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Time trends and geographical variation in hospital re-admissions for asthma

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Summary

Hospital re-admission rates are an indicator of the quality of health-care provision and have important implications for policy makers and health care planners.

This report examines the overall rate of re-admissions for asthma within 28 days in Australia, looking at time trends and differences according to age, sex, socioeconomic status and remoteness of residence.

Data was obtained from the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database. Record linkage analysis was used to identify re-admissions for asthma and the effect of sociodemographic factors were estimated using logistic regression.

Nationwide (excluding Queensland, data for which was not included in this report) re-admission rates for asthma remained stable between 1996–97 and 2004–05. The rate of re-admissions for asthma increased as the level of socioeconomic status decreased and varied by remoteness of residence.

These findings have implications for assessing health system performance in relation to asthma and suggest the need for further research using sub-state analysis of re-admission rates for asthma.

Background

Rates of admission to hospital are widely cited as an important indicator of health-care utilisation. However, they are an ambiguous indicator reflecting both the need for hospital care and the availability, or accessibility, of hospital care. Differences or changes in hospital admission rates cannot readily be interpreted and policy implications may be unclear. For example, a decline in hospitalisation rates over time might reflect improved disease control, and hence less need for hospitalisation, or alternatively, it may reflect closure of a hospital or a change to a more restrictive admission policy.

In order to interpret data on hospital utilisation in an unambiguous manner, it is necessary to have an indicator that is not influenced by the availability, accessibility or supply of beds.

Re-admission to hospital within a short period after previous discharge is an indicator of the quality of care. It is independent of accessibility of hospital care and underlying disease severity. This is because the denominator for this indicator is the number of people admitted to hospital and the numerator is the number of people re-admitted to hospital. Accessibility of hospital care affects the numerator and the denominator equally.

Other factors, such as underlying disease severity and propensity to require more frequent hospital care, also affect both the risk of initial admission (the denominator) and the risk of re-admission (the numerator) and hence this index is also independent of disease severity. Re-admission rates, at least in theory, are a good indicator of health system performance that can be unambiguously interpreted.

Re-admissions for asthma can be considered an indicator of health system performance in relation to the management of patients with asthma. Both inpatient care during the preceding hospital stay, and community-based care after discharge, may influence the likelihood of re-admission. There is empirical evidence to support the use of re-admissions as an indicator of health system performance.

A meta-analysis found that early re-admission to hospital is related to the quality of inpatient care (Ashton et al. 1997). In one review, between 9% and 48% of re-admissions were associated with evidence of substandard care during hospitalisation (Benbassat & Taragin 2000).

Programs to improve asthma care in the hospital or emergency department result in reduced hospital re-admissions (Blais et al. 1998; Madge et al. 1997; Mayo et al. 1990; Sin & Tu 2001; Wesseldine et al. 1999). As noted above, re-admission to hospital for asthma is related not only to the quality of care in hospital (Slack & Bucknall 1997) but also to the quality of care in the community (Sin et al. 2002). This is in particular in relation to care by the patient's general practitioner or specialist (Homer et al. 1996).

Increased hospital admissions and re-admissions are associated with:

- the absence of an asthma action plan (Adams et al. 2002; Farber 1998)
- not using inhaled steroids (Farber 1998; Pollack et al. 2002)
- discontinuity of care (Wakefield et al. 1997).

Re-admission rates are a useful indicator of the quality of care for asthma. However, as it is difficult to partition the responsibility for re-admissions between sectors, the re-admission rate should be considered as an indicator of the quality of care for patients with asthma across the whole health-care system.

Re-admissions data for asthma in New South Wales and Victoria have previously been reported by the Australian Centre for Asthma Monitoring (ACAM) (ACAM 2005; Correll et al. 2007; Ringland et al. 2006). In these two states, between 2000–01 and 2002–03, approximately 5% of people who were admitted to hospital for asthma were re-admitted for asthma and a further 2% visited an emergency department for asthma within 28 days, but were not admitted (ACAM 2005).

In addition, Correll et al. found those more likely to re-attend a hospital or emergency department for asthma were:

- females (Odds Ratio (OR) 1.09; 95% Confidence Interval (CI) 1.03–1.14)
- people who lived in areas of greater socioeconomic disadvantage (OR 1.20, 95% CI 1.12–1.29)
- Indigenous people (OR 1.15, 95% CI 1.00–1.32).

The lowest rate of re-attendance for asthma occurred among those aged 5 to 14 years and the rate differed with age ($P < 0.001$).

Here we present similar data on re-admissions for asthma within 28 days for all states and territories (except Queensland).

Objectives

The objectives of this investigation were to:

- examine the overall rate of re-admissions for asthma in Australia
- look at time trends in re-admissions for asthma, and differences according to age, sex, socioeconomic status and remoteness of residence.

Methods

Data source

An extract of public and private hospitalisations data was obtained from the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database in June 2008.

New South Wales, the Australian Capital Territory, Victoria, South Australia, Western Australia, and Northern Territory agreed to release the data for the purposes of our analysis.

The extract contained hospitalisation data where the principal diagnosis was asthma (International Statistical Classification of Diseases and Related Health Problems—Tenth Revision—Australian Modification (ICD-10-AM) code J45 or J46) from states and territories in this analysis from the period July 1996 to June 2005.

Ethics approval for the conduct of this analysis was obtained from the University of Sydney and the AIHW. The application stipulated that there would be no small area analysis. Hence, no small area data are presented in this report.

Record linkage

In the National Hospital Morbidity Database, hospital admissions are identified as 'separations'. The term 'hospital separation' refers to the formal process by which a hospital records the completion of treatment or care for an admitted patient. This includes completion due to discharge, death, transfer to another hospital or change in the type of care. Therefore, each episode of care for an admitted patient may include more than one separation, and each separation would appear as a separate record in the data.

For the purposes of this analysis it was important not to count episodes of transfer of care as re-admissions. To achieve this, we excluded cases for which the date of separation matched the date of commencement of the next record for an individual, from our definition of 're-admissions'. In these cases we assumed that the separation actually referred to a change in the type of care or transfer to another hospital. It is possible that, in some cases, the individual could have been discharged and then re-admitted later that same day. However, it is reasonable to consider these patients to be continuing with the same episode of care and not having been 're-admitted'.

We identified hospital episodes of care from the same individuals using record linkage analysis. Date of birth, sex and statistical local area (SLA) were used as linkage keys. Using this method, it can be expected we would capture approximately 96% of re-admissions for asthma identified using an optimal linkage strategy with all available identifiers (Ringland et al. 2006). We have previously shown that linkage strategies based on date of birth, sex and SLA have a higher sensitivity than those based on date of birth, sex and postcode (Ringland et al. 2006).

Re-admission for asthma within 28 days

Re-admissions for asthma within 28 days were defined as hospital admissions for asthma (principal diagnosis = ICD-10-AM code J45 or J46) which occurred within 28 days of the date of separation of the preceding hospitalisation for that individual.

Based on these criteria, each individual within the database was classified as being re-admitted, or not being re-admitted, to hospital for asthma within 28 days.

Re-admission rates were calculated using the number of individuals who were re-admitted to hospital for asthma within 28 days of separation as the numerator, and the total number of individuals who were hospitalised for asthma as the denominator.

The effect of age group, sex, socioeconomic status and remoteness as potential risk factors for re-admission was estimated using logistic regression and expressed as odds ratios (with 95% confidence intervals). See 'Glossary' for a detailed explanation of these statistical terms.

Socioeconomic status

We used the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socioeconomic Disadvantage (IRSD) to describe socioeconomic status according to residential location. This represents one of four indexes developed by the Australian Bureau of Statistics (ABS) to measure socioeconomic characteristics associated with geographical locations (ABS 2006) based on information from the Australian census. Each index summarises information relating to a variety of social and economic characteristics associated with families and households, personal education qualifications and occupation.

The SEIFA index provides a summary score for a range of key socioeconomic variables that are related to health status, including household income and resources, education, occupation, fluency in English, and Indigenous status. The index is constructed so that areas of relatively high socioeconomic status have high index values.

Individual records were classified into quintiles of socioeconomic status according to the SEIFA value associated with the statistical local area of usual residence of the individual. Quintile 1 (SEIFA 1) include the households of lowest socioeconomic status and quintile 5 (SEIFA 5) include the households of highest socioeconomic status.

It is important to note that the index reflects the relative socioeconomic status of all people living in an area, not an individual. Therefore, this measure may underestimate the true inequality in health at the individual level.

The effect of socioeconomic status on risk of re-admission was quantified by logistic regression, with SEIFA quintiles included as a scaled numerical explanatory variable adjusted for remoteness, age group, gender and state.

Remoteness of residence

Access to health and education services plays an important role in the successful management of asthma. We have used the Australian Standard Geographical Classification (ASGC) of remoteness to identify individuals from urban, rural and remote areas of Australia (excluding Queensland) according to their SLA of residence (ABS 2001).

The ASGC of remoteness is based on the Accessibility/Remoteness Index of Australia (ARIA), which measures remoteness solely on the basis of geographical accessibility, and excludes urban/rural, socioeconomic and population size factors (ABS 2001). This index can be applied to any location in Australia. It is based on physical geography, whereby locations are classified on the basis of their proximity (that is, the distance people must travel on a road network) to the nearest of 738 service centres, which differ in size and, hence, in the availability of education and health services. The centres with small populations generally have a limited choice of general practitioners, specialists and hospital care.

Values of remoteness for populated localities are calculated by measuring the shortest road distance between a locality and the nearest of each of five different categories of service centres. Each of the populated localities across Australia has been assigned an ARIA index score to assess their remoteness from goods, services and opportunities for social interaction. For full methodology, see ABS 2001.

The effect of remoteness of residence on risk of re-admission for asthma was estimated using logistic regression with ASGC categories of remoteness included as a scaled explanatory variable adjusted for SEIFA, age group, gender and state.

Results

Between July 1996 and June 2005, there were 347,579 hospital separations with a principal diagnosis of asthma from hospitals located in all states and territories of Australia, excluding Queensland. Of these, approximately 99.45% (345,679 records) had every element of the linkage key (sex, date of birth and SLA) available.

We excluded records because:

- the state of residence of a person at admission or re-admission was Queensland (1,508 records; 0.4%)
- the coding of sex was not male or female (3 records; 0.0009%)
- the date of subsequent admission was before the date of previous separation for an apparent individual (386 records; 0.1%)
- the date of separation matched the date of the next record for an individual (8,321 records; 2.4%).

All analyses were performed on the 335,461 admissions remaining after these exclusions. The distribution of these admissions over time is shown in Table 1. This confirms the decreasing trend in hospitalisations for asthma since the 1990s (ACAM 2008).

Table 1: Number of hospitalisations for asthma by year, all states and territories except Queensland, 1996–97 to 2004–05

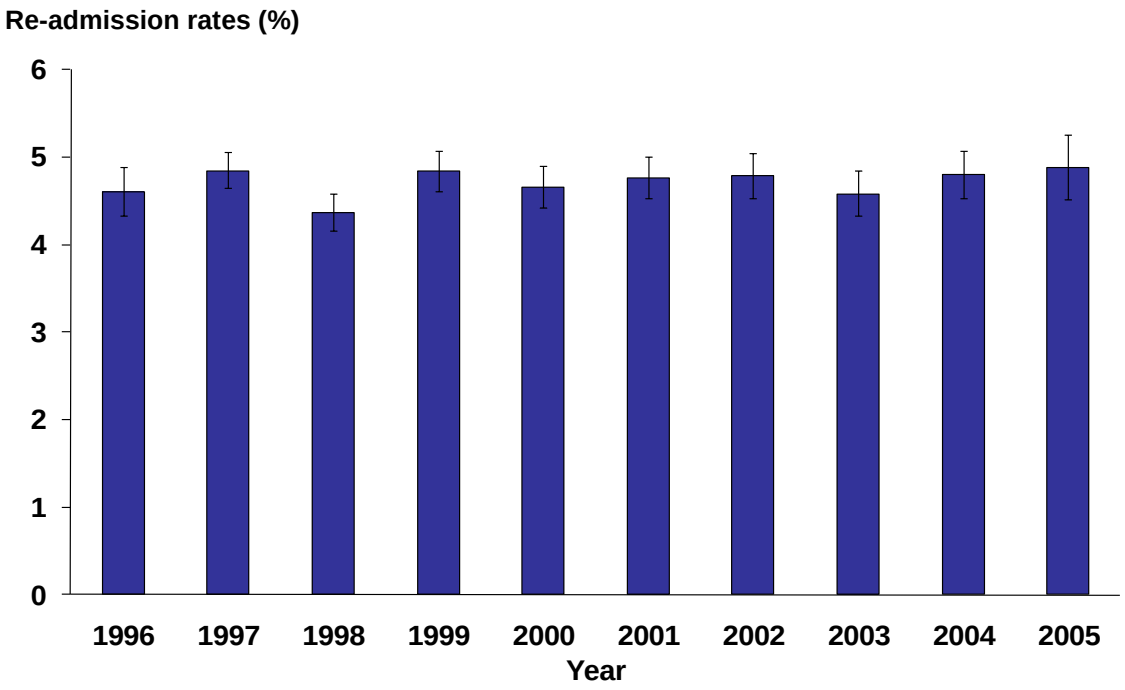
Year	Number of hospitalisations for asthma
1996 (July–December)	25,322
1997	50,163
1998	41,877
1999	41,147
2000	35,936
2001	36,847
2002	30,724
2003	30,057
2004	28,402
2005 (January–June)	14,986
1996–97 to 2004–05	**335,461**

Note: Data from all states and territories except Queensland are included.

The 335,461 admissions for asthma during the period 1996–97 to 2004–05 occurred in 287,924 individuals. Among these individuals, 13,551 (4.71%) were re-admitted to hospital for asthma within 28 days.

Time trends in re-admissions for asthma

There was little fluctuation in the rate of re-admissions for asthma over the period 1996–97 to 2004–05 (Figure 1). This contrasts with the marked decline in admissions for asthma over this period (ACAM 2008).



Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Re-admission rate	4.61%	4.85%	4.37%	4.84%	4.66%	4.77%	4.79%	4.58%	4.80%	4.88%

Source: AIHW National Hospital Morbidity Database.

Note: For individuals to be counted in the analysis for 1996 and 2005, admissions and re-admissions for the same individual were within the study period.

Figure 1: Re-admissions for asthma within 28 days, all states and territories except Queensland, 1996–97 to 2004–05

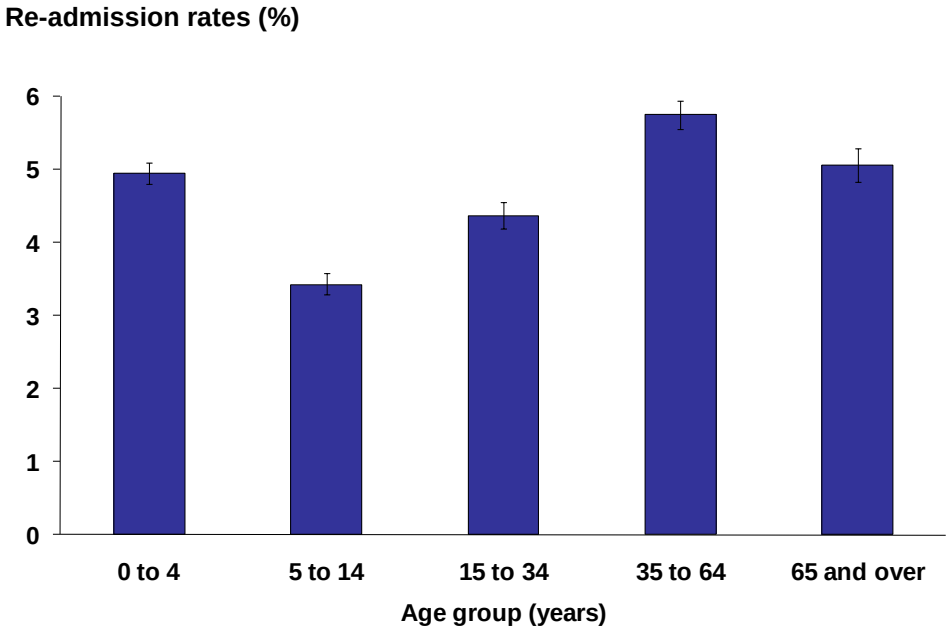
Re-admissions for asthma by population subgroups

Females had a higher rate of re-admission for asthma (4.97%) than males (4.42%) (Table 2), difference 0.55%; 95% CI 0.40% to 0.70%.

Table 2: Re-admissions to hospital for asthma, by gender, all states and territories except Queensland, 1996–97 to 2004–05

Sex	Number of re-admissions	(per cent)
Males	6,213	4.42
Females	7,338	4.97
Persons	**13,551**	**4.71**

The age distribution of re-admissions for asthma differs from that seen for admissions for asthma. Adults aged 35 to 64 had the highest rate of re-admission for asthma (5.75%) while children aged 5 to 14 years had the lowest (3.43%) (Figure 2). In contrast, children aged 0 to 4 years dominate the hospitalisations for asthma and adults have very low rates of hospitalisations for asthma (ACAM 2008).



Source: AIHW National Hospital Morbidity Database.

Figure 2: Re-admissions for asthma within 28 days by age, all states and territories except Queensland, 1996–97 to 2004–05

The rate of re-admissions for asthma increased as the level of socioeconomic status of the patient's residential locality decreased (odds ratio for lowest versus highest socioeconomic status quintile 1.18, 95% CI 1.11–1.26; p trend <0.0001) (Table 3).

Table 3: Re-admissions for asthma within 28 days by socioeconomic status, all states and territories except Queensland, 1996–97 to 2004–05

Socioeconomic status	Re-admission rate (per cent)	95% CI	Odds ratio (95% CI)
SEIFA 1 (lowest SES)	4.98	4.80–5.15	1.18 (1.11–1.26)
SEIFA 2	4.90	4.73–5.09	1.17 (1.09–1.25)
SEIFA 3	4.79	4.62–4.98	1.18 (1.11–1.26)
SEIFA 4	4.44	4.25–4.63	1.10 (1.03–1.18)
SEIFA 5 (highest SES)	4.12	3.93–4.32	1.00

Note: Socioeconomic status based on Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socioeconomic Disadvantage.

People living in *Very remote* areas were more likely to be re-admitted to hospital for asthma than those residing in *Major cities* (odds ratio 1.25, 95% CI 1.09–1.44) (Table 4).

Table 4: Re-admissions for asthma within 28 days by remoteness of residence, all states and territories except Queensland, 1996–97 to 2004–05

Remoteness category	Re-admission rate (per cent)	95% CI	Odds ratio (95% CI)
Major cities	4.67	4.58–4.77	1.00
Inner regional	4.45	4.29–4.63	0.94 (0.89–0.99)
Outer regional	4.84	4.62–5.07	0.97 (0.92–1.03)
Remote	5.25	4.76–5.79	1.04 (0.93–1.16)
Very remote	6.57	5.80–7.43	1.25 (1.09–1.44)

Note: Remoteness classified according to the Australian Standard Geographical Classification (ASGC) categories of remoteness.

Discussion

We have shown substantial variation in the risk of re-admissions to hospital for asthma. The main determinants identified in this analysis are the socioeconomic status and remoteness of patients' locality of residence. Since there is evidence that re-admission rates are an indicator of the quality of health-care, this observation has important implications.

Re-admission rates were relatively stable over the 10 year period of this analysis.

It is known that rates of hospitalisation for asthma, and indeed for all causes, are higher among people living in localities of lower socioeconomic status than those living in localities of higher socioeconomic status (ACAM 2005, 2008; AIHW 2008). This present analysis demonstrates that people living in areas of lower socioeconomic status also have the highest rates of re-admission for asthma.

While the rate of hospitalisation might be attributed to lifestyle or other factors associated with disease risk and severity, re-admissions rates are relatively independent of these factors. The reason for this is that lifestyle and severity would be expected to affect the numerator (number of re-admissions) and denominator (number of admissions) to a similar extent.

One interpretation of this finding is that people living in areas of lower socioeconomic status and in remote areas have a standard of care that leads to more re-admission, compared to those living in areas of higher socioeconomic status. The finding that the risk of re-admission for asthma is highest in those living in Very remote areas has similar implications for the assessment of the standard of health-care in remote regions.

These results imply that analysis of re-admission rates for asthma by smaller geographic units than jurisdictions may be informative. Such analyses would enable local and regional health service planners to assess health system performance in relation to asthma. Sub-state rates of re-admission for asthma can be quantified, are estimable from routinely collected data, and, using the analyses presented here, can be adjusted for local sociodemographic factors for benchmarking purposes.

Conclusions

Nationwide (excluding the participation of Queensland) re-admission rates for asthma remained stable between 1996–97 and 2004–05 and are similar to those reported previously for New South Wales and Victoria.

The socioeconomic and remoteness differences we have observed imply that sub-state analysis would be informative. This analysis would enable local and regional health service planners to assess health system performance in relation to asthma using an indicator that is benchmarked to national data, with adjustment for local sociodemographic factors including age distribution, remoteness and socioeconomic status.

Glossary

ARIA/ASGC classification	The Accessibility/Remoteness Index of Australia and Australian Standard Geographical Classification provide classification of the level of accessibility to goods and services (such as general practitioners, hospitals and specialist care) based on the proximity to these services (measured by road distance).
Confidence interval	A statistical term describing a range (interval) of values within which we can be 'confident' that the true value lies. For example, a 95% confidence interval implies that there is 95% confidence that the true value will be included in this interval.
International Classification of Diseases (ICD)	International Statistical Classification of Diseases and Related Health Problems. The World Health Organization's internationally accepted statistical classification of death and disease. The 10th Revision (ICD-10) is currently in use. In this report, hospital separations before 1998–99 and causes of death before 1997 under previous revisions have been reclassified to ICD-10. ICD-10-AM is the Australian modification of ICD-10, used for diagnoses and procedures recorded for patients admitted to hospitals.
Logistic regression	A statistical term used for prediction of the probability of occurrence of an event by fitting data to a generalised linear model. Results derived from logistic regression are expressed as odds ratios, with 95% confidence intervals.
Odds ratio	Measures the strength of an association between two variables (usually a risk factor and an outcome). Literally, the ratio of the odds of an outcome in the presence of a risk factor to the odds of that outcome in the absence of that risk factor. An odds ratio of 1 implies that there is no association between the risk factor and the outcome. An odds ratio greater than 1 indicates that those with the risk factor have a greater risk of having the outcome.
p value	The probability that the observed difference or association could have occurred by chance. If that probability is less than 5% (i.e. $p < 0.05$), it is conventionally held that it did not occur by chance and is a true difference or association.
Principal diagnosis	The diagnosis describing the problem that was chiefly responsible for the patient's episode of care in hospital.
Quintile	A group derived by ranking the population according to specified criteria and dividing it into five equal parts.

SEIFA Index of Relative Socioeconomic Disadvantage	An index of socioeconomic status which provides a summary score for a range of key socioeconomic variables that are related to health status, including household income and resources, education, occupation, fluency in English, and Indigenous status.
Statistical significance	An indication from a statistical test that an observed difference or association may be significant, or 'real', because it is unlikely to be due just to chance. A statistical result is often said to be 'significant' if it would occur by chance only once in twenty times or less often. See also *p value*.

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