inhalized corticosteroids (ICS) are recognised as the most effective long term control medication for most patients with persistent asthma. Most patients who have an asthma exacerbation leading to a visit to an emergency department (ED) will benefit from treatment with inhaled corticosteroids (ICS) at discharge. We investigated whether asthmatic children and adolescents were receiving ICS after discharge from the ED and identified the characteristics of patients and physicians associated with their use.

Methods: A cohort of 4042 asthmatic patients aged 5–17 years was selected from the administrative database of the Régie de l’assurance maladie du Québec between 1997 and 1999. The proportion of patients using ICS 1, 3, and 6 months after ED discharge was estimated. Using GEE models the independent contribution of sociodemographic variables, markers of asthma severity, prior use of healthcare services and ICS, and physician characteristics was investigated on the likelihood of using ICS after ED discharge.

Results: 68% of children and 51% of adolescents had a valid prescription for ICS in the month following discharge. At 6 months after discharge the corresponding figures were 77% and 60%. The strongest predictors of ICS use were age, with adolescents being less likely to use ICS than children (OR 0.49; 95% CI 0.43 to 0.56), prior use of ICS (OR 2.28; 95% CI 2.00 to 2.61), and filling a prescription for oral corticosteroids in the month following discharge (OR 2.29; 95% CI 2.03 to 2.58). However, patients who had an ED visit or a hospital admission for asthma during the 6 months before discharge were not more likely to use ICS after discharge.

Conclusion: A large proportion of patients with clear markers of uncontrolled or severe asthma did not have a valid prescription for an ICS after discharge from the ED.
tions has been proved to be both valid and comprehensive.22

For a short acting 

patients were required to have filled at least two prescriptions 

32 897 asthmatic patients aged 5–17 years. To be selected, 

Cohort of asthmatic patients visiting an ED

From the pharmacy database of the RAMQ we first identified 

32 897 asthmatic patients aged 5–17 years. To be selected, 

patients were required to have filled at least two prescriptions 

for a short acting \( \beta_2 \) agonist (albuterol, fenoterol, epinephr- 

ine, orciprenaline, pirbuterol, or terbutaline) on or after their 

fifth birthday between 1 January 1997 and 31 December 

1999. Patients using non-steroidal inhaled anti-inflammatory 

agents (disodium cromoglycate, nedocromil sodium and ketotifen) and leukotriene receptor antagonists (zafirlukast and montelukast) were excluded from the cohort because the frequency of use of these medications was less than 3%. This 

cohort is thus a representative sample of patients covered by 

the RAMQ drug plan who visited the ED at the time of the 

study. There are 92 ED facilities in the province of Québec, 10 of which are at academic centres. The four paediatric only ED facilities in the province are in academic centres. 

Patients entered the cohort on the date of the first ED visit 

for asthma (ICD-9 codes: 493.0, 493.1, 493.9) on or after 1 

July 1997. For each patient the number of ED visits made 

during the study follow up period was recorded. ED visits 

separated by two days or less were counted as one episode 

(that is, only one ED visit) and ED visits followed by a 

hospital admission for asthma within 2 days of discharge 

were not counted. A minimum of 6 months of RAMQ drug 

plan coverage before and a minimum of 1 month after the 

ED visit were required to measure the use and predictors of use of ICS. 

Use of ICS after discharge

Patients were considered to be users of ICS (beclomethasone, 

fluticasone, budesonide, flunisolide, triamcinolone) for a 

specific ED visit if they filled at least one prescription during 

the month following discharge or if they filled a prescription 

within 6 months before the ED visit that was still valid after 

discharge. A prescription was considered valid if the date of 

discharge from the ED was included in the time period 

estimated for its duration (estimated by the number of days 

between this refill and the previous one). 

Using the same definition, we also assessed the use of ICS 

within the first 3 months and the first 6 months following 

ED discharge. These measures were taken to investigate 

whether ICS use improved over time. 

Statistical analyses

The proportion of patients using ICS in the month following 

ED discharge was estimated as a function of patient 

characteristics such as sociodemographic factors, co-morbid-

ity, severity of the exacerbation, prior use of ICS, and markers 

of asthma severity and control. It is worth noting that the 

unit of analysis was the ED visit and that a patient might 

have had more than one ED visit during the study period. 

A maximum of four ED visits (that is, the first four ED visits) 

per patient were included in all analyses. 

We also looked further into the use of ICS after discharge 

from the ED to differentiate between patients who filled a 

prescription for ICS during the month following discharge 

and those who had only a valid prescription after discharge 

that was filled before the ED visit under study. We then 
estimated the proportion of patients using ICS in the first 3 

and 6 months following a visit to an ED. 

Following these descriptive analyses we investigated the 
predictors of ICS use in the month following discharge from 

the ED with a generalised estimation equation (GEE) model. 

Using this model we were able to include up to four ED visits 

per patient in the analysis and take into account the fact that 
a considerable proportion of patients had more than one ED 
visit during the study period. Mathematically, this model 
took into account the correlation between different ED visits 

for the same patient in the estimation of the confidence 
interval of the odds ratios (ORs) associated with the 
predictors under study. From this model we thus estimated 
adjusted ORs and 95% CI for the use of ICS in the month 
following discharge from the ED for the following variables: 

- socioeconomic factors: age at ED visit (13–17 v 5– 

12 years), sex (male v female), living in a family receiving 
social assistance (yes/no), living in Montreal Island (yes/ 

no); 
- co-morbidity: filling at least one prescription for a 

medication prescribed for a chronic condition other than 

asthma within 6 months before the ED visit (yes/no); 
- severity of the exacerbation: consultation with a paedia-

trician or a respiratory physician during the ED visit (yes/ 

no); prescription filled for an oral corticosteroid in the 

month following ED discharge (yes/no); 
- prior use of ICS: at least one prescription filled for an ICS 

(yes/no, excluding when relevant the prescription that was 

still valid at discharge) within 6 months before the ED 

visit; 
- marker of asthma severity and control (measured within 

6 months before the ED visit); at least one prescription 

filled for an oral corticosteroid (yes/no), average use of 10 
or more doses of short acting \( \beta_2 \) agonists per week (yes/

no), at least one prescription filled for a long acting \( \beta_2 

agonist (yes/no), hospital admission for asthma (yes/no), 
ED visit for asthma (yes/no), medical visit to a paedia-

trician or a respiratory physician (yes/no). 

The use of short acting \( \beta_2 \) agonists as a marker of asthma 

control is based on the recommendation of the Canadian 

asthma guidelines which states that asthma is well controlled 

if a patient uses less than four doses per week, excluding one 
dose per day for exercise — that is, 10 doses per week or 
more.1 All analyses were performed on the first four ED visits 
of each patient. This maximum of four visits per patient was set 
in order to stabilise the GEE model. Among patients who had 
an ED visit during the study period, only 3.7% had more than 
four visits. The conclusions about the effect of the predictors 
under study on the likelihood of using ICS after an ED visit 
were only based on the results provided by the GEE model 
and not on the descriptive analyses which did not take into 
account the correlation between the different ED visits of a 
patient. 

RESULTS

Of the 32 897 asthmatic patients identified from the RAMQ 
database, 4042 met the inclusion criteria to enter the ED 
cohort. Of these, 68.2% had only one ED visit during the 
study period, 18.4% had two, 6.7% had three, and 6.7% had 
four or more. 

The characteristics of the study patients are shown in 
table 1. More than 70% of patients visiting the ED were aged 
5–12 years and 52% were male. In 24.3% of cases a
paediatrician or a respiratory physician was consulted during the ED visit and 40% of patients filled a prescription for oral corticosteroids in the month following discharge. This cohort is likely to represent patients with uncontrolled asthma since 76% of them used an average of 10 doses or more of short acting β_2 agonists per week, 24% filled at least one prescription for oral corticosteroids, 27% had an ED visit for asthma, and nearly 6% had a hospital admission for asthma during the 6 months preceding the ED visit.

Table 1 shows the use of ICS in the month following ED discharge as a function of the characteristics of patients and physicians. Overall, patients filled a prescription of ICS in the month following discharge 63% of the time. Children were 17% more likely than adolescents to use ICS in the month following discharge. Patients who had at least one morbidity were slightly less likely to use ICS after discharge than patients without co-morbidity. The most prevalent co-morbidities observed in the cohort were psychiatric disorders (3.8%), dermatological diseases (3.4%), rhinitis (3.0%), and musculoskeletal disorders (3.0%). Patients who used asthma medications recognised as markers of uncontrolled asthma such as oral corticosteroids and high dose short acting β_2 agonists before the ED visit were more likely to use ICS after discharge. Patients who had been admitted to hospital during the 6 months before the ED visit were 14% more likely to use ICS after discharge than those who were not admitted to hospital. Surprisingly, patients who had an ED visit in the 6 months before the ED visit under investigation were only 6.7% more likely to use ICS after discharge. We also observed that nearly 24% of patients who filled a prescription for oral corticosteroids in the month following discharge from the ED did not have a valid prescription for ICS during the same period. Finally, patients who had at least one medical visit to a paediatrician or a respiratory physician before the ED visit were 21% more likely to use ICS after discharge.

We looked further into ICS use during the first month following discharge from the ED among the 2951 children (68.0% of all children) classified as users of ICS; 66% of these children (n = 1948) had filled a prescription for ICS in the month following discharge from the ED while 34% (n = 1003) only had a prescription filled before the ED visit which was considered valid after discharge. The corresponding figures were 67% (n = 615) and 33% (n = 303) among adolescents.

The use of ICS in the 6 months after discharge from the ED is shown in table 2. The proportion of children using ICS increased by 8.7% (from 68.0% to 76.7%) between the first and third month and by only 0.5% (from 76.7% to 77.2%) between the third and sixth month following ED discharge. The corresponding figures for adolescents were 8.4% and 0.8%.

Crude and adjusted odds ratios were then estimated for all potential predictors of ICS use during the month after ED discharge (table 3). The two strongest predictors of ICS use were filling a prescription for oral corticosteroids in the month following discharge (adjusted OR 2.31 (95% CI 2.05 to 2.60)) and prior use of ICS (adjusted OR 2.35 (95% CI 2.06 to 2.69)). Patients who filled at least one prescription for oral corticosteroids (adjusted OR 1.45) used high doses (>10 doses/week) of short acting β_2 agonists (adjusted OR 1.57) and those who had a visit with a paediatrician or a respiratory physician during the 6 months before an ED visit (adjusted OR 1.67) were also significantly more likely to use ICS after ED discharge. We also observed that adolescents were less likely to use ICS after discharge than children (adjusted OR 0.50). On the other hand, consultation with a paediatrician or a respiratory physician during the ED visit and prior hospital admissions and ED visits for asthma were not significantly associated with the use of ICS after discharge. In fact, although non-significant, the adjusted ORs found in the model indicated that patients with prior ED visits or hospital admissions for asthma would be less likely to use ICS after an ED visit.

**DISCUSSION**

The results of this study show that nearly 50% of adolescents and 32% of children did not have a valid prescription for ICS during the month following discharge from the ED. These results are in agreement with those found in a study...
conducted in the Canadian province of Saskatchewan which found that 25% of adult patients were discharged from the ED without a prescription for ICS. Our results indicate, however, that the situation might be more problematic for adolescents than for adults and children since the proportion of patients without a valid prescription for ICS after discharge was much lower in this group of patients.

Our results also show that the use of ICS after a visit to the ED does not improve over time. In fact, patients were less likely to fill a prescription for ICS as time evolved after discharge from the ED for an asthma exacerbation. For both children and adolescents, only an additional 10% of patients filled a prescription for ICS between the second and sixth month following ED discharge. This might indicate that patients who were discharged from the ED and did not use ICS in the following month—either because they were discharged without a prescription or because they did not fill the prescription they received—have very little chance of getting one in the future from a family physician or changing their behaviour to these medications.

The stratification of patient age was based on an anticipated difference in behaviour related to the management of medications. The cut off at 13 years to define adolescence was thought to be related to the age at which patients are likely to start being responsible for the management of their own medications for asthma. As expected, the use of ICS by patients aged 13–17 years after discharge from the ED was quite different from that of younger patients who were probably closely supervised by their parents.

Analysis of the predictors of ICS use shows that patients with the most severe markers of uncontrolled asthma—that is, patients with prior ED visits and hospital admissions for asthma and those who had a consultation with a respiratory physician or a paediatrician during the ED visit—were not more likely to use ICS after discharge. In other words, the presence of markers that are probably closely supervised by their parents.

The results of this study are highly representative of real life practice for the treatment of asthma in Canadian institutions and other tertiary care institutions since they are based on a large sample of patients retrieved from an administrative database. Using the RAMQ database allowed us to avoid recall bias for drug consumption and changes in medical practice due to the participation of physicians in a research project. Moreover, we were able to follow patients for up to 3 years and include up to four ED visits per patient in the analyses.

Inevitably, the use of administrative databases for such a study has limitations. Firstly, the use of ICS was based on the filling of prescriptions which might not accurately reflect intake of the medication. The definition we used to identify ICS users (especially considering a patient to be a user even if his only valid prescription for ICS found after discharge was filled before the ED) is likely to overestimate the number of patients using these medications after discharge and to underestimate the number of patients using ICS before discharge. This misclassification of ICS exposure, if present, might have underestimated the impact of prior use of ICS and other factors on the likelihood of use of ICS after discharge. Secondly, the diagnosis of asthma for the ED visit recorded in the database was not validated. However, we feel confident that a large proportion of these patients have asthma since 73% of them used an average of more than 10 doses of short acting β2 agonists per week before the ED visit.

| Table 3 | Predictors of ICS use in the month following discharge from the ED |
|-----------------|------------------|-----------------|
|                | Crude OR | Adjusted OR | 95% CI   |
| **Sociodemographic variables** |         |         |    |
| Age at ED visit (13–17/5–12 years) | 0.49 | 0.50 | 0.44 to 0.57 |
| Sex (male/female) | 1.16 | 1.02 | 0.91 to 1.15 |
| Social assistance (yes/no) | 0.93 | 0.96 | 0.86 to 1.08 |
| Living on Montreal Island (yes/no) | 0.96 | 0.79 | 0.69 to 0.91 |
| Co-morbidity (yes/no) | 1.08 | 1.09 | 0.93 to 1.27 |
| Severity of the exacerbation |         |         |    |
| Consultation with paediatrician or respiratory physician (yes/no) | 1.22 | 1.04 | 0.89 to 1.22 |
| Prescription of oral corticosteroids (yes/no) | 2.74 | 2.31 | 2.05 to 2.60 |
| Use of ICS 6 months before ED visit (yes/no) | 3.48 | 2.35 | 2.06 to 2.69 |
| Markers of asthma severity and control during 6 months before ED visit |         |         |    |
| Oral corticosteroids (yes/no) | 2.35 | 1.45 | 1.22 to 1.72 |
| Short acting β2 agonists (>10/≤10 doses per week) | 2.40 | 1.57 | 1.34 to 1.83 |
| Long acting β2 agonists (yes/no) | 2.05 | 1.17 | 0.63 to 2.15 |
| Hospital admission for asthma (yes/no) | 1.95 | 0.88 | 0.66 to 1.18 |
| ED visit for asthma (yes/no) | 1.35 | 0.86 | 0.74 to 1.00 |
| Medical visit to a paediatrician or a respiratory physician (yes/no) | 2.71 | 1.67 | 1.44 to 1.93 |

All adjusted odds ratios were obtained from a unique GEE model, implying that each variable is adjusted for all other variables in the table.
Thirdly, in this study it was not possible to differentiate between the behaviour of patients and physicians. It was not possible to know whether patients were classified as non-users of ICS because they did not fill their prescriptions or because the ED physician did not prescribe them. Fourthly, our cohort is a representative sample of Quebec residents covered by the RAMQ drug plan, but might not be a good representation of families with the highest incomes. However, a priori, there is no reason to believe that patients will be treated differently at the ED based on their socioeconomic status. In our model receiving social assistance was not significantly associated with the use of ICS after discharge. Finally, we had no access to clinical markers of asthma severity and control such as lung function measures or the frequency of symptoms. The markers that we used were based on the use of asthma medications and acute care services for asthma before the ED visit. These markers were evaluated over a 6 month period that was chosen to be a trade off between the proximity of the ED visit under study and a good representation of the underlying severity and control. It is worth noting that our markers of control are more likely to represent the long term than an acute phase of lack of control.

In conclusion, despite clear recommendations from the Canadian guidelines for the treatment of asthma after an ED visit, we found that a large proportion of patients did not use ICS after discharge and this was even more important among adolescents. A large proportion of patients with clear markers of uncontrolled or severe asthma—such as prior ED visits and hospital admissions for asthma—did not have a valid prescription for an ICS after discharge. Prescription of an ICS and promoting patient compliance should be emphasised in children and adolescents with prior ED visits or hospital admissions for asthma.

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