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The Victorian ambulatory care sensitive conditions study: rural and urban perspectives

Summary

Objectives: Ambulatory Care Sensitive Conditions (ACSCs) are those for which hospitalisation is thought to be avoidable with the application of preventive care and early disease management, usually delivered in the ambulatory setting. This study presents detailed analyses of ACSCs as a measure of health outcome that might vary with access to primary health care in rural and urban regions of Victoria.

Method: The Victorian Admitted Episodes Dataset (VAED), and data from the Health Insurance Commission, Medical Labour Force Annual Survey, socio-economic indexes for areas, and accessibility/remoteness index of Australia were merged to identify individual and aggregate level predictors of urban/rural differentials of ACSCs. Estimates of odds ratios and 95% confidence intervals were based on random effect multi-level generalised linear models.

Results: After adjustment for age, sex, and severity of illness, significant predictors of higher admission rates of ACSCs *within* rural areas include lack of insurance, emergency admissions, higher degree of remoteness, lower population density, lower number of general practitioners/10000 population by local government area (LGA), lower number of general practitioner visits per person by LGA, and areas with lower socio-economic status, education and occupation, and economic resources.

Conclusions: This study suggests that lack of timely and effective care may have a significant impact on rates of admissions for ACSCs in rural areas of Victoria especially in lower socio-economic groups.

The concept of access to primary health care can be viewed in a variety of ways, but broadly can be defined as: the timely use of personal health services to achieve the best possible health outcomes (Millman 1993). This definition takes into account barriers to receiving care as well as the quality of the care provided. Using this definition we can ask whether the relatively poorer health outcomes of some specific population groups can be explained by problems related to access.

Several factors can impair access to primary care (Gulzar 1999). They can be: *geographic* such as distance, travel time and means of transportation; *financial* such as costs associated with health care and ability to pay; *cultural* such as language, religion and personal beliefs; and *organisational* such as availability of the right kind of care on a continuing basis for those who need it.

The test of equity of access involves determining whether there are systematic differences in the use of health services and health outcomes among groups and whether these differences result from barriers to primary care services. Increasing access to primary care in communities is hypothesised to have a positive effect on reducing hospitalisations (Starfield 1991).

Measuring access to primary care is of great interest to policy makers who wish to evaluate the impact of changes in the way health care is delivered. However, monitoring access to care is not an easy task. There is no gold standard to measure access and new approaches are constantly being developed. In the past, researchers have relied primarily on population-based surveys. With these surveys, researchers can make inferences about who is at greatest risk for lacking access to care by comparing vulnerable populations, such as low-in-

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come persons, persons in poor health, and disadvantaged populations to the rest of the population. Population-based surveys, however, are not the best instruments to examine relationships in health outcomes as they relate to access. As a result, primary care need is often assessed indirectly by using one or more social or health indicators. One such indicator is the rate of admissions to hospital for Ambulatory Care Sensitive Conditions (ACSCs) (Billings et al. 1993; Millman 1993).

ACSCs are those for which hospitalisation is thought to be avoidable with the application of preventive care and early disease management, usually delivered in the ambulatory setting (Millman 1993). In theory, timely and effective ambulatory care can help reduce the risks of hospitalisation by: preventing the onset of an illness or condition; controlling an acute episodic illness or condition; or managing a chronic disease or condition (Billings et al. 1993). This has led to the concept of *preventable or avoidable hospitalisation* as an indicator of health outcomes for the purpose of evaluating adequacy of primary care. ACSCs admission rates have also been proposed as a measure of access to primary health care (Bindman et al. 1995).

Victoria is the second largest state in Australia with a population of 4.8 million people in 2001, of which 27% live in rural and regional areas of Victoria. A mix of private and public sector providers deliver health services in Victoria. Under the national healthcare funding system (Medicare), almost 80% of general practitioner consultations are free to the patient, and there is universal access to free treatment in public hospitals. Traditionally, the self-employed local general practitioner is the first point of contact to the health system, and is responsible for coordinating the ongoing healthcare of the patient. General practitioners act as gatekeepers to specialist medical care many of which require access to hospital in-patient facilities. Patient access to such specialist services is normally provided through referrals from general practitioners. However, admitting rights to the hospitals are granted to the most senior members of the medical professions within the hospital. In rural Victoria, general practitioners experience considerable obstacles in integrating patient care through the maze of services, a problem that is exacerbated because of the disparate players in the health sector. Separate funding streams with the Australian healthcare systems are a cause of fragmentation between primary care services of general practitioners, hospitals, and specialist services. There are acute shortages of general practitioners, nurses, pharmacists, specialists, and allied health workers in rural Victoria (Wilkinson & Symon 2000). In addition, many marginalised or mino-rity groups in rural and regional Victoria often experience significant difficulties in accessing primary care services.

The Victorian ACSCs study offers a new set of indicators describing differentials and inequalities in access to the primary health care system in Victoria (Ansari 2001; Ansari et al. 2001 a; Ansari et al. 2001 b). Although significant rural and urban differentials for ACSCs admission rates have been previously published, little is known about the health effects of variations in access to primary health care in rural Victoria (Ansari et al. 2000; Schreiber & Teresa 1997; Silver et al. 1997). The purpose of this paper is to present detailed analyses of ACSCs as a measure of health outcome that might vary with access to primary care in rural and urban settings in Victoria. More specifically, this paper describes (i) trends in variations of ACSCs admission rates between rural and urban Victoria; and (ii) reasons for these variations, i.e., individual and aggregate level predictors of ACSCs admissions in rural Victoria.

Methods

Data were obtained at both the individual-level and ecologic (small area)-level

Individual-level data

Hospital separation data were obtained from the Victorian Admitted Episodes Dataset (VAED). The VAED is a minimum dataset containing data on all admitted patient activity submitted by all public and private acute hospitals, including acute facilities in rehabilitation and extended care institutions and day procedure centres (Acute Health Division 2001).

Clinical data are stored as ICD-9-CM codes in 12 diagnosis and procedure fields in the VAED (National Coding Centre (NCC) 1995). The ACSCs identified using the ICD-9-CM codes were based on the published literature (Millman 1993; Weissman et al. 1992). The VAED records were selected based on diagnosis fields and some exclusions were made based on procedure fields (Appendix).

A binary outcome variable of ACSCs was created based on the presence or absence of individual conditions identified in the Appendix. Co-morbidities were identified by the Charlson index using ICD-9-CM codes in any of the diagnosis fields (Charlson et al. 1987; Deyo et al. 1992). The Charlson co-morbidity score is an index for measuring severity of illness using routine databases such as the VAED. The other individual level variables used in the analysis were age, sex, insurance status and type of admission (emergency, non-emergency).

Aggregate-level data

The aggregate-level data were obtained from information on local areas. The definition of local area selected for analysis was the Statistical Local Area (SLA) using the codes and boundaries defined by the Australian Bureau of Statistics (ABS) as used in the 1996 Australian Census of Population and Housing. SLAs are exact aggregations of Census Collection Districts (the smallest area for which Census data are available) and combine together to form precise Local Government Area (LGA) boundaries. There are 200 SLAs which make up 78 LGAs. SLA based locality information on individuals was derived from the VAED using patients' usual address.

Socio-economic indexes for areas (SEIFA)

The ABS compiled SEIFA from individual census variables aggregated at the local area level (Australian Bureau of Statistics 1996). SEIFA are measures of the social and economic status of individuals derived from a principal components analysis of variables from the 1996 Australian Census of Population and Housing summarised at a local area level (the smallest area being the Census Collection District). The SEIFA indices have been standardised to have a mean of 1000.0 across all Census Collection Districts with a standard deviation of 100.0. The following SEIFA indices were used in this study:

Index of relative socio-economic disadvantage (IRSED)

The IRSED is derived from summing multiple weighted variables relating to education, occupation, non-English speaking background, and indigenous origin and the economic resources of households. The higher the value of IRSED, the less disadvantaged the area is compared to others.

Index of economic resources

This index reflects the economic resources of the families within the areas. A higher score on this index indicates that the area has a higher proportion of families on high incomes, a lower proportion of low income families, more households purchasing or owning dwellings and living in large houses.

Index of education and occupation

This is designed to reflect the educational and occupational structure of communities. An area with a high score on this index would have a high concentration of persons with higher education or undergoing further education, with people being employed in the higher skilled occupations, rather than being labourers or unemployed.

Medical labour force data

The Medical Labour Force Annual Survey (1998) provided information about the number of medical practitioners in Victoria by postcode of practice location. Details of the survey have been described in earlier publications (Australian Institute of Health and Welfare 1999). For the purpose of this study, information was obtained on general practitioners. The number of general practitioners (GPs) per 10000 population in each LGA was calculated for further analysis.

Health insurance commission (HIC) data

The HIC provided data on the number of GP visits (consultations) occurring in Victoria by postcode. Number of GP visits per person (by LGA) was calculated for further analysis.

Accessibility/remoteness index of Australia (ARIA)

The ARIA provides a measure of the relative accessibility and remoteness of Victorian local areas for the study (Hugo et al. 1999). ARIA uses a database of road, locality and service information to provide an objective measure of remoteness (defined as lack of accessibility to services regarded as "normal" in urban areas). When applied to Victorian SLAs this index varies from less than 1.84 (highly accessible – relatively unrestricted accessibility to a wide range of goods and services) to between 3.51 and 5.80 (moderately accessible – significantly restricted accessibility of goods, services and opportunities for social interaction).

Population density

This variable was based on the ratio of the population in each LGA to the area of that LGA (square km).

Rural/urban variable

An additional variable directly derived from SLA was urban/rural location based on the nine Department of Human Services Health Regions in Victoria (four urban and five rural) with boundaries aligned with LGAs.

Coding of variables (table 1)

The outcome variable was ACSCs (0 = no, 1 = yes). The coding of other individual and aggregate variables is shown in Table 1. Aggregate variables were coded in quintiles (five groups each comprising one fifth of the population). Quintiles of SEIFA indices were based on population distribution of Victoria. In rural Victoria, there were no areas in the first quintile (the least socioeconomically disadvantaged) of IRSED and Index of economic resources, resulting in the next category (IRSED = 1 and Index of economic resources = 1) being used as a reference for comparison with the most disadvantaged areas.

Table 1 Descriptive statistics associated with Ambulatory Care Sensitive Conditions (ACSCs) and Non-ACSCs in Victoria using the Victorian Admitted Episodes Dataset (VAED), 1997–98/99–00.

Characteristics	ACSCs (N = 337,909) N (%)	Non-ACSCs (N = 4 065728) N (%)
Age (years)		
0–18	61835 (18.3)	498938 (12.3)
19–34	38558 (11.4)	754426 (18.6)
35–64	95601 (28.3)	1528132 (37.6)
≥65	141915 (42.0)	1284232 (31.6)
Females	167365 (49.5)	2228824 (54.8)
Urban residence	220860 (64.8)	2964801 (72.5)
Insured	84762 (25.1)	1308882 (32.2)
Emergency admissions	206159 (61.0)	795989 (19.6)
Charlson's index of co-morbidity		
0 (0)	150673 (44.6)	2848474 (70.1)
1 (1)	99450 (29.5)	370117 (9.1)
2 (2)	43238 (12.8)	548722 (13.5)
3 (3–12)	44448 (13.2)	298415 (7.3)
Quintiles of accessibility remoteness index of Australia		
0 (≤ 0.25)	55978 (16.6)	793627 (19.5)
1 (0.26–0.45)	61361 (18.2)	833710 (20.5)
2 (0.46–0.50)	57319 (17.0)	749990 (18.4)
3 (0.51–0.89)	73887 (21.9)	890982 (21.9)
4 (0.90–4.66)	89364 (26.4)	797419 (19.6)
Quintiles of population density		
0 (≤ 27.08)	86125 (25.5)	778315 (19.1)
1 (27.09–223.25)	66998 (19.8)	785424 (19.3)
2 (223.26–1144.99)	57113 (16.9)	725672 (17.8)
3 (1145.00–2116.62)	57230 (16.9)	779461 (19.2)
4 (≥2116.63)	70443 (20.8)	996856 (24.5)
Quintiles of index of relative socio-economic disadvantage		
0 (≥1064.69)	46909 (13.9)	694738 (17.1)
1 (1027.54–1064.68)	54229 (16.0)	743302 (18.3)
2 (994.02–1027.53)	95366 (28.2)	1018712 (25.1)
3 (968.56–994.01)	84720 (25.1)	928366 (22.8)
4 (≤968.55)	59769 (16.8)	704914 (16.7)
Quintiles of index of education and occupation		
0 (≥1079.84)	58495 (17.3)	851665 (20.9)
1 (1016.88–1079.83)	42452 (12.6)	607702 (14.9)
2 (978.94–1016.87)	94324 (27.9)	1086306 (26.7)
3 (945.79–978.93)	95549 (28.3)	958703 (23.6)
4 (≤945.78)	47089 (13.9)	561352 (13.8)
Quintiles of index of economic resources		
0 (≥1065.27)	49479 (14.6)	733394 (18.0)
1 (1027.36–1065.26)	58220 (17.2)	797846 (19.6)
2 (990.78–1027.35)	89002 (26.3)	1092929 (26.9)
3 (964.17–990.77)	88702 (26.3)	907565 (22.3)
4 (≤964.16)	52506 (15.5)	533994 (13.1)
Quintiles of number of GP/10000 population (by LGA)		
0 (≤8.70)	72617 (21.5)	778243 (19.1)
1 (8.71–10.10)	67668 (20.0)	796298 (19.6)
2 (10.11–12.52)	64024 (18.9)	694811 (17.1)
3 (12.53–14.41)	48847 (14.5)	653715 (16.1)
4 (≥14.42)	84753 (25.1)	1142661 (28.1)
Quintiles of Number of GP visits per person (by LGA)		
0 (…3.91)	80801 (23.9)	792137 (19.5)
1 (3.92–4.66)	65998 (19.5)	768361 (18.9)
2 (4.67–5.38)	51415 (15.2)	675630 (16.6)
3 (5.39–5.85)	59179 (17.5)	791684 (19.5)
4 (≥5.86)	80516 (23.8)	1037916(25.5)

Data analysis

Population-based ACSCs admission rates

Data from 1993–1994 to 1999–2000 were used in this analysis. Prior to 1993, not all hospitals were contributing to the database and this year also coincided with the introduction of case-mix funding for hospitals. Population figures by gender and five-year age groups were obtained by using the annual estimated resident population (ERP) figures produced by the Australian Bureau of Statistics (ABS) and were used for calculating admission rates and 95% confidence intervals (CI). Admission rates were age and sex standardised (direct method) using the 1996 Victorian population as the reference. 95% CIs for the standardised rates were based on the Poisson distribution.

Multivariable analysis

As the data had individual and aggregate level variables, we used random effect multi-level generalised linear models to identify the influence of theses variables on ACSCs (Snijders & Bosker 1999). These models were fitted using the command GLLAMMs (Generalised Linear Latent And Mixed Models) in STATA (Rabe-Hesketh et al. 2001a; Rabe-Hesketh et al. 2001b). These models took into account the nesting of subjects within LGAs. Initially a univariate model was fitted to identify rural and urban differences in ACSCs. To examine if these rural and urban differences in ACSCs persisted after adjusting for various confounders, we fitted several random effects multi-level models for estimating adjusted odds ratios (OR_{adj}). Three models are reported; model 1 identifies the impact of rural/urban differences in ACSCs after accounting for the influence of age, gender, and severity of illness; model 2 reports OR_{adj} after making allowance for all the above variables plus number of general practitioners/10000 population (by LGA); and model 3 includes all the above variables plus the IRSED. The predictors of ACSCs in rural Victoria were further examined using random effects multi-level

Table 2 Descriptive Characteristics: Study Variables by Urban-Rural Groups

Variable	Urban (N=3 185 661)						Rural (N=1 217 976)					
	Mean	Median	Minimum	Maximum	Range	SD	Mean	Median	Minimum	Maximum	Range	SD
Population Density	1487.42	1344.08	1.28	3526.31	3525.03	993.92	42.38	8.68	0.55	1226.33	1225.78	69.37
Accessibility remoteness index of Australia (ARIA)	0.4512	0.4461	0.10	3.38	3.28	0.19	1.54	1.42	0.10	4.66	4.56	0.95
Index of relative socio-economic disadvantage (IRSED)	1023.92	1018.16	887.68	1133.77	246.09	58.63	992.57	989.64	927.91	1061.82	133.91	21.29
Index of economic resources	1032.09	1033.23	915.95	1139.18	223.24	49.95	973.02	971.53	936.29	1053.52	117.23	20.76
Index of education and occupation	1028.27	1010.87	906.77	1186.52	279.75	77.16	973.72	971.12	912.89	1152.99	240.09	22.33
Number of GPs/10 000 population (by LGA)	13.33	12.94	5.11	61.92	56.81	6.57	9.84	10.10	4.06	61.92	57.86	3.28
Number of GP consultations per person (by LGA)	5.47	5.39	2.47	8.99	6.52	1.04	3.96	3.88	1.30	8.99	7.69	0.88

generalised linear models. The linear relationship of the variable IRSED to the log odds of ACSCs was tested as a trend across categories, by testing the significance of a single variable coded as the category of IRSED. A similar method was used to test for trend for other aggregate variables. The statistical significance of the fit of the logistic models in describing ACSCs was assessed using likelihood ratio chi-square.

Results

During the study period there were 4403637 total admissions in Victoria, of which 337909 (7.7%) were for ACSCs. Forty two percent of the ACSCs admissions were among inpatients aged 65 and older with higher frequency (64.8%) of residence in urban Victoria (Table 1). The proportion of emergency admissions was higher for ACSCs compared to Non-ACSCs (61% vs 19.6%, $p < 0.001$). About 75% of ACSCs admissions were among the uninsured.

Figure 1 shows the variation in standardised rates of admissions for ACSCs between 1993/94 to1999/2000. The admission rates for ACSCs in Victoria increased from 20.52/1000 (20.39–20.65) in 1993–94 to 24.35/1000 (24.21–24.49) in 1999–2000. A similar increase was observed in rural and urban areas. The rates of admission for ACSCs were consistently higher in rural compared to urban Victoria over the seven year period.

Higher mean and median values for population density, number of GP/10 000 population (by LGA) and number of GP visits per person (by LGA) were observed in urban compared to rural areas (Tab. 2). Better socio-economic status in urban Victoria compared to its rural counterpart was shown by higher mean and median values for indices of socio-economic status (IRSED, Index of education and occupation, and Index of economic resources).

The variations in ACSCs admission rates between rural and urban Victoria were further examined using random effect multilevel generalised linear models (Tab. 3). ACSCs admissions were 32% more likely in rural areas compared to urban (crude OR 1.32, 95% CI 1.31–1.33). When age, sex, and severity of illness were included in model 1, rural areas still showed higher ACSCs admission rates compared to urban (OR_{adj} 1.49, 95% CI 1.47–1.51). Significant differences between rural and urban areas were still maintained with the addition of number of GP/10000 population (by LGA) in model 2 and IRSED in model 3.

The reasons for variations in ACSCs admission rates *within* rural Victoria were further examined using random effect multilevel generalised liner models (Table 4). The following strong associations were observed:

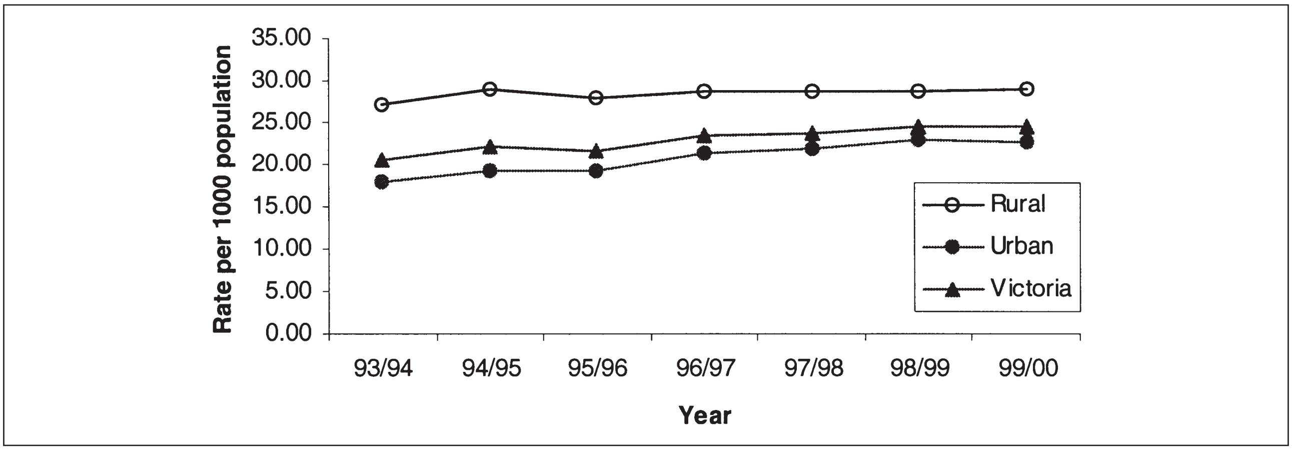

Figure 1 Total ambulatory care sensitive conditions admissions rates for rural regions, urban regions and Victoria by year

Table 3 Urban versus rural comparisons of Ambulatory Care Sensitive Conditions (ACSCs): Crude and adjusted odds ratios (OR_{adj}) and 95% confidence intervals (CI) based on random effect multi-level generalised linear models.

Characteristics	Total ACSCs (N = 337909)	Crude OR (95% CI)	Model 1[a] OR_{adj} (95% CI)	Model 2[b] OR_{adj} (95% CI)	Model 3[c] OR_{adj} (95% CI)
Urban	N = 220 860 (65.4%)	1.00	1.00	1.00	1.00
Rural	N = 117 049 (34.6%)	1.32 (1.31–1.33)	1.49 (1.47–1.51)	1.16 (1.15–1.17)	1.38 (1.36–1.40)

[a] OR_{adj} based on the model that included variables age, sex, and Charlson's index of co-morbidity; Likelihood ratio chisquare (χ^2_{LR}) for the model = 49021.60, degrees of freedom (df) = 4, p < 0.001.
[b] OR_{adj} based on the model that included variables age, sex, Charlson's index of comorbidity, and number of general practitioners (GPs) per 10000 persons (by LGA); χ^2_{LR} for the model=49585.44, df = 5, p < 0.001.
[c] OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity, number of GPs per 10 000 persons (by LGA), and Index of Relative Socio-Economic Disadvantage (IRSED); χ^2_{LR} for the model = 49731.92, df = 6, p < 0.001.

(i) being insured was associated with 24% lower rates of ACSCs admissions compared to uninsured [OR_{adj} 0.76, 95% CI (0.75–0.77)];

(ii) ACSCs were five times more likely to be emergency compared to non-emergency admissions [(OR_{adj} 5.16, 95% CI (5.10–5.23)];

(iii) the highest quintile of ARIA (highest degree of remoteness) was associated with 17% higher admission rates for ACSCs compared to the lowest quintile [OR_{adj} =1.17, 95% CI (1.14–1.21)]. For every quintile increase in accessibility and remoteness, the ACSCs admission rates increased by 13.5% (OR_{adj} for trend = 1.135, $p < 0.0001$);

(iv) the highest quintile of population density was associated with 24% lower admission rates of ACSCs compared to the lowest quintile [OR_{adj} = 0.76, 95% CI (0.74–0.78)]. For every quintile increase in population density, the ACSCs admission rates decreased by 4.3% (OR_{adj} for trend = 0.957, $p < 0.0001$);

(v) the highest quintile of number of GP/10000 population (by LGA) was associated with 21% lower admission rates for ACSCs compared to the lowest quintile [OR_{adj} = 0.79, 95% CI (0.78–0.81)]. For every quintile increase in number of GP/10 000 population (by LGA), the ACSCs admission rates decreased by 4.4% (OR_{adj} for trend=0.956, p <.0001).

(vi) the highest quintile of number of GP visits per person (by LGA) was associated with 35% lower admission rates for ACSCs compared to the lowest quintile [OR_{adj} = 0.65, 95% CI (0.64–0.67)]. For every quintile increase in number of GP visits per person (by LGA), the ACSCs admission rates decreased by 6.8% (OR_{adj} for trend = 0.932, $p < 0.0001$);

(vii) ACSCs admission rates were 40% higher in the most disadvantaged socio-economic areas compared to areas with better socio-economic status [OR_{adj} = 1.40, 95% CI (1.35–1.45)]. The ACSCs admission rates increased by 1.6% for every category increase in social disadvantage (OR_{adj} for trend = 1.016, $p < 0.0001$).

(viii) the highest quintile (most disadvantaged) of Index of Education and Occupation was associated with 48% higher admission rates for ACSCs compared to the

Table 4 Predictors of Ambulatory Care Sensitive Conditions (ACSCs) in rural Victoria (N = 1217976): Adjusted odds ratios (OR_{adj}) and 95 % confidence intervals (CI) based on random effect multi-level generalised linear models.

Variables	N (%)	OR_{adj}	Adjusted trends across categories OR_{adj} (95 % CI), P_{value}
Insured [a]	279424 (22.9)	0.76 (0.75–0.77)	
Emergency admissions [b]	318516 (26.2)	5.16 (5.10–5.23)	
Accessibility remoteness index of Australia [c]			
0	226386 (18.6)	1.00 –	
1	249930 (20.5)	0.97 (0.94–0.99)	
2	247028 (20.3)	1.18 (1.16–1.21)	
3	249830 (20.5)	1.34 (1.32–1.37)	
4	244802 (20.1)	1.17 (1.14–1.21)	1.135 (1.128–1.142), $p < 0.0001$
Population density [d]			
0	221782 (18.2)	1.00 –	
1	241640 (19.8)	1.02 (0.99–1.04)	
2	250814 (20.6)	0.92 (0.90–0.94)	
3	240840 (19.8)	0.75 (0.73–0.77)	
4	262900 (21.6)	0.76 (0.74–0.78)	0.957 (0.952–0.962), $p < 0.0001$
Number of GP/10 000 population (by LGA) [e]			
0	240041 (19.7)	1.00 –	
1	178492 (14.7)	0.89 (0.87–0.91)	
2	297051 (24.4)	0.86 (0.85–0.88)	
3	235829 (19.4)	0.91 (0.89–0.93)	
4	266563 (21.9)	0.79 (0.78–0.81)	0.956 (0.951–0.961), $p < 0.0001$
Number of GP visits per person (by LGA) [f]			
0	209059 (17.2)	1.00 –	
1	270398 (22.2)	0.79 (0.77–0.81)	
2	229179 (18.8)	0.76 (0.74–0.78)	
3	263557 (21.6)	0.83 (0.81–0.85)	
4	245783 (20.2)	0.65 (0.64–0.67)	0.932 (0.927–0.938), $p < 0.0001$
Index of relative socio-economic disadvantage [g]			
1	281527 (23.1)	1.00 –	
2	351057 (28.8)	1.28 (1.24–1.32)	
3	293176 (24.1)	1.17 (1.14–1.21)	
4	292216 (24.0)	1.40 (1.35–1.45)	1.016 (1.007–1.024), $p < 0.0001$
Index of education and occupation [h]			
0	244452 (20.1)	1.00 –	
1	256571 (21.0)	0.95 (0.85–1.08)	
2	194949 (16.0)	1.15 (1.04–1.28)	
3	270470 (22.2)	1.33 (1.20–1.49)	
4	251534 (20.3)	1.48 (1.32–1.65)	1.152 (1.140–1.165), p < 0.0001
Index of economic resources [i]			
1	288084 (23.6)	1.00 –	
2	321166 (26.4)	1.18 (1.12–1.24)	
3	307258 (25.2)	1.47 (1.40–1.54)	
4	301468 (24.8)	1.56 (1.49–1.64)	1.122 (1.109–1.134), $p < 0.0001$

[a] Reference = 0 (no insurance); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; Likelihood ratio chi-square (χ^2_{LR}) for the model = 10605.27, degrees of freedom (df) = 4 , p < 0.001.
[b] Reference = 0 (non emergency admissions); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; (χ^2_{LR}) for the model = 73619.33, df = 4, p < 0.001.
[c] Reference = 0 (least remote); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 10489.84, df = 7, p < 0.001.
[d] Reference = 0 (least population density); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 10035.09, df = 7, p < 0.001.
[e] Reference = 0 (least number of GP/10 000 population by LGA); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 9907.74, df = 7, p < 0.001.
[f] Reference = 0 (least number of GP visits per person by LGA); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 9952.00, df = 7, p < 0.001.
[g] Reference = 1 (best socio-economic status); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 10263.52, df = 6, p < 0.001.
[h] Reference = 0 (best education & occupation index); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 10122.22, df = 7, p < 0.001.
[i] Reference = 1 (best index of economic resources); OR_{adj} based on the model that included variables age, sex, Charlson's index of co-morbidity; χ^2_{LR} for the model = 10798.92, df = 6, p < 0.001.

lowest (most advantaged) [OR_{adj} = 1.48, 95% CI (1.32–1.65)]. For every quintile increase in the Index of Education and Occupation, the ACSCs admission rates increased by 15.2% (OR_{adj} for trend = 1.152, $p < 0.0001$); and

(ix) ACSCs admission rates were 56% higher in areas with lower Index of Economic Resources (most disadvantaged) compared to areas with better economic resources [OR_{adj} = 1.56, 95% (CI 1.49–1.64)]. The ACSCs admission rates increased by 12.2% for every category increase in economic disadvantage (OR_{adj} for trend = 1.122, $p < 0.0001$).

Discussion

This study reveals significant problems with hospitalisations that may be prevented with timely ambulatory care. These problems are more marked in rural compared to urban Victoria with consistently higher rates of admissions for ACSCs over the seven-year study period. Our data show that even after adjusting for various measures such as age, gender, and severity of illness, rural Victorians have an excess of hospitalisations with ACSCs admissions. Residents of rural Victoria without health insurance and those living in areas with lower socio-economic status, education and economic resources, were more likely to be hospitalised with ACSCs than residents of wealthier areas. In rural areas, the trend of continuous increase in ACSCs admissions with increasing disadvantage in socio-economic status is substantial. Social inequalities in access to primary healthcare have also been observed in the USA and New Zealand (Andrulis 1998; Begley et al. 1994; Billings et al. 1996; Billings et al. 1993; Blustein et al. 1998; Jackson & Tobias 2001; Pappas et al. 1997). In the USA, there are known variations in access to healthcare mainly due to the lack of a universal health insurance scheme (Andrulis 1998; Weissman et al. 1992). However, differences between rich and poor areas in ACSCs admission rates also exist in Canada but are less marked than most major cities in the USA (Billings et al. 1996).

Are socio-economic factors the major determinants in driving the excess rates of ACSCs admissions in rural Victoria? Variations in the likelihood of admissions for ACSCs might reflect a number of underlying mechanisms. We have attempted to minimise this via careful selection of individual conditions (Millman 1993; Weissman et al. 1992). Hospital admissions fall across a wide spectrum of preventability. Admissions for certain conditions may be considered more preventable than others. We might consider that hospital admissions for vaccine preventable diseases such as measles and diphtheria are almost completely preventable while those for complications of chronic conditions are less so. ACSCs have been chosen in this study as those that are "sensitive" to prophylactic or therapeutic interventions deliverable in a primary health care setting. However, we have not included psychiatric conditions (Iglehart 1995), care of newborn, or complications of delivery that might be avoided with improved ambulatory care. Validation studies are needed to identify the degree to which these indicators are ambulatory care sensitive.

Systematic variations in disease prevalence or incidence can contribute to observed differentials in the rates of ACSCs. As data were not available, we were unable to adjust for differences in disease prevalence in this analysis. However, in determining the magnitude of rural/urban differences, the adjustment for age, sex, severity of illness, and socio-economic status should have corrected for dissimilarities in need or demand for services in the population. We also adjusted for age, gender, and severity of illness in explaining socio-economic differentials within rural areas. The relationship between ACSCs admission rates and socio-economic status did not diminish. Although disease prevalence may explain some of our findings, it is unlikely to be the main explanation for rural/urban differences in ACSCs admission rates, and variations by socio-economic status within rural areas. This view is strengthened by the finding that disease prevalence only explained a small portion of differences in hospitalisation rates for ACSCs among low and higher income areas in the New York City (Billings et al. 1993).

Lifestyle factors, lower threshold of admissions by rural physicians, and propensity to seek care may also explain rural/urban ACSCs admission rates differentials, as well as variations by socio-economic status within rural areas (Billings et al. 1993; Silver et al. 1997). Although associations between ACSCs admission rates and lifestyle factors such as alcohol intake have been identified, the differences in ACSCs admission rates between lower and higher income areas persisted even after adjustment for lifestyle factors (Billings et al. 1993). A lower clinical threshold of rural clinicians, with a tendency to admit patients with a lower severity of illness in disadvantaged areas, may also contribute to higher ACSCs admission rates (Billings et al. 1993; Silver et al. 1997). This is an unlikely explanation for socio-economic differentials in ACSCs admissions in our study as we adjusted for severity of illness in our analyses. Some studies have reported lower propensity to seek care among rural residents (Shapiro & Roos 1985; Veitch 1995; Weinert & Burman 1994). These effects cannot be ruled out as contributing factors in causing variations in ACSCs admissions. Consistent with the observation of Schreiber et al. (1997), we found a negative association between population density and ACSCs admission rates in rural Victoria. We also observed that degree of remoteness and accessibility to services is a strong predictor of ACSCs admission rates in rural areas. It is likely that less densely populated areas are more remote and experience more access barriers and therefore have higher rates of ACSCs admissions. The inverse association between the number of GPs in the population and ACSCs admission rates suggests that remote areas appear to have fewer sources of easy-to-reach primary care. This lack of GP capacity in turn may lead to their higher admission rates of ACSCs.

Our data are subject to various caveats. As an administrative database was used to identify ACSCs, the recorded diagnoses are prone to coding errors. However, earlier studies have identified the reliability and accuracy of coding in the VAED (MacIntyre et al. 1997b). Severity of illness was measured using the co-morbidities in the diagnoses fields. Comorbidities are under-recorded in the administrative databases (Jencks et al. 1988). The evaluation of coding errors in this database supports the fact that the majority of coding errors are omissions of codes for co-morbid conditions (MacIntyre et al. 1997a). Under-recording of co-morbidities in hospital discharge data limits the effectiveness of statistical methods for eliminating case mix bias (Jencks et al. 1988).

Conclusions and policy implications

This study suggests that lack of timely and effective care may have a significant impact on rates of admissions for ACSCs in rural areas of Victoria, especially in lower socio-economic groups. These access barriers may lead to adverse health outcomes in the population and create further difficulties in the delivery of health care. The removal of disparities in health care access between higher and lower socio-economic groups through targeted public health and health services interventions will have the potential to improve health outcomes in the population and reduce demand on hospital services. The impact of these interventions can be evaluated over time through monitoring and analyses of ACSCs indicators to identify remaining gaps in the health system. However, barriers to access are complex, and further research is needed to identify the impact of geographical, financial, cultural and organisational factors that affect access to primary care in lower socio-economic groups and to understand their impact on admission rates for ACSCs.

Zusammenfassung

Die „Ambulatory Care Sensitive Conditions" Studie: Unterschiede zwischen Stadt und Land in Victoria/Australien

Fragestellung: Vorsorge und frühzeitige Krankheitsbehandlung, die normalerweise in ambulanten Einrichtungen erfolgen, sollten eine Hospitalisierung im Fall von Erkrankungen vermeiden, die grundsätzlich eine Ambulantversorgung erlauben (EGAVE). EGAVEs wurden in dieser Studie als Gesundheitsindikator analysiert, der je nach Zugang zu Einrichtungen der medizinischen Grundversorgung in ländlichen und städtischen Gebieten der Provinz Victoria/Austalien variieren kann.

Methode: Der Datensatz der Einweisungen in Spitäler in Victoria sowie Daten der Krankenversicherungskommission, der jährlichen Befragung des medizinischen Personals, der gebietsspezifischen sozio-ökonomischen Indices und des Australischen Index für Erreichbarkeit/Abgeschiedenheit wurden zusammengeführt, um jene Faktoren zu identifizieren, die das Stadt-Land-Gefälle von EGAVEs auf individuellem und gesamthaftem Niveau bestimmen. Die Berechnungen der Odds Ratios und 95%-Konfidenzintervalle basierten auf mehrstufigen verallgemeinerten linearen Modellen für Zufallsereignisse.

Ergebnisse: Nach Adjustierung für Alter, Geschlecht und Krankheitsschwere, wurden folgende signifikanten Faktoren für höhere Spitaleinweisungsraten bei EGAVEs in ländlichen Gebieten identifiziert: schlecht versichert; Notfalleinweisungen; grosse Abgelegenheit; geringere Bevölkerungsdichte; geringere Anzahl Allgemeinärzte pro 10000 Einwohner und Gemeindegebiet; weniger Hausarztbesuche pro Person und Gemeindegebiet und Gebieten mit schlechteren sozio-ökonomischen Bedingungen, Ausbildung, Beruf und Einkommensquellen.

Schlussfolgerungen: Diese Studie weist darauf hin, dass fehlende rasche und wirkungsvolle medizinische Versorgung die Einweisungsrate bei EGAVEs in ländlichen Gebieten von Victoria signifikant beeinflussen kann, vor allem für sozio-ökonomisch schlechter gestellte Gruppen.

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Résumé

L'étude victorienne des affections relevant potentiellement de la médecine ambulatoire

Objectif: Les maladies relevant potentiellement des soins ambulatoires (MRPSA) sont celles pour lesquelles l'hospitalisation serait évitable si un traitement préventif ou curatif est appliqué précocement en médecine de premier recours. Cette étude montre que les MRPSA sont un indicateur de santé qui peut varier selon que l'accès aux services médicaux de premier recours a lieu dans des régions rurales ou urbaines de la province de Victoria, en Australie.

Méthodes: Données sur des admissions, de la Commission des Assurances de Santé, des enquêtes annuelles des ouvriers médicales, des indexes socio-économiques géographiques et des indexes d'accès et isolation étaient jointes pour identifier de facteurs que prédirent des différences en MSSA. Estimes de rapports de cotes et intervalles de confiance (95 %) étaient calculées avec des modèles linéaires généralisées en plusieurs niveaux d'effet hasard.

Résultats: Après contrôler pour âge, sexe et gravité de maladie, les facteurs significants que prédirent un taux élevé d'admission pour MSSA incluent manque d'assurance, admission d'urgence, isolation, plus bas densité de population, plus bas nombre de médecins/10000 population en districts de gouvernement locale, plus bas nombre de visites au médecin par personne et districts avec plus bas circonstances socio-économiques, d'éducation, d'emploi et ressources économiques.

Conclusions: Cette étude suggère que manque de soins prompts et effectifs peut influer significativement les taux d'admissions pour MSSA en campagne de Victoria, particulièrement dans les groups plus bas socio-économiques.

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Appendix Ambulatory Care Sensitive Conditions and ICD-9 Codes Used in this Analyses
The following conditions and codes were drawn from Weissman et al 1992[a] and the Institute of Medicine 1993[b].

Category	ICD9 codes	Notes
Influenza and pneumonia	481 4870 4871 4878	In any diagnosis field
Other vaccine preventable	032 0330 0339 037 045 055 056 0703 072 3200	In any diagnosis field
Asthma	493	Principal diagnosis only
Congestive heart failure	428 40201 40211 40291 5184	Principal diagnosis only, exclude cases with procedure codes of 35 36 375 376 377 378
Diabetes complications	2501 2502 2503 2504 2505 2506 2507 2508 2509	In any diagnosis field
Chronic obstructive pulmonary disease	491 492 494 496 4660	Principal diagnosis only, 4660 only with diag2 of 491 492 494 496
Angina	4111 4118 413	Principal diagnosis only, exclude cases with procedure codes 01 to 8699
Iron deficiency anaemia	2801 2808 2809	Principal diagnosis only
Hypertension	4010 4019 40200 40210 40290	Principal diagnosis only, exclude cases with procedure codes of 35 36 375 376 377 378
Nutritional deficiencies	260 261 262 2680 2681	Principal diagnosis only
Dehydration and gastroenteritis	2765 5589	Principal diagnosis only
Pyelonephritis	5900 5901 5908	Principal diagnosis only
Perforated/bleeding ulcer	5310 5311 5312 5314 5315 5316 5320 5321 5322 5324 5325 5326 5330 5331 5332 5334 5335 5336 5340 5341 5342 5344 5345 5346	Principal diagnosis only
Cellulitis	681 682 683 686	Principal diagnosis only, exclude cases with procedure codes 01 to 8699, except 860 where it is the only listed procedure
Pelvic inflammatory disease	614	Principal diagnosis only
Ear nose and throat infections	382 462 463 465 4721	Principal diagnosis only
Dental conditions	521 522 523 525 528	Principal diagnosis only
Convulsions and epilepsy	345 7803 6426	Principal diagnosis only
Gangrene	7854	In any diagnosis field

[a] *Weissman JS, Gatsonis C, Epstein AM* (1992). Rates of avoidable hospitalisation by insurance status in Massachusetts and Maryland. JAMA *268*; 2388–94.
[b] *Millman M, ed.* (1993), Access to health care in America: report of a study by a committee of the Institute of Medicine, Division of Health Care Services. Washington DC: National Academy Press.