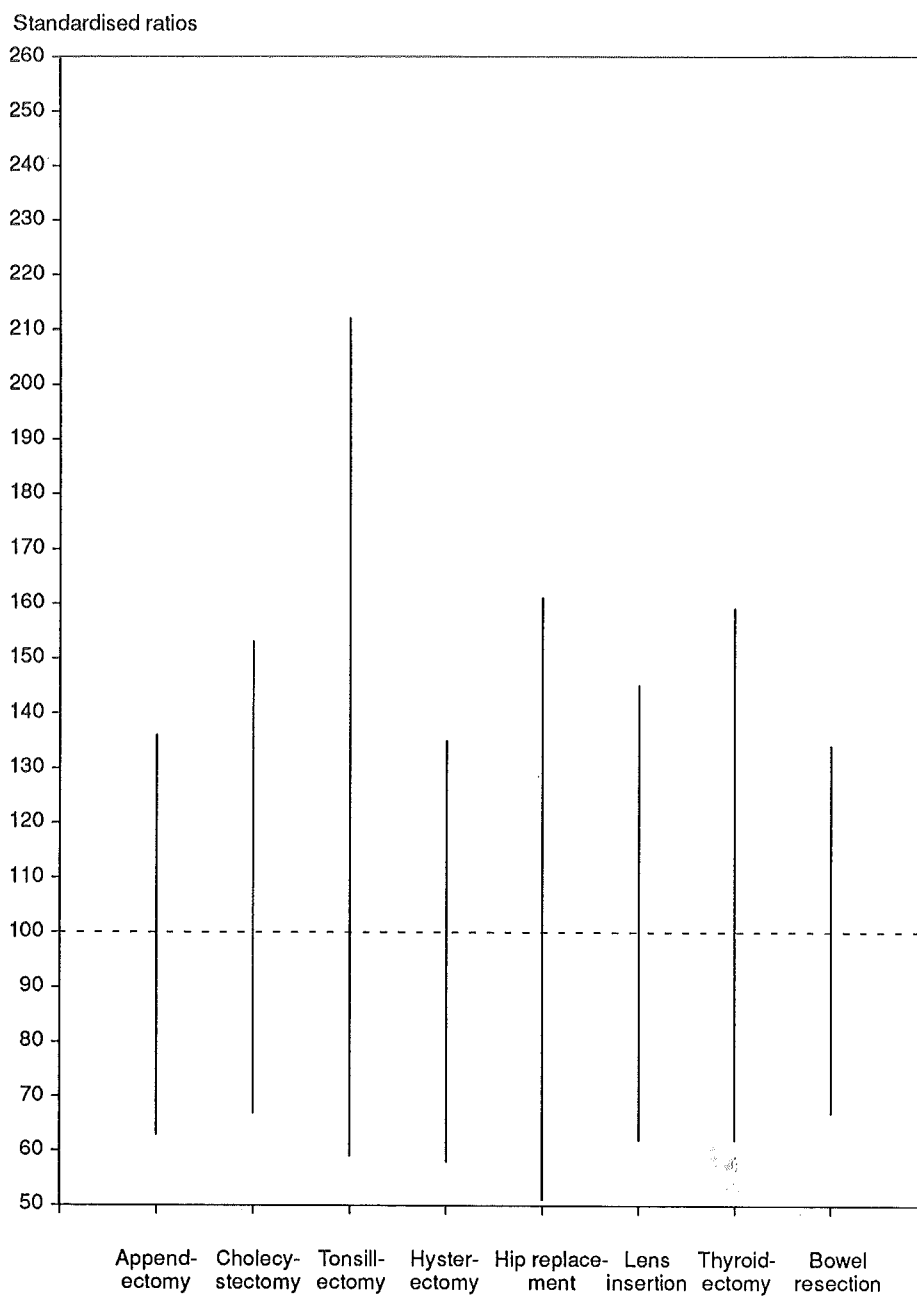


Figure 5: *Range of standardised ratios across statistical subdivisions (SSDs) of Sydney, Melbourne and Adelaide, 1986*

Table 15: Age and sex standardised ratios for surgical procedures, State metropolitan and non-metropolitan regions, 1986

Region	Appendix	Cholecyst	Tonsillect	Hystercty	Hip replt	Lens ins	Thyroidty	Bowel res
New South Wales metropolitan	*109.2	102.4	*93.4	*92.2	*90.2	*122.8	*113.9	97.5
Victoria metropolitan	*90.7	*85.1	*87.9	*88.0	*93.5	*81.1	100.2	104.1
Queensland metropolitan	*95.9	*109.8	*108.8	*105.3	*80.3	*110.4	*113.1	*112.5
Western Australia metropolitan	*105.0	*92.2	*110.7	*109.0	*112.7	*107.7	*81.6	105.7
South Australia metropolitan	*84.1	*123.3	*164.2	99.0	*131.2	*93.0	*68.2	105.1
All metropolitan	*98.2	100.04	*101.7	*93.4	*95.3	*103.5	*103.6	102.7
New South Wales non-metropolitan	*106.5	*108.4	*107.2	*113.2	101.3	*93.8	103.1	98.3
Victoria non-metropolitan	*104.6	*92.2	*87.3	*87.5	100.4	*59.7	97.6	*92.4
Queensland non-metropolitan	*95.5	98.3	*75.3	*110.1	94.4	*120.8	104.0	*96.3
Western Australia non-metropolitan	*122.1	*90.6	99.1	*143.1	*155.7	*117.0	92.7	105.2
South Australia non-metropolitan	*83.1	*111.4	*146.7	103.5	*122.9	*69.6	*82.6	88.8
All non-metropolitan	*107.4	*97.9	98.8	*115.3	*113.6	*98.2	*95.8	99.0

* The difference from the national rate is statistically significant at ≤ 0.05 .

The statistical test was not sufficiently powerful to reach a conclusion because of small numbers.

Cesarean section

The following tables present rates of cesarean delivery per 100 live births and their confidence limits at three levels of disaggregation. Table 16 has State/Territory rates, and Tables 17 to 20 have rates for SDs in New South Wales, Victoria, Queensland, and South Australia. Appendix C should be consulted for cautionary notes regarding interpretation of rates with wide confidence intervals.

(TABLES 16–28 AND FIGURE 6 FOLLOW, COMMENCING ON PAGE 28)

Table 16: Cesarean section rates per 100 live births, mainland Australia, States and Territories, 1986

State/Territory	Rate	Confidence limits	
New South Wales	16.0	15.8	16.3
Victoria	16.5	16.2	16.8
Queensland	18.4	18.0	18.8
Western Australia	15.1	14.6	15.5
South Australia	18.2	17.6	18.7
Australian Capital Territory	26.3	25.0	27.7
Northern Territory	19.8	18.5	21.2
<i>Mainland Australia</i>	16.9		

Table 17: Cesarean section rates per 100 live births, New South Wales statistical divisions, 1986

Statistical division	Rate	Confidence limits	
Sydney	17.2	16.9	17.6
Hunter	15.1	14.3	15.9
Illawarra	14.9	14.0	15.9
Richmond-Tweed	14.5	13.1	15.9
Mid-North Coast	16.1	14.8	17.4
Northern	13.0	11.8	14.3
North Western	15.6	14.3	17.0
Central Western	12.5	11.2	14.0
South Eastern	12.1	10.8	13.4
Murrumbidgee	10.6	9.4	11.8
Murray	14.3	12.7	16.0
Far West	14.1	11.3	17.3

**Table 18: Cesarean section rates per 100 live births,
Victorian statistical divisions, 1986**

Statistical division	Rate	Confidence limits	
Melbourne	17.4	17.1	17.8
Barwon	11.3	10.2	12.4
South Western	15.2	13.4	17.1
Central Highlands	13.9	12.4	15.5
Wimmera	9.6	7.6	11.9
North Mallee	20.3	18.0	22.6
Loddon-Campaspe	15.7	14.3	17.2
Goulburn	19.7	18.1	21.4
North Eastern	12.3	10.6	14.2
East Gippsland	14.3	12.2	16.6
Central Gippsland	13.2	11.9	14.5
East Central	12.8	10.7	15.0

**Table 19: Cesarean section rates per 100 live births,
Queensland statistical divisions, 1986**

Statistical division	Rate	Confidence limits	
Brisbane	20.0	19.4	20.6
Moreton	17.2	16.3	18.3
Wide Bay - Burnett	16.5	15.0	18.0
Darling Downs	18.0	16.6	19.4
South West	16.0	13.1	19.3
Fitzroy	14.5	13.2	15.8
Central West	14.0	10.1	18.5
Mackay	19.0	17.2	20.8
Northern	17.5	16.1	18.9
Far North	18.7	17.3	20.1
North West	16.8	14.5	19.3

Table 20: Cesarean section rates per 100 live births, South Australia, statistical divisions, 1986

Statistical division	Rate	Confidence limits	
Adelaide	18.8	18.1	19.4
Outer Adelaide	16.4	14.3	18.6
Yorke-Lower North	15.6	13.0	18.6
Murray Lands	17.8	15.5	20.2
South East	18.8	16.5	21.2
Eyre	14.5	11.8	17.5
Northern	16.6	14.8	18.5

Table 21: Cesarean section rates per 100 live births, Sydney metropolitan area, 1986

Statistical subdivision	Rate	Confidence limits	
Inner Sydney	16.2	15.0	17.4
Eastern Sydney	15.8	14.4	17.2
St George-Sutherland	21.6	20.5	22.7
Canterbury-Bankstown	16.4	15.3	17.5
Fairfield-Liverpool	14.0	13.0	15.0
Outer South West	14.7	13.6	15.8
Inner West	17.3	15.7	19.0
Central West	18.4	17.2	19.6
Outer West	16.7	15.7	17.7
Blacktown-Baulkham Hills	18.2	17.1	19.2
Lower North	19.6	18.3	21.0
Hornsby-Kuringai	16.4	15.0	17.8
Manly-Warringah	20.2	18.7	21.7
Gosford-Wyong	14.4	13.1	15.7

Table 22: Cesarean section rates per 100 live births, Melbourne metropolitan area, 1986

Statistical region sector	Rate	Confidence limits	
Western Melbourne	18.6	17.8	19.4
Inner Melbourne	14.5	13.4	15.6
North East	17.0	16.0	18.0
Inner East	17.2	16.2	18.2
Southern Melbourne	15.5	14.4	16.6
Outer East	18.2	17.2	19.2
Mornington Peninsula	18.7	17.8	19.6

**Table 23: Cesarean section rates per 100 live births,
Brisbane metropolitan area, 1986**

Statistical subdivision	Rate	Confidence limits	
City Core	25.4	22.0	28.9
Northern Inner	21.9	19.7	24.1
Eastern Inner	21.3	18.9	23.9
Southern Inner	23.0	20.0	26.3
Western Inner	24.0	20.3	28.0
Northern Outer	19.3	17.6	21.1
Eastern Outer	16.7	13.9	19.7
Southern Outer	24.4	22.1	26.8
Western Outer	22.6	20.2	25.0
Albert Shire - A	15.1	12.2	18.4
Beaudesert - A	46.1	30.9	59.8
Caboolture - A	14.0	11.4	16.8
Ipswich City	17.9	15.9	20.1
Logan City	17.7	16.2	19.2
Moreton Shire - A	18.5	15.5	21.7
Pine Rivers - A	19.7	17.5	21.9
Redcliffe City	14.6	11.9	17.6
Redland Shire	20.8	18.5	23.3

**Table 24: Cesarean section rates per 100 live births,
Adelaide metropolitan area, 1986**

Statistical subdivision	Rate	Confidence limits	
Northern	19.3	18.2	20.4
Western	16.8	15.4	18.3
Eastern	18.5	16.9	20.1
Southern	19.6	18.4	20.8

**Table 25: Cesarean section rates per 100 live births,
State/Territory capital cities, 1986**

City	Rate	Confidence limits	
Sydney	17.2	16.9	17.6
Melbourne	17.4	17.1	17.8
Brisbane	20.0	19.4	20.6
Adelaide	18.8	18.1	19.4
Perth	14.9	14.3	15.4
Canberra	26.3	25.0	27.7

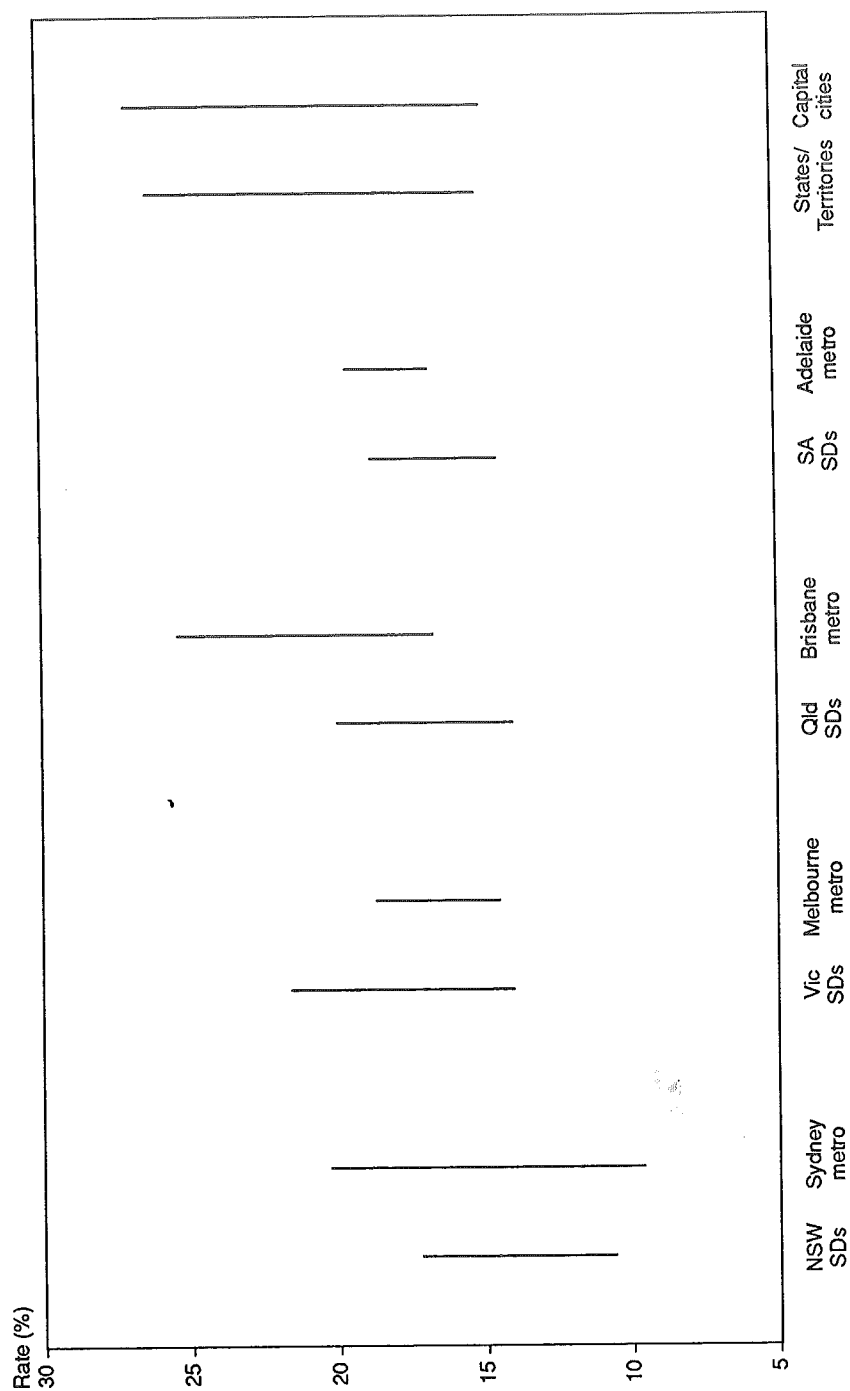


Figure 6: Cesarean section rate (% livebirths)—range across State statistical divisions (SDs), metropolitan areas, States/Territories and capital cities, 1986

Table 26: Cesarean section rates per 100 live births, State metropolitan/non-metropolitan areas, 1986

	NSW	Vic	Qld	SA	WA	All
Metropolitan	17.2	17.4	20.0	18.8	14.9	17.5
Non-metropolitan	14.2	14.5	17.2	16.8	15.6	15.3

Table 27: Cesarean section rates per 100 births* for insured and uninsured women, mainland Australia, States and Territories 1986

	NSW	Vic	Qld	SA	WA	NT	ACT	Total
Insured	18.3	17.7	24.7	21.0	17.8	16.3	26.9	19.4
Uninsured	12.9	14.6	13.5	14.5	12.3	21.7	24.4	13.7
All	16.0	16.5	18.4	18.2	15.1	19.8	26.3	16.9

* Still births have not been excluded.

Table 28: Percentage of private patients among cesarean sections and all births for States and Territories and mainland Australia, 1986

	NSW	Vic	Qld	SA	WA	NT	ACT	All
Cesarean sections	65.3	65.2	58.8	86.6	59.5	28.4	78.8	63.3
All births	57.0	60.7	43.8	56.8	50.4	34.5	77.1	54.9

4 Discussion

National rates

When Table 5 is compared with Table 1, indications are that in the decade ending 1986, rates for appendectomy and tonsillectomy fell appreciably, while rates for hysterectomy, cholecystectomy and hip replacement remained relatively stable. Rates for cesarean section and lens insertion increased. There is insufficient information from previous studies about hip replacement, thyroidectomy and bowel resection to discern any trends.

Little useful knowledge can be gained from this comparison with State rates, however, because of differences in method and reference populations. A national morbidity data collection is needed to allow the continuous monitoring of national rates and the evaluation of trends soon after they become discernible.

Clinical management of the conditions underlying the procedures selected for this study depends almost entirely on the decision to use surgical rather than non-surgical intervention. Comparing international rates, therefore, has some utility. All the procedures require acute hospitalisation, so the vagaries of institutional admission policies and health system definitions do not obscure the meaning of the statistics. It can be assumed, therefore, that international comparisons reflect not only differences in bed supply and culturally-determined attitudes and values affecting demand, but also cultural differences in clinical practice. As Klein (1984) has demonstrated, clinical practice is more aggressively interventionist in the USA than in the UK, and in some European countries it is strongly influenced by national philosophical heritages (Payer 1988).

Table 29 shows rates for OECD countries for 'around' 1980 (i.e. the years varied around 1980).

Gender differences in rates are usually ascribed to

- gender-specific symptoms
- the greater longevity of women compared with men
- the greater tendency for women to seek medical attention.

This table appears to contain some doubtful statistics, most notably for cesarean section in the USA, which conflicts with the percentage rate shown in Table 31. OECD statistics are reported as they are made available from the source countries, and there may be inconsistencies in definitions and reference populations. Some countries estimate national rates from sampled data in the absence of national collections—as Australia does. The Australian rates cited in Table 31 were reported by the Commonwealth Department of Health, and were for 1980. Some procedures experiencing rapid change in use rates (notably lens insertion, tonsillectomy and cesarean section) can show marked differences if the statistics reported are not for the same year.

In view of the anomalies and potential inconsistencies described, these international comparisons do little more than suggest that Australia's clinical culture is closer to North America's than to Britain's.

Table 29: Prevalence of surgical procedures in OECD countries (rate per 1,000 population)

Country	Appendix	Cholecyst	Tonsillity	Hystercty	C section	Lens ins	Thyroidty
Females							
Australia	3.94	2.16	1.36	4.05	0.14	1.12	0.64
Canada	1.31	3.16	2.98	4.70	4.56	1.57	0.29
Denmark	2.96	0.19	1.46	2.55	2.31	1.40	0.05
Ireland	2.45	1.43	2.63	1.23	0.17	0.70	0.30
Japan				0.90	—		
Netherlands	1.62	1.92	4.21	3.81	—	0.80	—
New Zealand	1.54	1.46	1.25	4.31	0.78	1.06	0.30
Sweden	1.71	1.78	0.70	1.45	0.01	—	0.05
UK				1.32	—		
USA	1.24	2.88	2.31	5.56	0.16(sic)	2.35	0.53
THIS STUDY	2.40	2.36	1.95	3.97	5.12	2.63	0.49
Males							
Australia	2.86	0.74	0.83			0.90	0.13
Canada	1.55	1.20	2.54			1.19	0.06
Denmark	1.99	0.23	1.12			1.19	0.06
Ireland	2.46	0.38	2.48			0.57	0.04
Netherlands	1.36	0.69	4.21			0.55	—
New Zealand	1.83	0.51	0.78			0.83	0.05
Sweden	1.65	1.01	0.59			—	0.01
USA	1.34	1.12	1.79			1.78	0.12
THIS STUDY	1.92	0.88	1.51			1.65	0.09
Persons							
Japan	2.44	0.02	0.61			0.88	0.06
UK	1.32	0.27	1.91			0.98	0.20
THIS STUDY	2.16	1.62	1.73	3.97	5.12	2.14	0.29

Note: Tonsillectomy in this table does not include adenoidectomy.

Source (other than this study): *Measuring health care 1960–1983*, OECD, Paris, 1985

Variability at State/Territory level

The mainland Australian States are much more like one another than the Territories, so when examining the variability existing at State/Territory level, it is prudent to compare the States first.

At this level of analysis, it could be expected that most of the heterogeneity of clinical decision-making would be lost and that there would be similar ratios for States with comparable health profiles, once adjustments have been made for different age and sex structures of the population. Table 7 indicates that this was so for most procedures. However, while variation in lens insertion, hip replacement and thyroidectomy was of the order of one-and-a-half-fold (the other procedures varied less), the tonsillectomy ratio in South Australia was nearly twice the ratio in Victoria. Other notable statistics

are the low lens insertion ratios in South Australia and Victoria, and the high ratio for hip replacement in South Australia—all varying by more than 25 per cent from the mainland Australian average. Bowel resection showed the least variability, as might be predicted, since the indications for surgery are well-defined.

While there is no reason to regard these procedures as clinical sentinels (other than that they probably cover most surgical specialties), it may be worth comparing the variation across the procedures in each State. Table 30 shows the data from Table 7 re-worked to indicate the extent of variation, and it can then be seen that New South Wales showed the greatest homogeneity, with Victoria and Queensland only a little less.² Western Australia followed fairly closely but South Australia (like the Australian Capital Territory) was considerably less homogeneous.

Table 30: *Extent of variation in State/Territory standardised ratios for nine surgical procedures*

Variation above/below 100	NSW	Vic	Qld	SA	WA	NT	ACT
<10%	8	5	6	3	6	1	3
>10%–<20%	1	3	3	2	2	–	3
>20%	–	1	–	4	1	8	3

If the variation in Victoria is measured around a standardised ratio of 90, which is close to the mean of the figures for that State (see Table 7), seven of the nine procedures are less than 10 per cent above or below. This exercise serves to highlight the low ratios overall for Victoria. This, in turn, suggests a relation with bed supply, as beds in Victoria in 1985–86 were 13 per cent lower per capita than in Australia overall, although the occupancy rate made up for this to some extent (Mathers & Harvey 1989).

The ratios in the Northern Territory and the Australian Capital Territory were more diverse and affect the picture shown in Figure 1. The high ratio for hip replacement in the Northern Territory is noteworthy, but the statistic has relatively wide confidence limits because of the small population. Only 12 per cent of these joint replacements were performed in the Territory itself and only 18 per cent were performed on public patients (a reversal of the pattern in the Northern Territory, where about 70 per cent of most procedures were done in the public sector).

There is a general pattern in the Northern Territory of very high or very low ratios, perhaps reflecting clinical practice patterns, consumer expectations, access barriers and health status differentials. The low tonsillectomy rate is difficult to interpret. Given the susceptibility of Aboriginal children to ear, nose and throat infection, it may reflect cultural access barriers to hospital services or a strong clinical culture to seek non-surgical solutions to tonsillitis.

The Australian Capital Territory is, essentially, a city with a diverse socioeconomic structure. It has relatively high proportions of affluent, well-educated and well-travelled residents, and of socially disadvantaged people. Because of its size and spatial distribution it is probably more comparable with New South Wales SDs rather than any

2. It should be noted that the Australian rate is heavily weighted by the ratios in New South Wales and Victoria, and that the larger population in New South Wales combined with the relatively high prevalence of procedures, tends to yield more ratios that are statistically reliable than do the less populated States and Territories.

other geographic unit. Table 30 shows a degree of diversity for the ACT, although this is in the general context of fairly high ratios.

Variability within States at statistical division (SD) level

The intrastate level of analysis is an interesting one for Australia because of the small populations in some SDs and, in some cases, their very sparse distribution (e.g. in the remote areas of South Australia and Queensland). While health services have been organised to deal with these special characteristics, the extent to which they circumvent natural barriers to access may be revealed by population-based studies of this type. It is possible, however, that the Australian solutions to rural isolation—air ambulances, reliance on general practitioner surgery, the survival of the 'general' surgeon—cannot be interpreted in the same way as small area analysis in more densely populated countries like the United Kingdom.³

Small area analysis is based on small population units served by only a few medical practices, but with sufficient specialist resources available on a routine basis to offer the procedures selected for this investigation. This scenario would be comparable, perhaps, with SDs on the tablelands and western slopes of New South Wales and most rural SDs in Victoria, but not those in the central and south-west of Queensland or the north of South Australia.

New South Wales

Table 8 shows that ratios varied across SDs in New South Wales from about one-and-a-half-fold for cesarean section, cholecystectomy, and hysterectomy through about two-fold for appendectomy, thyroidectomy, bowel resection, tonsillectomy and lens insertion, to nearly five-fold for hip replacement.

Ratios were consistently high for the Central West, with only three procedures having rates within 20 per cent of the Australian rate. The greatest variability occurred in the Murrumbidgee, Murray and Far West SDs. The ratio for thyroidectomy in the Far West, together with the ratios for lens insertion in some other rural SDs, suggest the possibility of access barriers.⁴

Another causal factor contributing to these low ratios in country New South Wales may be low expectations on the part of rural dwellers. However, since this does not apply universally (especially in the Central West), other interacting causes may have been in operation, such as differences in the supply of doctors and in clinical practice patterns.

The pattern for the Australian Capital Territory seems to fit quite well with Table 8, the variability being somewhere between those of the Hunter and the Central West.

Victoria

The differences in incidence between New South Wales and Victoria, where ratios were generally lower, effectively produced a greater number of unreliable statistics in Victoria. Generally the variability across SDs was mostly of a similar order of magnitude, except for the variation in hip replacement, which was higher in New South Wales. In

3. Despite the trend towards specialisation, general practitioners still perform some of these surgical procedures. For example, of the private practitioners claiming a fee for tonsillectomy in children under 12 years in Australia in 1986, 9 per cent claimed the generalist rather than the higher specialist fee.

4. The number of thyroidectomies performed on residents of the Far West was extraordinarily low in 1986 and so this ratio has been excluded from subsequent calculations of variability.

Victoria, the greatest variability occurred with tonsillectomy, hysterectomy and cesarean section, which all had more than two-fold variations, while the other six procedures showed variations of about one-and-a-half-fold.

The low ratios for Victoria at the State level were repeated at the SD level, although with a few notable exceptions, especially a ratio of 157.7 for thyroidectomy in the North Eastern SD (possibly an example of a substantial fluctuation resulting from a once-only study). Generally speaking, though, the reverse was true: there was a large number of low ratios, even when compared with those for the State. Wimmera and East Central were conspicuous for uniformly low ratios across the nine procedures, whereas North Eastern, Goulburn and Loddon-Campaspe SDs showed the greatest variability.

Queensland

SDs within Queensland presented a more diverse pattern, possibly reflecting the spatial distribution of the population. Ratios for tonsillectomy and lens insertion varied more than four-fold and there were pockets of very low use for these two procedures and appendectomy. Rates in remote areas—the South West, Central West, and North West SDs—were often statistically unreliable.

The Darling Downs tended to have consistently high ratios. The Far North and Northern SDs also yielded some very high ratios and showed the most variability across procedures, particularly the Far North, which had greater variability than any other SD in the four States.

South Australia

A less variable pattern was found in South Australia. Lens insertion varied by over two-fold, but was the only procedure to do so. Tonsillectomy and hip replacement tended to have consistently high ratios while lens insertion, appendectomy and thyroidectomy had low ratios (most of the SD ratios for thyroidectomy were unreliable). South Eastern and Murray Lands SDs showed the most variability, but no SD gave a picture of consistently low or high ratios.

Overall, the four State SD ratios conformed to the hypothesis that variability increases as the population unit reduces and, particularly, as the population is dispersed spatially. Other consistent patterns, however, are difficult to discern. Only hysterectomy, a 'high variation' procedure, showed almost no SDs where the ratios were more than 15 per cent lower than the State ratio (the four exceptions were Wimmera and Central Gippsland in Victoria, Fitzroy in Queensland, and Yorke-Lower North in South Australia).

Variability within SDs at statistical subdivision (SSD) level

SDs consist of a number of SSDs, which in turn are usually an aggregation of from two to six local government areas (LGA/SLA). The metropolitan areas of Sydney and Melbourne at SLA level would provide the best opportunity to test the small area hypothesis, but even in the most densely settled areas the figures were frequently unreliable. At SSD level, this problem arose only for the less prevalent procedures like thyroidectomy, bowel resection and hip replacement. At this level of disaggregation, a noticeably greater degree of homogeneity than at the SD level could be expected and consequently more diversity should be found between the SSD ratios.

Sydney metropolitan area

In the Sydney metropolitan area, every procedure except appendectomy showed at least two-fold variation, with some marked contrasts between SSDs (see Table 11).

Lens insertion was performed on residents of Fairfield–Liverpool twice as frequently as on people living in its adjoining area, Outer South West, despite the general lack of services this area has suffered for many years (Australian College of Health Service Executives 1990). The Central West and Blacktown–Baulkham Hills also had very high ratios for lens insertion, although this procedure tended to yield high ratios everywhere except in the Outer South West, the Outer West, and Gosford–Wyong. Perhaps these variations in rates of lens insertion directly reflect patterns of eye disease in the resident populations, or pockets of overservicing, or both.

With the exception of the Outer West, ratios for hip replacement possibly reflected a low supply of orthopedic surgeons in 1986, with a particularly low ratio in Fairfield–Liverpool. Indeed, this SSD presented the most variable picture, with high ratios for cholecystectomy and thyroidectomy as well as for lens insertion.

No SSD in Sydney had uniformly high or low ratios.

Hip replacement, tonsillectomy and thyroidectomy varied more than the other procedures. There were very high ratios for tonsillectomy and cholecystectomy in the Outer South West and for thyroidectomy in the Central West.

Melbourne metropolitan area

The pattern was less varied between Melbourne SSDs (or, more correctly, SRSs) where only three procedures—cesarean section, hysterectomy and tonsillectomy—showed nearly two-fold variation. Inner Melbourne and Geelong had consistently low ratios and Outer Eastern revealed more variability. Generally, the low ratios held at the SSD level.

Brisbane and Adelaide metropolitan areas

Variations in the Brisbane metropolitan area ranged from one-and-a-half- to six-fold but, because Brisbane is divided into 18 SRSs/SSDs, many of them are based on small numbers of procedures and yielded ratios with wide confidence limits.

Metropolitan Adelaide, on the other hand, is divided into only four SSDs, and many of the ratios were more statistically reliable. The extent of variation was a little less than that in Melbourne.

The small area hypothesis, then, which could be explored reliably only in metropolitan Sydney and Melbourne, was upheld only in Sydney where, to use Deming's terms, the 'system' seemed less in control than in Melbourne.

Variability across capital cities

It seems reasonable to propose that the Australian way of life (and its health system) is founded on egalitarian principles and, while rural dwellers may be willing to trade restricted services for a perceived improvement in their quality of life, people living in the suburbs of the major cities expect similar services, of a comparable quality, irrespective of the State in which they live.

While this proposition may not be universally acceptable, the following analysis of variability across capital cities is nevertheless based on it. The data in Table 13, and Figures 4 and 5 allow the proposition to be tested in the context of this study (assuming also that patterns of illness are not significantly different between the capital cities).

Table 13 suggests that the chances of residents of Sydney, Melbourne, Brisbane and Perth having surgery for any of the conditions studied here were very similar, but not so for the people of Adelaide. The ratio for tonsillectomy in Adelaide was nearly twice as high as that in Melbourne and for hip replacement more than one-and-a-half times, as Figure 4 makes clear.

This picture can be augmented by including the variability within the capital cities at SSD level. (Perth has to be omitted from this analysis as SSD data were not available). Data from metropolitan Brisbane also had to be excluded because of the lack of comparability between population units, although with local knowledge they could be aggregated appropriately. The variation within Sydney, Melbourne and Adelaide was at least two-fold for all procedures and exceeded three-fold for tonsillectomy and hip replacement, as Figure 5 illustrates.

It seems, therefore, that the variability is magnified when the three cities are regarded as a single unit. It also seems that if, indeed, people living in the State capitals do expect equity of access to the health system (as exemplified by these surgical procedures), then this expectation is not well founded. Access may not be the major reason for the variations, of course. They may also reflect 'welcome diversity or disturbing differences' in clinical practice (Jennett 1988), or in consumer expectations.

Variability between metropolitan/non-metropolitan areas

HUCS 1985-86 (Harvey & Mathers 1989) found that metropolitan admission rates for surgery were higher than non-metropolitan rates with 10 to 20 per cent variation across States. As Table 14 shows, when States were aggregated, there was little difference between the metropolitan and non-metropolitan ratios—with two exceptions. Non-metropolitan ratios were about 20 per cent higher than metropolitan ones for hysterectomy and hip replacement.

It becomes clear when individual States are examined that most of this variation arose from differentials in Western Australia, where the non-metropolitan ratios for hysterectomy and hip replacement were considerably higher than the corresponding ratios in metropolitan Perth.

It is generally accepted that the more urgent conditions show higher rates in rural areas because of access difficulties, and this may account for these differentials in Western Australia, although hysterectomy is not usually perceived as an urgent operation (Bombardier et al. 1977).

The high hip replacement ratio for non-metropolitan Western Australia may imply improved access to this procedure in 1986, but local knowledge is needed to interpret this statistic.

It needs to be noted that these ratios are based on the area of usual *residence* of the patient, so differences in the availability of beds between city and rural areas should not significantly affect use rates if referrals to metropolitan hospitals can be accommodated. The low non-metropolitan ratios in Victoria and South Australia for lens insertion may reflect access barriers of one kind or another, but otherwise the metropolitan/non-metropolitan differentials, at the State level of analysis, seem not to indicate referral bottlenecks.

Cesarean section

The discussion of cesarean section ratios has not yet taken account of the fertility of the population. The rate per 100 live births for mainland Australia in 1986 was 16.9 per cent of live births and Table 31 shows how this compares with some other OECD countries (the 16.4 per cent figure for Australia includes Tasmania). Cultural determinants of cesarean delivery appear to be very prominent in this table, and it is usually agreed that social expectations and affluence are especially influential (Stafford 1991). The supply of specialist obstetricians and their tendency to intervene are also considered to affect rates (Opit & Selwood 1979; Taylor 1982), as is the insurance status of the birthing women (Learoyd 1985a; Cary 1990).

Table 31: Cesarean sections (per cent of all deliveries in clinics or maternity wards) in OECD countries, around 1986*

Australia	16.4
Canada	18.5
Finland	14.9
France	12.6
Iceland	12.3
Ireland	8.5
Japan	8.5
New Zealand	10.3
Norway	12.9
Portugal	16.0
Spain	12.0
UK	10.5
USA	24.4

* Latest available—from 1985 to 1988

Note: The Australian rate is for 1986

Source: Health OECD: facts and trends (OECD, unpublished) 1990

Table 16 shows that there was considerable variability in the cesarean section rates across Australian States and Territories. While the rates in the Northern Territory, Queensland, and South Australia were appreciably higher than those in New South Wales, Victoria and Western Australia, the Australian Capital Territory rate was exceptionally high. As Table 27 shows, rates for insured women for all States and the Australian Capital Territory were higher than those for uninsured women, with a reversal of this trend in the Northern Territory. This latter finding may be the effect of small numbers and/or a reflection of a much higher at-risk population of uninsured women. These differences were statistically significant ($p < 0.01$).

The Australian Capital Territory rate, at 26.3 per cent, was nearly two-thirds higher than the rate for New South Wales (16 per cent) and more than double the rate for women in the adjoining South Eastern SD of that State (12.1 per cent). The rate in that SD is supported by a New South Wales Department of Health study (1988). Rates for the

first half of 1986 for hospitals in the area were 10.2 per cent for Goulburn Base Hospital, 9.4 per cent for Wagga Wagga Base Hospital and 11.2 per cent for Albury Base Hospital. These hospital-based rates have not included referrals to metropolitan teaching hospitals or to Australian Capital Territory hospitals.

One factor that almost certainly contributed to the high rate for the Australian Capital Territory was the disproportionately high number of women in the labourforce—62.5 per cent compared with 48.4 per cent for Australia (Australian Bureau of Statistics 1986), which may have affected the age of first delivery and also the likelihood of repeat cesareans.

The fact that all the specialist obstetricians were in private practice might also be expected to have an influence on the rate, since women with private health insurance have been found to have a significantly higher rate than women who are not insured (National Health and Medical Research Council 1984; Health Department Victoria 1989). However, the proportion of public patients among women having cesarean delivery was almost as high as that among all birthing women. Only 21 per cent of cesarean births and 23 per cent of all births were to public patients in the Australian Capital Territory. Corresponding figures for mainland Australia were 37 per cent and 55 per cent. Combined with the slight difference between rates of cesarean section for insured and uninsured women in the Australian Capital Territory, it would seem that the lack of availability of salaried obstetricians was not a direct factor.

It is arguably more realistic to view the Australian Capital Territory rate in the context of SDs, and comparison may be more relevant at that level of analysis.

Rates in the Northern Territory, Queensland and South Australia were also very high compared with the other States: the Queensland rate was around 15 per cent higher than the rate for Australia for instance. Disparities between rates for insured and uninsured women were highest in Queensland, South Australia and Western Australia.

Variability at SD level

As with the standardised population ratios, it would be expected that variability would increase across SDs. In New South Wales, the rate for Sydney was the highest, perhaps influenced by higher than average consumer demand and obstetrician supply. These two factors may also have affected the Mid-North Coast rate which was 50 per cent higher than in the Murrumbidgee SD.

The rates across Victorian SDs showed much more variability, with Northern Mallee having a rate more than twice as high as the rate for the adjoining Wimmera SD (which, as mentioned earlier, had low rates for most of the procedures). While these two SDs are contiguous, they are in different Victorian Health Regions. The rate for Melbourne was not the highest in the State (unlike the other capital cities)—both the Northern Mallee and Goulburn rates were higher.

The Queensland SD rates, given in Table 22, varied considerably less than those in New South Wales, although all but two SDs (Fitzroy and Central West) were higher than the overall New South Wales rate. The northern coastal and Darling Downs SDs in Queensland were all higher than the other rural SDs and, again, maybe doctor supply and consumer demand were involved.

South Australia showed the least variability, with Adelaide and the South Eastern division having the highest rates (19.8 per cent) and Eyre the lowest (14.5 per cent). Some of the rates for the more remote SDs in Queensland and South Australia have

wide confidence limits, so the data are not as reliable as those for the more populous divisions and should be interpreted cautiously.

It seems, then, that the extent of variability fluctuates across the SDs of all the States and there is no clear support for the small area hypothesis. No further insight into the rate for the Australian Capital Territory is gained by comparing it with SD rates, or with those for other capital cities (Table 24 and Figure 6). The only areas with similarly high rates were some of the Brisbane SSDs, but there appears to be no parallel between rates for insured women in the Australian Capital Territory and Queensland (or with the percentage of women who were treated privately), and unfortunately these indicators of insurance status are not available at SSD level.

Variability at SSD level

When SSD level data for the capital cities are examined (Tables 20 to 24) the variability continues to be somewhat haphazard. In the Sydney metropolitan area it was less than across the New South Wales SDs. In contrast, in Brisbane, rates varied more than those for Queensland SDs, with the city core having the second highest rate in Australia—25.4 per cent. In Melbourne and Adelaide, the variability was very low.

There is no clear consistent pattern linking high rates with affluent, well-resourced areas or with obviously high risk populations.

Variability between metropolitan/non-metropolitan areas

In all mainland States except Western Australia the rates for metropolitan areas were higher than non-metropolitan, possibly reflecting obstetrician supply. The reversal in Western Australia was slight and, without more disaggregated data, little can be inferred.

Overall, with the high rates in all the capital cities and the differentials between rates for insured and uninsured women, cesarean delivery seems to be strongly influenced by the availability of resources. The relationship with female labourforce participation rates seems to be inconsistent. The contrast between rates in Queensland and Western Australia may suggest that practice patterns on the eastern seaboard are more readily influenced by cultural diffusion from the USA—including the 'intervention cascade', increasing pressure to safeguard against possible litigation, and heightened consumer demand. However, it may only reflect the supply of obstetricians. Together with the pattern of high rates within Queensland and in the Australian Capital Territory, there appears to be some support for a model of supplier-induced demand.

Summary

A reasonably consistent pattern was present across the mainland States for the nine procedures, with two notable exceptions: a high rate of tonsillectomy in South Australia and low rates of lens insertion in South Australia and Victoria. Another remarkable finding was the uniformly lower rates prevalent in Victoria compared with other States. There was also an exceptionally high rate of cesarean section in the Australian Capital Territory. These statistics suggest that further investigation into their causes may be fruitful.

The data collected here were often inadequate to test whether or not small populations are more homogeneous than larger ones and if variability increases as the population unit reduces. However, to the extent to which reliable ratios could be obtained for New South Wales, Victoria, Queensland and South Australia (at the SD level), they supported the small area hypothesis. Further support was given by the analysis within metropolitan Sydney. There also appeared to be an association at SD level between the size of the population in the small areas and their spatial distribution, but these data were not adequate to explore the nature of that association.

There were two- to three-and-a-half-fold variations when the Sydney, Melbourne and Adelaide metropolitan areas were viewed as one unit. Living in suburban Australia does not seem to assure consistent patterns of use of these surgical procedures, although it is possible that these variations resulted from different patterns of illness.

Comparison of metropolitan and non-metropolitan areas of the mainland States suggests that while, generally, there was an equitable distribution of resources in 1986 between city and country, there were some important exceptions: the differentials in South Australia and Victoria for lens insertion and the high ratios in non-metropolitan Western Australia for hysterectomy and hip replacement.

When the variability is viewed from a clinical specialty perspective rather than a geographic one, the procedures with the most variation in rates were lens insertion, tonsillectomy, and hip replacement. It should be noted that there was, and still is, little clinical indecision about the indications for lens insertion and hip replacement and thus the high variability of these procedures is suggestive of barriers to access, with low rates implying poor accessibility in 1986 and high rates poor accessibility before then.

The high variability in the tonsillectomy rate is disturbing because clinical indicators for this procedure had been promulgated before 1986 (Thompson 1985b). This procedure exemplifies the 'grey areas of medicine' requiring more precise clinical guidelines. The other 'discretionary procedures'—hysterectomy, cesarean section, cholecystectomy, and appendectomy—all showed, at a minimum, approximately two-fold variations at some level of analysis. The development of clinical indicators, and ultimately guidelines, for these frequently performed surgical procedures would be timely.

Possible causal factors

When attempting to seek causal interpretations of these variations, it is important to remember that there are three possible explanations (Wennberg 1987) and that this study cannot distinguish between them:

- inappropriate use in areas with high rates due to unnecessary care
- inappropriate use in areas with low rates due to insufficient care
- appropriate use in all areas with most of the differences explained by differences in illness rates.

The following speculations are offered to stimulate debate and further investigation:

- The lower ratios in Victoria may have been the result of an undersupply of beds: the existence of waiting lists in 1986 supports this possibility (Royal Australasian College of Surgeons 1991). If the health status of Victorians was discernibly different, it was not reported. While hospital bed supply in non-metropolitan areas was greater than in metropolitan areas, inadequate supply of separate nursing home facilities may

have led to 'inappropriate' use of hospital beds, leaving an undersupply of beds for discretionary surgery (especially for lens insertion). The important issue is whether the lower ratios generally in Victoria reflected other real differences, such as social expectations and/or clinical practice.

- The relationship of rates with health status at small area level is unclear without further information about the epidemiology of illness.
- Evidence supporting a direct association between surgery rates and supply of resources is equivocal. Comparison of affluent areas with working class suburbs in Sydney and Melbourne, and examination of the distribution of public and private status, reveal no apparent trends. More information about the geographic distribution of surgeons and surgical resources would be needed to explain the variability in rural areas of the mainland States in terms of Roemer's Law. Because similar variability existed within metropolitan areas the association seems to be influenced by other factors too.
- In the case of cesarean section, the high rates in all the capital cities and the disparity between rates for insured and uninsured women lends support to a direct relation between rates and supply of resources. Other factors also seem to have contributed, such as rising consumer expectations and the practice of defensive medicine.
- Because the extent of variation was high in metropolitan areas as well as among Australia's dispersed population, there appears to have been a substantial diversity in clinical decision-making. The extent of variations, even in procedures where there is presumably general accord about the indications for surgery (bowel resection, thyroidectomy, hip replacement and lens insertion), suggests a need for surgeons to review their standards of practice and monitor them closely. It may then be possible to discover which rates are reasonably 'right' for Australians.
- The effect of peer pressure in group and solo practices and in hospitals has not been studied in Australia. A quality assurance survey of hospitals in 1987 (Renwick & Harvey 1989) found that hospital quality assurance was still embryonic and, while peer review was fairly prevalent, its effectiveness was not assessed. Greer (1988) has pointed out that it is necessary to appreciate the extent to which medical practice is locally organised to understand the poor relationship between doctors' actual behaviour and published guidelines for practice. The development of clinical indicators and their incorporation into hospital accreditation by the Australian Council on Healthcare Standards will need to be subjected to stringent scrutiny if the quality of care is to be assured.
- While clinical practice undoubtedly responds to consumer expectations, and both reflect the attitudes and values of the wider social unit of which patients and their doctors form a part, patients need to be fully informed about the benefits and risks of the various treatment options they are offered. Thus, by taking responsibility for giving their patients an informed choice, doctors can modify consumer demand.
- In his definitive essay on the role of uncertainty in clinical practice, Eddy (1984) pointed out that there is frequently no definition of disease sufficiently clear to provide a doctor with an unequivocal guide to treatment (or non-treatment) for many conditions. It is well for consumers of health care to heed his admonition: 'It is difficult ... to appreciate ... how easy it is for honest people to come to different conclusions' (Eddy 1984, p. 75). Nevertheless, the profession has the responsibility to in-

investigate the variations in surgical rates revealed by this study and search for special causes that could be attributable to their decisions.

- If no apparent correlation with health status can be demonstrated, the cost implications of the variability in rates is considerable, e.g. if the Victorian rates applied universally. The savings would be significant also if the cesarean section rates were closer to those of 10 years ago—10 per cent. The notional savings can be estimated using the difference between the diagnosis-related group (DRG) weights for uncomplicated cesarean section and complicated vaginal delivery. On the assumption that all the additional deliveries were complicated (and this would obviously overstate the probability), the national expenditure on hospitals in 1986 alone, for this one procedure, could have been reduced by about \$11 million. Reducing the variation could also help to contain costs—the opportunity costs of not doing so should not be overlooked.

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Appendix A

Mappings for selected surgical procedures

Procedure	ICPM	ICD-9-CM	CMBS
Appendectomy	5470	470	4074
		471	4080
			4084
			4087
			4093
Cholecystectomy	5511	512	3793
			3798
			3820
Tonsillectomy	5281	282	5363
(with/without adenoidectomy)	5282	283	5366
			5389
			5392
Hysterectomy	5682	683	6513
	5683	684	6517
	5684	685	6532
	5685	686	6533
	5686	687	6536
			6542
Cesarean section	5740	740	6544
			234
			241
Total hip replacement	5741	741	
		742	
		744	
		7499	
Lens insertion	5815	815	8053
		816	8069
			8070
Thyroidectomy	5147	137	6852
			6858
		062	3542
		063	3563
		064	3576
Bowel resection	5061	065	
		5455	4018
		5456	4046
		5484	4048
		5485	4068
		4862	4202
		4863	4209

Appendix B

Area of usual residence conversions

The following table lists the Australian Standard Geographical Classification (ASGC) coding of area of usual residence of the patient in the source data from State/Territory morbidity collections and the conversions required for processing.

State/Territory	ASGC code of data	
	on receipt	for processing
New South Wales	LGA	SLA
Victoria	SLA	SLA SD 5 (Melbourne) has no SLA structure so it was divided into pseudo SSDs using MSRSs
Queensland	SAC or postcode	SLA SD 5 (Brisbane) has no SLA structure so it was divided into pseudo SSDs using MSRSs
South Australia	SLA	SLA
Western Australia	metropolitan/ non-metropolitan	metropolitan/ non-metropolitan
Tasmania	no data	
Australian Capital Territory	LGA	Territory
Northern Territory	Territory	Territory

Notes:

LGA—Local government area
SLA—Statistical local area
SD—Statistical division
SSD—Statistical subdivision
MSRS—Major statistical region sector

Appendix C

Notes on statistical procedures and tests for analysing surgery rates

1. Indirect standardisation

The purpose of this analysis is to examine the variation in rates of surgery between small geographical areas. However, surgery rates vary with the age and sex of the patient and each small area will have a different age and sex population distribution. So, allowance needs to be made for this when studying the variability of the rates. This is done by the process of indirect standardisation.

- The expected value for each small area was calculated. This is the number of occurrences of a given surgical procedure which we would expect if the overall Australian age-sex specific surgery rates applied to this small area.
- The observed value, which is the actual number of occurrences of the procedure in the small area, is divided by the expected value. The result is called the Standardised Ratio.
- The Standardised Ratio will have a value close to one when the surgery rates for the given procedure in the small area do not vary greatly from the overall Australian rates. [We have multiplied the ratio by 100, which is a common practice.]

2. Testing for departure from expected values

Assumptions:

- The numbers of observations in each area is small relative to the total population, i.e. the size of the population is approximately unchanged after the numbers undergoing surgery are removed. This enables us to assume that the numbers of observations in each area is Poisson, with a mean equal to the expected (standardised) numbers.
- Each observation is independent, i.e. a person having the procedure does not make them more likely to have the same procedure a second time in the same period; and one person having the procedure does not increase or decrease the probability of another person in the same area having the procedure.
- The numbers in the population used for standardisation are large enough so that the expected surgery rates can be treated as being exact values.

Given these assumptions, then we can get a test of departure from the expected value using the POISSON function in SAS. The probability associated with our observed value being drawn from the Poisson distribution is

$$P = \text{POISSON}(e, o)$$

where e is the expected (standardised) value and o is the observed value. Since we are doing a two-tailed test, this gives a p -value associated with a test of $o < e$ of $2P$. Similarly, a p -value can be associated with a test of $o > e$ by calculating

$$2(1 - P)$$

3. Confidence limits for the observed value

Under the above assumptions, we can also calculate confidence limits for the observed value under the hypothesis of no regional variation. These will give an idea of the ability of the above p -value to detect differences in the surgery rates. For example, a very wide confidence interval would indicate that only very large differences would be detectable.

In this case the observed value is Poisson as above and confidence limits are:⁵

$$\text{Upper CL } O_u = (o + 1) \left(1 - \frac{1}{9(o + 1)} + \frac{C_{\frac{\alpha}{2}}}{3(o + 1)^{\frac{1}{2}}} \right)^3 \quad (1)$$

$$\text{Lower CL } O_l = o \left(1 - \frac{1}{9o} - \frac{C_{\frac{\alpha}{2}}}{3o^{\frac{1}{2}}} \right)^3 \quad (2)$$

where $C_{\frac{\alpha}{2}}$ denotes the $100\left(1 - \frac{\alpha}{2}\right)$ percentile of the unit normal distribution.

4. Power estimates

A more formal estimate of the ability of the p -value to detect rate differences is the power estimate. This is the probability that an observed value would be correctly identified as significantly different from the expected value under specified alternative hypotheses. This is calculated at α significance level by:

$$\text{POISSON } (e', E_l)$$

for the test $o < e$, and

$$1 - \text{POISSON } (e', E_u)$$

for the test $o > e$; where e' is the expected value under the alternative hypothesis, and E_l and E_u are the limits obtained by substituting e for o in equations (1) and (2). For example, to know the power of our test to detect an increase of 15% in the surgery rate,

$$e' = 1.15e$$

and we can then calculate

$$1 - \text{POISSON } (1.15e, E_u)$$

Usually the alternative hypothesis is specified as the smallest difference that would have *practical* significance. Alternatively, the power can be calculated for a range of values. For example, we could do the calculation for $e' = 1.1e, 1.2e, 1.3e \dots$ etc.

5. Breslow, NE & Day, NE (1987) *Statistical methods in cancer research. Volume 2: The design and analysis of cohort studies*. IARC Scientific Publications No. 82, Lyon

Appendix D

Other limitations of the data

1. Postcodes of Medicare data

The usual residence of the patient undergoing private hospital treatment may be inaccurate because changes of address may not be notified to Medicare. There is no reason to assume any systematic bias other than for one group of patients: those who were bulk-billed. The Health Insurance Commission relies on claimants to notify changes of address when they make a claim for reimbursement, but when a medical practitioner bulk-bills a patient, such a notification is less likely to take place—so addresses are likely to be less accurate for that group of patients.

As bulk-billing is more likely for people receiving the age pension, there is a disproportionate probability that areas of usual residence are inaccurate for older people. However, population mobility is likely to be less for age pensioners than for other population subgroups, so the net effect is difficult to assess. Whatever it is, it would have most significance for procedures more commonly performed on this age group (e.g. hip replacement and lens insertion).

Bulk-billing also varies by State/Territory, being lowest in the Australian Capital Territory and highest in New South Wales. The Health Insurance Commission has been unable to determine how age and State together affect the likelihood of being bulk-billed.

All that can be concluded is that bulk-billed patients are less likely to update their addresses and we cannot estimate the direction or the size of the error.

2. Border flows for public hospital patients

People who choose to be treated in a State/Territory other than the one of their usual domicile are likely to do so because of proximity to better services across the border or because a medical emergency occurs while they are visiting interstate. In 1986, hospital inpatient statistical collections included SLA/LGA of usual residence only for people admitted to hospitals in their home State. For interstate patients, only the State of domicile was coded (with the exception of NSW residents treated in ACT hospitals).

The proportion of border flows varied with the procedure and the State, being highest in New South Wales and Victoria. In New South Wales, they ranged from 0.4 per cent for lens insertion to 1.8 per cent for appendectomy. In Victoria, they ranged from 0.7 per cent for thyroidectomy to 1.7 per cent for lens insertion. In Queensland, the range was 0.1 per cent for tonsillectomy to 0.5 per cent for appendectomy. In South Australia, it was from 0 to 0.8 per cent for bowel resection.

As it was not possible to allocate these records to a specific SLA, SSD or SD, they were distributed to SLAs in the State of usual residence by post-stratification, using Probability Proportional to Size (Cochran 1977). This method allocates the border flows relative to cell frequencies. Thus, cells that are empty receive no additional allocation, while cells with frequencies receive additional allocations proportional to their size. The allocation was stratified by age group and sex. This would have the effect of slightly inflating metropolitan rates.

3. Postcode/SLA conversion

The ABS conversion of postcode to SLA introduced a further imprecision, although the new conversion is a great improvement on the earlier one. This new conversion accounts for minor postcode boundary changes, and proportional allocation to SLAs was based on Census collection districts. Nevertheless, any conversion of this nature contains some minor inaccuracies that cannot be identified.

4. Reference populations and once-only procedures

In deriving rates for procedures (such as hysterectomy and cholecystectomy) that can only be performed once in a lifetime, no attempt was made to reduce the reference population for persons who had had the operation before 1986 (see, for example, Holman & Armstrong 1987; Dickinson & Hill 1988). While it would have been preferable to do this, the number of assumptions required would have probably outweighed the advantages, especially as *variations* in rates was the primary focus of this study. By not adjusting in this way, the rates are underestimated. Some idea of the extent of the underestimate can be gained from a comparison with estimates of the number of women at risk of cervical cancer. Using the Holman and Armstrong (1987) method, it appears that only about 87 per cent of women over 15 in the population have an intact uterus.

5. Coding errors

Coding errors in source data are always possible and cannot be quantified. This applies to all the variables collected, including insurance status. Thus there is the possibility that some private patients have not been excluded from the hospital morbidity data and have therefore been double counted—serving to inflate the rates. The overall effect of coding errors is impossible to estimate. Quality control checks in the New South Wales Department of Health have found that the introduction of computerised hospital record systems has vastly improved the accuracy of coding (Gibberd 1990); however, in 1986, computerised record systems were not universal across Australia.

6. Age standardisation

Standardisation would have been more accurate had ages been grouped into smaller ranges. However, when the data were collected, confidentiality at small area level was expected to be a problem and, because the study was exploratory, it was not possible to forecast the likely 'cell sizes' had age groups been smaller. Any effect that might have resulted from the age groupings is considered very minor.

7. Mapping difficulties

There was only one significant problem in their mapping of the selected procedures across the two coding systems, and this related to hip replacement. Adjustment for hip replacements in Medicare data because of incompatible mappings were based on public rather than private hospital patterns. Since hospital morbidity data suggests that hip replacements are more frequently performed in public rather than private hospitals, the formula used to modify the Medicare data would tend to overestimate the incidence in the private sector.

8. Year of study

The Census year 1986 was chosen as the reference year for the study in order to maximise the reliability of the population data. It was also the first year after the initial mappings were prepared for which hospital morbidity data were available. There were also

no major problems in the delivery of hospital services in that year as there had been in 1985 when a protracted dispute between the Federal Government and the procedural specialists occurred. However, it is possible that some of the rates are affected by the dispute because of backlogs in patients awaiting elective surgery. This would serve to elevate the rates of some of the procedures examined here.

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