Pediatric ambulatory care sensitive conditions: Birth cohorts and the socio-economic gradient

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ABSTRACT

OBJECTIVES: This study examines the socio-economic gradient in utilization and the risk factors associated with hospitalization for four pediatric ambulatory care sensitive conditions (dental conditions, asthma, gastroenteritis, and bacterial pneumonia). Dental conditions, where much care is provided by dentists and insurance coverage varies among different population segments, present special issues.

METHODS: A population registry, provider registry, physician ambulatory claims, and hospital discharge abstracts from 28 398 children born in 2003–2006 in urban centres in Manitoba, Canada were the main data sources. Physician visits and hospitalizations were compared across neighbourhood income groupings using rank correlations and logistic regressions.

RESULTS: Very strong relationships between neighbourhood income and utilization were highlighted. Additional variables – family on income assistance, mother's age at first birth, breastfeeding – helped predict the probability of hospitalization. Despite the complete insurance coverage (including visits to dentists and physicians and for hospitalizations) provided, receiving income assistance was associated with higher probabilities of hospitalization.

CONCLUSIONS: We found a socio-economic gradient in utilization for pediatric ambulatory care sensitive conditions, with higher rates of ambulatory visits and hospitalizations in the poorest neighbourhoods. Insurance coverage which varies between different segments of the population complicates matters. Providing funding for dental care for Manitobans on income assistance has not prevented physician visits or intensive treatment in high-cost facilities, specifically treatment under general anesthesia. When services from one type of provider (dentist) are not universally insured but those from another type (physician) are, using rates of hospitalization to indicate problems in the organization of care seems particularly difficult.

KEY WORDS: Pediatric dental conditions; early childhood caries; physician visits; hospitalizations; birth cohorts; socio-economic gradient

La traduction du résumé se trouve à la fin de l'article.

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Appropriate care in primary care physicians' offices is presumed to prevent expensive hospitalizations for untreated conditions.[1] "Timely and effective outpatient care can help to reduce the risks of hospitalization by preventing the onset of an illness or condition, controlling an acute episodic illness or condition, or managing a chronic disease or condition"; conditions sensitive to such care have been defined as "ambulatory care sensitive" (ACS).[2,3] For example, asthma patients may benefit from structured efforts to manage their care outside of hospital.[4] Physicians may promote early childhood oral health through anticipatory guidance.[5,6]

However, socio-economic status appears to influence the ability of primary care to reduce use of hospital services. Roos et al. examined 12 ACS conditions for 1998–2001 across differing levels of neighbourhood household income in Manitoba, Canada.[7] Analyses of three major ACS conditions – asthma, congestive heart failure and bacterial pneumonia – showed those residing in the poorest neighbourhoods to have both more ambulatory visits and more hospitalizations than their higher income counterparts. "Ambulatory care (by physicians) may be more effective in preventing hospitalizations among relatively affluent individuals than among the less well off".[8]

This study focuses on children, 0–5 years old, born in urban Manitoba during fiscal years 2003–2006. Manitoba (with a 2011 population of 1.2 million) has generally ranked in the mid-range of indicators of health status, health care expenditures and education.[9] Our definition of urban (the cities of Winnipeg and Brandon) accords with provincial legislation.

This study compares rates of physician visits and hospitalizations for several ACS conditions among children of

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varying socio-economic status in an urban population with complete coverage for physician visits and hospitalizations. The relationship between socio-economic position – as measured by neighbourhood income and several other variables – and utilization is explored. The extensive list of predictors aids in understanding the factors influencing physician visits and hospitalizations. Dental conditions (the most frequent pediatric ACS condition) highlight issues associated with insurance coverage and care unrecorded in existing data systems.

METHODS

Data sources and design

The Manitoba Population Data Repository contains province-wide, routinely collected individual data over time, across space (with residential location documented every 6 months using 6-digit postal codes), and for each resident. Health variables are measured continuously from physician claims and hospital abstracts (as long as an individual remains in Manitoba).

A research registry identifies every individual resident in the province, with information on births, arrival and departure dates, and deaths created from the provincial health registry and coordinated with Vital Statistics files. Validity checks have been noted elsewhere.[7,10] Appendix A describes the various data sources.

Of 56 741 Manitoba children born during fiscal 2003–2006, 4925 (8.7%) were lost to follow-up with insurance coverage ending prior to their fifth birthday. Follow-up is comparable to that in the largest cohort studies based on primary data.[11] A total of 451 deaths were recorded, 708 cohort members could not be located, and 3809 children were specifically noted as leaving Manitoba. Mortality is concentrated in the first year of life; biases associated with migration have been shown to be minimal.[9] Selecting just those born in urban areas reduced the sample to 28 398 children. Ambulatory visits to physicians and hospitalizations related to ACS conditions from birth until the child's fifth birthday were considered. Inpatient and day surgery stays were counted as hospitalizations, with transfers noted as a single hospitalization. ACS conditions were identified according to Billings et al., Roos et al., and the Canadian Institute for Health Information.[2,7,12]

The most common ACS conditions in the sample were analyzed: dental conditions, asthma, gastroenteritis, bacterial pneumonia, severe ear-nose-throat (ENT) infections, and epilepsy. Manitoba hospital separations recorded up to 5 digits "International Classification of Diseases" ICD-9-CM diagnostic codes until March 31, 2004; after that date, up to 7 digits ICD-10 codes were used. Physician claims used the first 3 digits of ICD-9-CM diagnostic codes. The number of ACS conditions identified using 3-digit adaptations relative to full codes varied by <1%.

With most dental care not part of Canada's universal health care system, ambulatory visits to the dentist are generally not provincially funded and not captured in Manitoba's health care administrative databases. Dental visits for children of families on Employment and Income Assistance (welfare) are provincially funded but not included in the administrative database. Dental visits for First Nations children are paid for by the federal government but not captured in the data. Only ambulatory care visits to physicians for a dental-related condition are funded, captured and identified. Children requiring pediatric dental day surgery in hospital or approved surgical centres under general anesthesia are the exception. Such treatments are either covered by insurance (private or government sponsored) or paid on a fee-for-service basis. However, general anesthesia and associated hospital costs for day surgery for children <72 months of age are covered for surgery performed by a pediatric dentist.

Using an urban sample reduced the variability in access to primary care, physicians and hospitals. Urban census dissemination areas (referred to as neighbourhoods) typically ranged between 400 and 700 individuals. Assignment to income quintiles was based on residence at birth, with (2006) census areas ordered by average household income. Residential mobility in the 5 years after birth was ignored. Each income quintile contained about 20% of the population.

Models and variables

Logistic regression models examined the effects of each predictor on each dichotomous outcome (Models 1, 2 and 3 in Table 4): Y = an individual was hospitalized for one of the indicated ACS conditions. Let $Pr(Y = 1|\boldsymbol{x}) = \pi(\boldsymbol{x})$, then

$$\ln\left(\frac{\pi(\boldsymbol{x})}{1-\pi(\boldsymbol{x})}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_{2\ldots} + \beta_{26} x_{26} + \beta_{27} x_{27}$$

Multinomial logistic regression addresses prediction with more than two possible discrete outcomes.[13] A statistically significant χ^2 value (the right-hand column in Table 4) indicates that coefficients for a particular explanatory variable differ between the models compared.

Variables included in the study are noted in Table 1. Manitoba Health, Seniors and Active Living provided the data (unless otherwise indicated in Appendix A).

Research approval

This study was approved by the University of Manitoba Health Research Ethics Board and the provincial Health Information Privacy Committee.

RESULTS

Rates of visits and hospitalizations

Table 2 reports rates (in person years) of ambulatory visits and hospitalizations for ACS conditions in children by income quintiles. The numerator was the number of ACS events of interest during the 5 years. The denominator was the number of person years. Thus, the rate of ambulatory visits for asthma in the lowest quintile (Q1) was calculated as:

$$\mathrm{Q1}_{\mathrm{asthma}} = \frac{\text{asthma-related ambulatory visits of the children in income quintile Q1}}{(\text{the children in income quintile Q1}) \times 5 \text{ years}} \times 10\,000$$

Table 1. Sample characteristics used to model ACS hospitalizations-(2003–2006 urban Manitoba birth cohorts 1–4 years old)

Variable	Percentage/mean*
ACS hospitalization type	
No ACS hospitalization	92.18
Dental conditions	5.88
Asthma	0.86
Gastroenteritis	0.36
Bacterial pneumonia	0.72
Group†	1.94
Income quintile	
Q1 (lowest)	25.74
Q2	21.62
Q3	19.08
Q4	18.14
Q5 (highest)‡	15.42
Employment and income assistance at birth	
Yes	16.97
No‡	83.03
Large for gestational age	
Not large‡	86.64
Large	13.36
Continuity of care	
Low users‡	42.72
No	20.80
Yes	36.48
No. of visits to general practitioners*	1.86
No. of visits to pediatricians*	1.96
No. of visits to specialist physicians*	0.28
Sex	
Male	51.34
Female‡	48.66
Mother's age at first birth (years)	
12 ≤ 15	0.49
16 ≤ 17	2.45
18 ≤ 19	5.36
20 ≤ 21	6.84
22 ≤ 23	7.96
24 ≤ 25	9.63
26 ≤ 29	25.00
30 ≤ 34‡	28.45
35 ≤ 39	11.58
40+	2.24
Breastfeeding initiation in hospital	
Breastfed‡	84.61
Not breastfed	15.39
Marital status	
Single parent	11.74
Married‡	76.02
Unknown	12.25
Fiscal year of birth	
2003	24.88
2004	23.96
2005	25.40
2006‡	25.76

Note: $N = 26\,374$ children.
* The mean for the number of visits to general practitioners/pediatricians/specialists and the percentage of children in each category for the categorical variables are reported.
† *Group* represents asthma, gastroenteritis and bacterial pneumonia grouped for use in the logistic model.
‡ Reference category for odds ratios.

Rates of physician ambulatory visits varied more across conditions than did hospitalization rates. The highest ambulatory visit rates (column "overall" in Table 2) were for severe ENT infections, asthma and gastroenteritis. Dental conditions, bacterial pneumonia and asthma showed the highest hospitalization rates. In order to have sufficient cases for the subsequent regression analyses, the ACS conditions were divided into: dental conditions (74.6% of the hospitalizations) and the *group* including cases of asthma (11.4%), gastroenteritis (4.7%) and bacterial pneumonia (8.3%) (Tables 1–3). Epilepsy and severe ENT infections recorded the lowest rates; epilepsy diagnoses were least frequent among ambulatory visits. Both ambulatory visit and hospitalization rates were highest in the poorest neighbourhoods (income quintile Q1) across all ACS conditions. The Q1/Q5 ratio highlights the rate differences among poor and rich neighbourhoods. The largest differences in ambulatory visits were for: dental conditions (Q1/Q5 ratio of 3.70), epilepsy (2.10) and gastroenteritis (2.08). A child in a Q1 neighbourhood averages 3.7 times as many physician ambulatory visits for dental conditions as a child residing in a Q5 neighbourhood. Among hospitalizations, the highest Q1/Q5 ratios were for: dental conditions (7.90), bacterial pneumonia (6.49) and severe ENT infections (2.78). Two measures – severe ENT infections and epilepsy – were not included in the regressions because of very low rates.

Primary care and hospitalizations

The ratio of ambulatory visits per hospitalization across conditions by income quintile reflects both the prevalence of the condition and the disease (Table 3). Visit rates per hospitalization varied markedly with the lower ratios noted in the lower quintiles. Care for severe ENT infections was mainly ambulatory (1617 visits per hospitalization). Dental conditions had the lowest ratio of physician ambulatory visits per hospitalization.

The year prior to the initial ACS hospitalization was also examined, looking at both all visits and those having the same diagnosis as the hospitalization. Numbers of ACS hospitalizations with diagnoses of asthma, gastroenteritis or bacterial pneumonia among children in Q5 neighbourhoods were *grouped* together as too few to support separate analyses. Differences in Q1/Q5 ratios were small for both dental conditions and the *group* ACS conditions.

Spearman rank correlations using 20 roughly equally-sized areas were calculated, with neighbourhood income as one variable and rates of visits and hospitalizations as the other. Visit rates were higher in the poorer areas. These correlations were high and negative both for dental conditions (−0.98 for visits and −0.97 for hospitalizations) and for the *group* conditions (−0.94 for visits and −0.95 for hospitalizations). Medical visits per hospitalization were highest in the more affluent areas; rank order correlations were 0.92 for dental conditions and 0.83 for the *group* conditions.

Logistic regression models

Of the sample of 26 374 children in Model 1, 7.8% had one or more ACS hospitalizations at ages 1–4 years. Only the first ACS hospitalization for each child was included; 10.2% had two or more such hospitalizations. Table 4 presents several logistic models of the probability of an ACS hospitalization at ages 1–4 years. Model 2 (dental) includes only children with dental ACS hospitalizations and those without ACS hospitalizations. Model 3 (*group*) includes only children with three other ACS hospitalizations (asthma, gastroenteritis and bacterial pneumonia) and those without ACS hospitalizations.

Given the much larger *N* for dental conditions, Model 1 involving the entire sample and Model 2 for just the dental conditions were very similar. Model 2 highlighted a regular relationship between income and the hospitalization (yes/no) measure, with the lowest income quintile (Q1) showing a dramatically larger odds ratio (4.23). For the *grouped* ACS

Table 2. Rates (per 10 000 person years) of ambulatory visits and hospitalizations (2003–2006 urban Manitoba birth cohorts, 0–4 years old)

ACS conditions	Income quintile*					Overall	Q1/Q5	95% CI‡
	Q1	Q2	Q3	Q4	Q5			
Ambulatory visits								
Dental conditions	639.14	372.88	299.80	226.63	172.68	370.38	3.70	3.32–4.12
Asthma	1524.94	1330.39	1338.38	1256.75	1092.28	1332.14	1.40	1.33–1.47
Gastroenteritis	1057.24	764.05	655.34	618.46	508.91	753.36	2.08	1.95–2.23
Bacterial pneumonia	322.98	313.73	287.61	289.60	269.07	299.88	1.20	1.09–1.34
Group†	*2905.16*	*2408.17*	*2281.33*	*2164.81*	*1870.26*	*2385.38*	*1.55*	*1.50–1.61*
Severe ENT infections	12 426.00	10 802.29	11 064.80	10 399.61	9898.58	11 059.65	1.26	1.23–1.28
Epilepsy	33.52	33.01	21.78	32.65	15.99	28.31	2.10	1.43–3.19
Hospitalizations								
Dental conditions	281.55	105.56	81.23	50.15	35.63	125.57	7.90	6.37–10.34
Asthma	38.16	22.88	26.58	17.10	15.99	25.42	2.39	1.71–3.58
Gastroenteritis	17.99	14.71	12.18	8.94	10.05	13.31	1.79	1.19–2.98
Bacterial pneumonia	50.42	26.14	12.92	18.66	7.77	25.71	6.49	4.24–12.00
Group	*106.57*	*63.73*	*51.69*	*44.70*	*33.81*	*64.44*	*3.15*	*2.47–4.19*
Severe ENT infections	11.45	5.56	7.02	3.89	4.11	6.83	2.78	1.47–∞
Epilepsy	7.63	6.86	3.32	3.89	4.11	5.42	1.86	0.96–4.92

Note: Overall $N = 28\,398$ children.
* Q1 was the lowest neighbourhood income quintile and Q5 the highest. The Q1/Q5 ratio was generated from rates without rounding off to two decimal places. Only 9 hospitalizations for those in the Q5 category were recorded for severe ENT (ear-nose-throat) infections and for epilepsy. A table presenting the *N* in each cell is available on request.
† *Group* represents asthma, gastroenteritis and bacterial pneumonia grouped for later use in the logistic model.
‡ 95% confidence intervals for Q1/Q5 were generated from 1000 bootstrap replications per ACS condition. We randomized over the medical claims (or hospitalizations) from the sample, including only the ACS condition of interest, such that the overall rate for each ACS condition stayed constant across bootstrap replications. Conditions with fewer cases have skewed histograms (for the distribution of Q1/Q5) and wider confidence intervals.

Table 3. Ambulatory visits per hospitalization for ACS conditions (2003–2006 urban Manitoba birth cohorts, 0–4 years old)

	Income quintile							
	Ratio of visit rates (V) to hospitalization rates (H)							
	Q1* V/H	Q2 V/H	Q3 V/H	Q4 V/H	Q5 V/H	Overall V/H	Q5 V/H versus Q1 V/H	95% CI‡
ACS conditions								
Dental conditions	2.27	3.53	3.69	4.52	4.85	2.95	2.13	1.68–2.87
Asthma	39.96	58.16	50.35	73.48	68.31	52.40	1.71	1.21–2.58
Gastroenteritis	58.77	51.95	53.79	69.17	50.64	56.60	0.86	0.56–1.46
Bacterial pneumonia	6.41	12.00	22.26	15.52	34.65	11.67	5.41	3.49–10.25
Group†	*27.26*	*37.79*	*44.14*	*48.43*	*55.32*	*37.02*	*2.03*	*1.60–2.70*
Severe ENT infections	1085.52	1944.26	1577.31	2675.28	2407.53	1619.04		
Epilepsy	4.39	4.81	6.55	8.40	3.89	5.22	0.89	0.42–2.53

Note: $N = 28\,398$ children.
* Q1 represents the lowest neighbourhood income quintile.
† *Group* represents asthma, gastroenteritis and bacterial pneumonia grouped for later use in the logistic model.
‡ 95% confidence intervals for the ratio (Q5 V/H versus Q1 V/H) were generated from 1000 bootstrap replications per ACS condition. Conditions with few hospitalizations in the highest income quintile, Q5, have skewed histograms (for the distribution of Q5/Q1) and wider confidence intervals.

hospitalizations, the corresponding odds were only 1.80 (Model 3). Being on income assistance (with no out of pocket costs) was associated with 2.57 times higher odds of hospitalization for dental surgery (and 1.48 times higher odds of hospitalization for the other conditions (Model 3)).

Mother's age at first birth was strongly associated with the probability of child hospitalization, while living in a single-parent family, not having been breastfed, and being large for gestational age all showed smaller yet statistically significant relationships with this probability. With the reference category being relatively few physician visits, continuity of care seemed relatively unimportant. Few differences in odds ratios were seen among specialties; the frequency of visits was, however, a statistically significant predictor of hospitalization. Finally, the *group* model showed significantly smaller odds ratios associated with income quintile of residence and income assistance than the dental model.

DISCUSSION

This study highlights the influence of socio-economics on pediatric physician visits and hospitalizations for four ACS conditions: dental conditions, asthma, gastroenteritis and bacterial pneumonia. Analyses across the three logistic regression models increase confidence in the robustness of the results. Such predictors as income quintile (Q1 and Q2), income assistance, continuity of care, numbers of visits to different types of physicians, and mother's age at first birth (compared with the 30–34 year old

Table 4. Logistic models for ACS hospitalizations (2003–2006 urban Manitoba birth cohorts, 1–4 years old)

Explanatory variables	Model 1. Original		Model 2. Dental		Model 3. *Group*		Test	
	Coefficient (SE)	Odds ratio	Coefficient (SE)	Odds ratio	Coefficient (SE)	Odds ratio	χ^2	*p*-value
Intercept	−4.83**(0.13)		−5.09**(0.16)		−6.58**(0.23)		**29.88**	<0.0001
Income quintile								
Q1 (lowest)	1.19**(0.11)	3.27	1.44**(0.14)	4.23	0.58**(0.18)	1.8	**13.75**	0.0002
Q2	0.68**(0.11)	1.97	0.83**(0.15)	2.3	0.44*(0.18)	1.55	3.04	0.0815
Q3	0.54**(0.12)	1.72	0.72**(0.15)	2.06	0.23(0.19)	1.26	*4.07*	0.0437
Q4	0.3*(0.13)	1.35	0.34*(0.16)	1.41	0.26(0.19)	1.3	0.11	0.7403
Income assistance at birth	0.83**(0.06)	2.3	0.94**(0.07)	2.57	0.39**(0.14)	1.48	**13.81**	0.0002
Large for gestational age	0.26**(0.07)	1.3	0.34**(0.07)	1.4	0(0.14)	1	*4.8*	0.0285
Continuity of care								
No	0.3**(0.08)	1.35	0.45**(0.09)	1.57	0.16(0.17)	1.18	2.83	0.0923
Yes	0.25**(0.07)	1.29	0.24**(0.08)	1.27	0.61**(0.15)	1.84	*4.22*	0.0399
No. of visits to general practitioners	0.1**(0.01)	1.1	0.06**(0.01)	1.07	0.16**(0.01)	1.17	**46.62**	<0.0001
No. of visits to pediatricians	0.14**(0.01)	1.15	0.08**(0.01)	1.08	0.22**(0.01)	1.24	**77.08**	<0.0001
No. of visits to specialists	0.11**(0.02)	1.11	0.06*(0.02)	1.06	0.14**(0.02)	1.16	**10.66**	0.0011
Sex								
Male	0.17**(0.05)	1.18	0.1(0.06)	1.1	0.42**(0.1)	1.52	**8.8**	0.003
Mother's age at first birth (years) (ref. group 30 ≤ 34)								
12 ≤ 15	1.37**(0.22)	3.92	1.35**(0.23)	3.86	0.97(0.55)	2.64	0.25	0.6193
16 ≤ 17	0.78**(0.12)	2.17	0.8**(0.13)	2.22	0.47(0.28)	1.6	0.91	0.3403
18 ≤ 19	0.48**(0.1)	1.62	0.45**(0.11)	1.57	0.53*(0.21)	1.7	0.07	0.7863
20 ≤21	0.36**(0.1)	1.44	0.27*(0.11)	1.31	0.63**(0.19)	1.88	3.38	0.0661
22 ≤23	0.32**(0.1)	1.38	0.29**(0.11)	1.33	0.39*(0.19)	1.48	0.32	0.5694
24 ≤ 25	0.32**(0.09)	1.38	0.26*(0.11)	1.29	0.5**(0.17)	1.65	1.65	0.1984
26 ≤ 29	0.16*(0.08)	1.17	0.14(0.09)	1.15	0.22(0.14)	1.24	0.27	0.6008
35 ≤ 39	0.24*(0.1)	1.28	0.12(0.12)	1.13	0.5**(0.17)	1.64	3.45	0.0633
40+	0.38*(0.18)	1.47	0.58**(0.19)	1.79	−0.45(0.48)	0.64	*4.37*	0.0366
Not breastfed	0.24**(0.06)	1.27	0.24**(0.06)	1.27	0.22(0.12)	1.25	0	0.9957
Marital status								
Single parent	0.18*(0.07)	1.2	0.24**(0.08)	1.27	−0.04(0.16)	0.96	2.56	0.1097
Unknown	0.44**(0.07)	1.55	0.5**(0.08)	1.65	0.2(0.14)	1.22	3.32	0.0685
Fiscal year of birth								
2003	0.18**(0.07)	1.2	0.12(0.08)	1.12	0.38**(0.13)	1.47	2.72	0.0993
2004	0.19**(0.07)	1.21	0.16*(0.08)	1.17	0.33*(0.14)	1.39	1.17	0.2787
2005	0.07(0.07)	1.07	0.02(0.08)	1.02	0.2(0.14)	1.22	1.08	0.2977
C statistic	0.788		0.797		0.8			
Number of children	26374		25863		24823		26374	
-2LL	2141.4231		1798.4513		753.1057		2500.4728	

Note: Model 1 estimates the log of the odds that the child is hospitalized for any of the four ACS conditions studied (dental conditions, asthma, gastroenteritis and bacterial pneumonia); Model 2 considers only dental hospitalizations; Model 3 (*Group*) considers only asthma, gastroenteritis and bacterial pneumonia hospitalizations. The Test column reports if the coefficients differ across Models 2 and 3 in the multinomial logistic regression. In bold are the χ^2 values that are significantly different at *p*-value < 0.01, in italics are those with *p*-value < 0.05. ** $p < 0.01$. * $p < 0.05$.

reference) were significantly associated with ACS hospitalization across the models. Several of these measures relate to socio-economic status but have seldom been available for consideration as predictors of utilization for ACS conditions.

Comparisons of Models 2 (dental) and 3 (*group*) demonstrated the importance of income quintile and income assistance in predicting hospitalization for dental conditions. With ambulatory visits to a dentist not captured, the "number of visits" to physician providers was only weakly associated with the probability of hospitalization for dental conditions. Physician visits for dental conditions may have primarily been related to pain control and infection from untreated dental caries. Many vulnerable Canadians (i.e., homeless and low-income individuals) visit physicians and emergency departments for oral health-related problems because of poor access to affordable dental care.[14–16] On the other hand, the "number of visits" to physicians – particularly to pediatricians – was substantially associated with hospitalization for the *group* conditions – asthma, gastroenteritis and bacterial pneumonia.

Dental conditions – with much of the care delivered by dentists – are hard to study using just ambulatory physician visits. Continuity of care is difficult to assess. Primary care visits to a physician can identify childhood caries or other oral problems, but subsequent visits (likely to dentists) will not be picked up in a physician-oriented system. How care is financed may well magnify differences associated with socio-economic status. Incentives such as free ambulatory dental visits (provided to children in families on income assistance) should facilitate care otherwise inaccessible to the poor. The high physician visit rates for dental conditions among poor children would seem to support the role of incentives. However, the extremely high rates of pediatric dental day surgery (the most common such surgery in Canada) suggest that early preventive dental visits are not the norm.[17] With dental visits beginning at 12 months of age now the gold standard, far too many children do not receive their first visit by this milestone.[18,19]

While physicians and other primary care providers may deliver some preventive oral health care to young children, there is little evidence that such screening reduces early caries.[20] But early preventive visits to the dentist can reduce the need for restorative and emergency care, lowering associated costs among high-risk children.[21] Since some children continue to have limited access to dental care, expanding the preventive safety net by equipping other providers to deliver early screening, caries-risk assessment, and topical fluoride varnishes makes sense.

Poor children are more likely to have tooth decay and its more severe form.[22–24] Due to the challenges in managing an uncooperative preschooler, a two-hour session in the operating room under general anesthesia can accomplish what otherwise would require four or five office visits or may not be able to be completed. This being said, government insurance provides opportunity for access to dental care for Manitobans on income assistance, but poor children still access physicians or intensive treatment in high-cost facilities.

Why is this research noteworthy? As in Ontario, the socio-economic gradient found for adult Manitobans was also present among children.[25] Significant factors – neighbourhood income quintile, family on income assistance, mother's age at first birth – were correlated with socio-economic position, operating in the same direction (but often with different odds ratios) for both dental conditions and the *group* ACS conditions.[11]

Study strengths include the population-based cohort, the large sample size, the ability to compare dental and other ACS conditions, and the capacity to link different data sets. Limitations include the use of neighbourhood rather than family income data. Earlier Manitoba research examining health and educational outcomes has supported the use of ecologic-level measures when individual measures are not available.[26,27] Other limitations include imperfect diagnostic information and the construction of the marital status measure from several sources.

Model fit without including any specific quality indicators was very good to excellent. Even in urban Canada, where differences in physician access are minimized, socio-economic gradients exist across types of pediatric utilization. With the odds of hospitalization for the *group* ACS conditions 1.47 times higher for a child born in 2003 than for one born in 2006 (Model 3), research on moving care outside of the hospital setting is indicated.

CONCLUSION

Complicated insurance coverage (as with pediatric dental conditions) may contribute to a particularly marked socio-economic gradient in the probability of ambulatory visits and hospitalizations for pediatric patients. When services from one type of provider (dentist) are not generally insured but those from another (physician) are, assessing quality of care using utilization-based approaches seems particularly difficult. Since pediatric hospitalizations for dental conditions are so frequent, finding ways to appropriately reduce these hospitalizations is clearly called for.

APPENDIX A

Details on the variables used

Income quintile from neighbourhood of residence (data from research registry and Statistics Canada). Income quintile of urban residential neighbourhood provides a marker of socio-economic status. Given the small areas (400–700 persons), this measure has consistently produced results close to those using individual income data[7,26,27] (x_1 = individual resides in lowest income quintile Q_1; x_2 = individual in Q_2; x_3 = individual in Q_3; x_4 = individual in Q_4).

Employment and income assistance (Manitoba Families). Families and individuals receiving provincial Income Assistance are covered for dental treatment procedures (as well as for anesthesia and associated hospital costs) (x_5 = parents received assistance at time of birth).

Large for gestational age (hospital discharge abstracts). Large for gestational age indicates infants who are at or above the 90th percentile in birth weight (from an infant population of the same sex and gestational age)[28] (x_6 = large for gestational age).

Continuity of care (ambulatory visits and hospital discharge abstracts). For children with an ACS hospitalization, the relevant time period for producing a continuity score was the year prior to hospitalization. We looked back a year from the mean number of days between the birthdate and the admission date of hospitalized children to generate a continuity of care score for those children without hospitalization. Low users had fewer than three visits to general practitioners or pediatricians during the relevant time period. Continuity of care (COC) was defined as having more than 50% of visits to the same physician (general practitioner or pediatrician) during the relevant time period (x_7 = did not have continuity of care, x_8 = had continuity of care).

Number of visits by physician specialty (provider registry). The number of ambulatory visits to general practitioners, pediatricians and specialists during the continuity of care time period were counted (x_9 = number of visits to general practitioner, x_{10} = number to pediatrician, x_{11} = number to specialist). As seen in Table 1, the smallest number of cases was for x_{11} (N = 74).

Sex (research registry). Young males are generally less healthy than females (x_{12} = male).[9,11]

Mother's age at first birth (research registry and hospital discharge abstracts). Children of younger mothers are more likely to have health problems and to drop out of school (x_{13} = mother between 12 and 15 at time of first birth, x_{14} = mother between 16 and 17,[10] x_{15} = mother between 18 and 19, x_{16} = mother between 20 and 21, x_{17} = mother between 22 and 23, x_{18} = mother between 24 and 25, x_{19} = mother between 26 and 29, x_{20} = mother between 35 and 39, x_{21} = mother 40 or older). These categories were selected because of regular relationships between age and probability of hospitalization. As seen in Table 1, the smallest number of cases was for x_{13} (N = 129).

Breastfeeding initiation in hospital (hospital discharge abstracts). Breastfeeding initiation is noted on the hospital chart and transferred to the hospital discharge abstract. Breastfeeding has been associated with a reduced risk of many infant diseases (x_{22} = infant was breastfed).[29]

Marital status (research registry and survey data from Families First program). Single parenthood typically leads to both a loss of income and lack of a partner to assist with child rearing. With missing survey data, positive evidence of marital status on the registry was used to assign the mother to the "married" category. With missing survey data and no positive evidence of marital status, the mother was assigned to the "unknown" category (x_{23} = mother is single parent at time of infant's birth, x_{24} = mother's marital status at time of infant's birth is unknown).

Fiscal year of birth (research registry). x_{25} = infant born in fiscal year 2003, x_{26} = infant born in fiscal year 2004 and x_{27} = infant born in fiscal year 2005.

APPENDIX B

Variables which did not improve fit

A number of variables originally included did not improve model fit. These included various statistics associated with birth: Apgar score five minutes after birth, indicator for Apgar score five minutes after birth larger than seven, birthweight, and small for gestation age.

Several psychological variables (based on the Hopkins Expanded Diagnosis Clusters (EDCs)), including "mother had anxiety or depression" and "mother had any of the psychological EDCs", were explored over different time periods. Overall, maternal psychological distress did not independently affect the ACS hospitalizations.

Logistic models with continuity of care over two years

To consider continuity of care over two years, the ACS hospitalizations were limited to ages 2–4 years. This resulted in fewer ACS hospitalizations in the "two year" sample – 1529 for dental conditions and 254 for the three/grouped diagnoses (the "one year" sample notes 1551 for dental conditions and 511 for the grouped diagnoses). With fewer hospitalizations, only the coefficients on the number of visits to pediatricians and specialists differed across ACS types.

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RÉSUMÉ

OBJECTIFS : Notre étude porte sur le gradient socioéconomique du recours à l'hospitalisation et sur les facteurs de risque associés pour quatre conditions pédiatriques propices aux soins ambulatoires (problèmes dentaires, asthme, gastroentérite et pneumonie bactérienne). Les problèmes dentaires présentent des enjeux particuliers, car la plupart sont traités par des dentistes, et la couverture d'assurance de ces soins varie selon le segment démographique.

MÉTHODE : Nos données provenaient principalement d'un registre de population, d'un registre des fournisseurs, des demandes de paiement des médecins pour consultations en médecine ambulatoire et du registre des sorties des hôpitaux de 28 398 enfants nés entre 2003 et 2006 dans les centres urbains du Manitoba, au Canada. Nous avons comparé les visites chez le médecin et les hospitalisations pour différents groupes de revenu selon le quartier à l'aide de corrélations des rangs et de régressions logistiques.

RÉSULTATS : Des liens très solides sont apparus entre le revenu selon le quartier et le recours à l'hospitalisation. D'autres variables – le fait pour la

famille de toucher une aide au revenu, l'âge de la mère à la première naissance, l'allaitement maternel – ont aidé à prédire la probabilité d'hospitalisation. Malgré la couverture d'assurance complète assortie à l'aide au revenu (y compris les visites chez le dentiste et le médecin et les hospitalisations), le fait de toucher une telle aide était associé à des probabilités d'hospitalisation supérieures.

CONCLUSIONS : Nous avons constaté la présence d'un gradient socioéconomique dans le recours à l'hospitalisation pour les conditions pédiatriques propices aux soins ambulatoires, avec des taux de visites sur pied et d'hospitalisation plus élevés dans les quartiers les plus pauvres. La couverture d'assurance, qui varie selon le segment démographique, complique encore les choses. Le financement des soins dentaires des Manitobains prestataires de l'aide au revenu n'a pas empêché les visites chez le médecin ni les traitements intensifs dans des installations à coût élevé, plus précisément les traitements sous anesthésie générale. En l'absence d'une couverture universelle des services d'une catégorie de fournisseurs (les dentistes) alors qu'une telle couverture existe pour les services d'une autre catégorie de fournisseurs (les médecins), il semble particulièrement difficile d'utiliser les taux d'hospitalisation pour repérer des problèmes dans l'organisation des soins.

MOTS CLÉS : problèmes dentaires pédiatriques; caries du jeune enfant; visites chez le médecin; hospitalisations; cohortes de naissance; gradient socioéconomique