

Reasons for and costs of hospitalization for pediatric asthma: A prospective 1-year follow-up in a population-based setting

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The aims of this study were to examine the frequency of, and the reasons for, emergency hospitalization for asthma among children. In addition, the costs of hospital treatment, preventive medication, and productivity losses of the caregivers were evaluated in a population-based setting during 1 year. Data on purchases of regular asthma medication were obtained from the Social Insurance Institution. In total, 106 (2.3/1000) children aged up to 15 years were admitted 136 times for asthma exacerbation to the Kuopio University Hospital in 1998. This represented $\approx 5\%$ of all children with asthma in the area. The trigger for the exacerbation was respiratory infection in 63% of the episodes, allergen exposure in 24%, and unknown in 13%. The age-adjusted risk for admittance was 5.3% in children on inhaled steroids, 5.8% in those on cromones, and 7.9% in those with no regular medication for asthma. The mean direct cost for an admission was \$1,209 (median \$908; range \$454–6,812) and the indirect cost was \$358 (\$316; \$253–1,139). The cost of regular medication for asthma was, on average, \$272 per admitted child on maintenance. The annual total cost as a result of asthma rose eight-fold if a child on regular medication was admitted for asthma.

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Asthma is the most common chronic disease of children in Finland (1). The goal for preventive, long-term therapy of asthma is to keep the child symptomless with maintenance of normal lung function and the ability to undertake normal physical activity. Inhaled anti-inflammatory drugs are the cornerstones of maintenance therapy (2). Being hospitalized for asthma can be, at least partly, considered to be a failure of the preventive treatment.

There are few studies evaluating the reasons for exacerbations of asthma in children; however, viral infections (3), allergen exposures (4,5) or insufficient maintenance medication (6) are considered to be the most common causes of asthma exacerbation. The effectiveness of ongoing maintenance therapy in relation to use of hospital care has been analyzed even less (7,8). In particular, there are a lack of studies evaluating the effectiveness of cromone therapy, or the costs of asthma in children at the population level.

The aims of this study were to examine the frequency of, and the reasons for, emergency hospitalization for asthma among children. In addition, the costs of preventive medication, those of hospital treatment, and those of productivity losses of the caregivers, were evaluated in a population-based setting.

Materials and methods

The data on patients up to 16 years of age, treated for an exacerbation of asthma in the Department of Paediatrics, Kuopio University Hospital, from January 1st to December 31st 1998, were registered prospectively. This hospital is the only one providing in-patient treatment for pediatric patients in the geographically defined area, the province of Kuopio, eastern Finland. An exception is the regional hospital in Varkaus, located inside the area, which provides care for the inhabitants of that town. Children from Varkaus,

as well as those living outside the province of Kuopio, were excluded from the analyses. There were 46,515 children under 16 years of age in the study area at the end of 1997 (The Official Statistics of Finland). Based on recent, population-based studies, the prevalence of pediatric asthma is 4.5% in our area (9,10). Thus, 2,093 children are estimated to have asthma.

Children with acute exacerbation of asthma were hospitalized on the basis of clinical indications; our policy is to consider in-patient care if the obstruction does not improve after two doses of nebulized salbutamol given 30-min apart at the out-patient clinic. Salbutamol is given by a drug nebulizer (Spira[®]; Spira, Respiratory Care Unit Ltd, Hämeenlinna, Finland) at a dose of 0.15 mg/kg. The decision to admit was made by the doctor on duty, and therefore took place independently of the study and the authors. Children with previously diagnosed asthma (ICD-10 J45*) and those in whom the diagnosis was made (2) during the hospital stay, were included; in the latter cases, the diagnosis was based on a doctor's observation of three wheezing episodes. In addition, 10 severe cases, not controllable by per-oral steroids, nebulized sympathomimetics, and nebulized anticholinergics during hospital care, were included regardless of previous history. In total, 106 children were included: 75 (71%) had previously been diagnosed with asthma, while for 31 (29%) the diagnosis was new.

The treatment policy of our hospital states that children on cromones are advised to add inhaled corticosteroids to their maintenance medication for 1 to 3 weeks during respiratory infections and during seasonal pollen peaks if they are sensitized to that pollen (11), while children on inhaled steroids are advised to double the dosage of their maintenance medication. Our step-wise choice of regular anti-inflammatory medication for asthma, according to the severity of the disease, is different from the practice of other centers in Finland: the treatment is begun with steroids but at the steady stage it is continued with cromones far more frequently than in other centers of the country (Social Insurance Institution [SII] registers; unpublished). The data on regular maintenance medication, including possible intensification preceding the hospitalization, were collected using a structured questionnaire at admission. In addition, the numbers of days when inhaled sympathomimetics were used prior to the hospitalization were recorded.

During the hospital care, two authors (K.K. and M.K.) defined the clinically most probable triggering reason for the exacerbation of asthma leading to admission, on the basis of previously

defined criteria. The reasons were classified as acute respiratory infection or acute allergen exposure and, if neither was evident, as unknown. Acute respiratory infection was diagnosed clinically; the child had to have symptoms suggestive of respiratory infection such as cough, cold, sore throat or fever. The diagnosis of acute allergen exposure was based on history: allergic rhinitis and/or conjunctivitis during the pollen season, or animal exposure preceding asthmatic symptoms.

Data on daily pollen concentrations (grains/m³ in air) in Kuopio province during the study period were obtained from the Unit of Aerobiology of Turku University, Finland, and regional data on viral outbreaks were obtained from the infection epidemiological register of the National Public Health Institute, Helsinki, Finland.

The SII provides data on drug prescribing in Finland through a nationwide register. We obtained exact data on the purchases of prescribed cromones and inhaled steroids in the province of Kuopio during the study year from the register of the SII. Those children for whom both cromones and inhaled steroids had been purchased during the study year, were classified as using cromones as basic maintenance and steroids only intermittently.

The annual costs of maintenance medication for asthma were calculated separately for inhaled steroids (budesonide, Pulmicort[®]; AstraZeneca, Masala, Finland) and for cromones (cromolyn sodium, Lomudal[®]; Rhône-Poulenc Rorer, Helsinki, Finland), by multiplying the retail drug price of a daily dose by the number of doses needed for 1 year's maintenance medication. The daily dose for budesonide maintenance was 200 µg twice a day, that for cromolyn sodium aerosol maintenance 10 mg three times a day, and for cromolyn dry powder maintenance 20 mg three times a day. In these calculations, children who were <5 years of age were regarded to use aerosols and those >5 years of age, dry powder preparations. The retail prices were obtained from the Finnish drug catalog (Pharmaca Fennica 1998). The exchange rate was: euro (\$) = FIM5.94573 (The Finnish Bank). According to the Finnish health and social security system, patients with chronic asthma pay only 25% of the prescription medication costs for asthma, and the general sickness insurance scheme pays the rest.

Retail prices of the maintenance drugs and in-patient care charges were used as a proxy for direct costs. The charge of 1 day at the department, where children with acute asthma are treated, is fixed, being \$454.10. This means that the costs rise linearly with the length of stay. The charge includes all in-patient care expenses,

Table 1. Maintenance medication for asthma in children treated in hospital for an exacerbation of asthma

Age group	Number of children*	Cromones		Inhaled steroids
		Alone	With inhaled steroids†	
<2 years	31	0	2 (6%)	15 (48%)
2–4 years	36	4 (11%)	3 (8%)	19 (53%)
5–15 years	39	10 (26%)	9 (23%)	13 (33%)
All	106	14 (13%)	14 (13%)	47 (44%)

*All hospitalized children.

†During respiratory infections or the peak of pollen seasons.

including the physician's time. The charge is paid by the patient's home town; only \$21 per day is paid by the patient.

Estimated data on the number of days for which the caretaker had to stay away from work for daily visits to hospital (the duration of hospital stay) and for care at home (a common practice is 3 days after discharge) were used as a proxy for indirect costs. The number of days were multiplied by the average daily earnings (\$63.27; the Finnish Office of Statistics, Helsinki, Finland). Neither the economic costs because of missed schooldays nor patient travel costs were included.

Statistical analysis of data

In statistical analysis, the spss statistical package, version 8.0, was used (SPSS, Chicago, IL, USA). The only exception was the monthly variation of the admission periods, which was assessed by using Poisson regression analysis (sas; SAS Institute Inc., Cary, NC, USA). The chi-square test was performed in paired comparisons. The changes of risks were expressed as absolute risk reductions (ARR) and/or relative risk reductions (RRR) compared to baseline risks. The number needed to treat (NNT) values were calculated by using the ARR to estimate the magnitude of the treatment effect ($NNT = 1 \div ARR$).

Results

There were 136 admissions for asthma during the surveillance period. One-hundred and six children were admitted: 66 (62%) boys and 40 (38%) girls. A total of 20 (19%) children, 14 boys and six girls, were admitted more than once. None of the children were admitted to the intensive care unit. The median age of the children was 3.2 years (range 0.3–15.3 years). The age distribution was as follows: <2 years, 31 (29%); 2–4 years, 36 (34%); and ≥ 5 years, 39 (37%). The respective age-related figures for the 31 new diagnoses were 14 (45%), 13 (42%), and four (12%). The month with the greatest number of admissions was May, when 45% of the patients were >5 years of age, com-

prising 21% of all admissions at that age. Children <2 years of age were admitted most often in November and December, comprising 52% of the cases admitted during these months and 33% of the cases at that age. The differences between the monthly admission rates did not reach statistical significance.

During the index admission, i.e. the first period for the patient during the study year, 75 (71%) children were on regular maintenance therapy (Table 1). Of these, 28 (37%) were on cromones (cromolyn sodium in 22 patients and nedocromil in six patients), and 47 (63%) were on inhaled steroids, mostly budesonide. In addition, 50% of the children on cromones used inhaled steroids intermittently. Most of the children <5 years of age were on inhaled steroids, unlike the older children. The 28 children on cromones needed 30 hospitalization periods, and the 47 on inhaled steroids 68 periods.

As many as 80 (75%) patients had sympathomimetics included with their medication preceding the hospitalization, on average 4.8 days (median 2.0 days; range 1–30 days) before admission. The mean delay between the onset of symptoms and the initiation of sympathomimetic was 1.1 days (median 0 days; range 0–20 days). Only 15 of the 28 children (54%) on cromones had inhaled steroids added to their medication, on average 5.5 days (median 3.5 days; range 1–30 days) preceding the hospitalization. The mean of the delay was 1.3 days (median 0 days; range 0–20 days). Of the 47 children on inhaled steroids, only 28 (60%) had doubled the dosage of their maintenance medication, on average 6.9 days (median 4.0 days; range 1–30 days) preceding the hospitalization. The mean delay was 1.2 days (median 0 days; range 0–12 days).

The main trigger for the exacerbation leading to admission was acute respiratory infection in 99 (73%) patients and allergen exposure in 19 (14%) (Table 2). The age-adjusted proportions were 63% and 24%, respectively. The trigger was birch pollen in 11 (58%) patients, cat dander in five, dog dander in two, and grass pollen in one. Five children hospitalized after birch pollen

Table 2. Reasons for hospitalization in different medication groups.

Reason	No. of episodes	Cromones (n=30*)	Inhaled steroids (n=68†)	No anti-inflammatory medication (n=38‡)
Infection	99	21 (70%)	57 (84%)	21 (55%)
Allergen exposure	19	6 (20%)	7 (10%)	6 (16%)
Unknown	18	3 (10%)	4 (6%)	11 (29%)

*30 episodes in 28 children.

†68 episodes in 47 children.

‡38 episodes in 31 children.

There were no statistically significant differences between the medication groups.

exposure were on cromones, two were on inhaled steroids, and four had no maintenance medication. The cause of the exacerbation was unknown in 18 (13%) patients: 11 (61%) of these had no previous asthma diagnosis, three were on cromones, and four were on inhaled steroids on a regular basis. Among the 31 children with a new asthma diagnosis, the reason for the hospitalization was acute respiratory infection in 16 (52%) patients, acute allergen exposure in four (13%), and unknown in 11 (35%).

According to the SII registers, 1699 (3.7%) children received reimbursement for asthma medication in the province of Kuopio in 1998 (Table 3). According to the official follow-up of drug purchases, 817 (48%) of these children had bought inhaled corticosteroids, of whom 47 (5.8%) were hospitalized during the study period. A total of 882 (52%) children had bought cromones, of whom 28 (3.2%) were hospitalized. After adjusting by age, the figures were similar, 5.3% and 5.8%, respectively. In total, 343 of 882 children on cromones (39%) had used cromones alone, of whom 4.1% were hospitalized, and 539 (61%) had (in addition) inhaled steroids intermittently, of whom 2.6% were hospitalized. Again, the age-adjusted analysis gave a different result: the figures were even higher for children on cromones with intermittent inhaled steroids (Table 4).

The children admitted for an asthma exacerbation needed 362 in-patient days, which constitutes 7% of all in-patient days of the pediatric ward. The median duration of hospital care was 2.0 (range 1–15) days. The direct expenses of

hospital treatment for asthma were \$164,387 during the study year, so the mean cost for an admission period was \$1209 (median \$908; range \$454–\$6811). The estimated cost of productivity losses of a caregiver was \$48,718, so the mean indirect cost for an admission was \$358 (median \$316; range \$253–\$1139). The costs of hospital treatment and productivity losses divided into different medication groups are presented in Table 5.

For the admitted children <5 years of age who were receiving aerosol preparations, the costs of regular 1-year maintenance medication for cromones were \$5474 per patient, and for inhaled steroids \$6197. The corresponding costs for those >5 years of age receiving dry powder preparations were \$5910 and \$2820. The total costs, as well as the costs of maintenance medication at the population level in different therapeutic groups, are presented in Table 5.

At the population level, the total costs of asthma, i.e. the expenditures of regular medication and the direct and indirect costs of hospitalization, rose eight-fold (from \$286 to \$2327) if the child on regular medication was admitted because of asthma.

A total of 31 of the estimated 394 asthmatic children with no regular medication for asthma in Kuopio province needed in-patient care for an asthma exacerbation, which means an annual 7.9% risk for hospitalization. Interestingly, all the hospitalized children with no regular medication for asthma had 'new' asthma, i.e. no child with previously diagnosed asthma and with no regular medication was admitted. The respective age-

Table 3. Maintenance medication for asthma in children with asthma in the Kuopio province in 1998

Age group	Number of children*	Cromones		
		Alone	With inhaled steroids†	Inhaled steroids
<2 years	110 (7%)	2 (2%)	5 (4%)	103 (94%)
2–4 years	308 (18%)	33 (11%)	106 (34%)	169 (55%)
5–15 years	1281 (75%)	308 (24%)	428 (33%)	545 (43%)
All	1699 (100%)	343 (20%)	539 (32%)	817 (48%)

*Receiving reimbursement for asthma medication in the province of Kuopio.

†The children who had bought both cromones and inhaled steroids during the follow-up year.

Table 4. Hospital-admitted children in different maintenance groups in relation to the out-patient use of the drugs

Maintenance	Number of children*	Number of hospitalized children		
		n	% crude†	% adjusted‡
Cromones	882	28§	3.2	5.8
Alone	343	14¶	4.1	4.5
With intermittent inhaled steroids	539	14**	2.6	6.3
Inhaled steroids	817	47	5.8	5.3

*Receiving regular anti-inflammatory medication for asthma in the Kuopio province.

†Crude risk (%) for hospitalization at the population level.

‡Age-adjusted risk (%) for hospitalization at the population level.

§p=NS vs. inhaled steroids.

¶p=NS vs. intermittent inhaled steroids.

**ARR vs. cromones alone 1.5% (95% CI: -1.0 to 4.0); RRR vs. cromones alone 37% (95% CI: -32 to 69).

adjusted annual risk was 5.3% in children on inhaled steroids and 5.8% in those on cromones. The NNT values were calculated from these figures. The regular cromone medication decreased the absolute risk for hospitalization by 2.1%, and the NNT value was 48, which means that 48 children should be transferred to regular medication to avoid one hospitalization period during 1 year. The respective figure was 39 for inhaled steroids. The annual costs would be \$14,931 to \$29,197 if the children were treated with cromones, and \$7110 to \$8462 if they were treated with inhaled steroids.

Discussion

There were three main findings in the present study. First, hospital treatment was rarely used in children with asthma, and regular medication significantly decreased the use of hospitals. The hospitalization risk was 5.3–5.8% for children on regular asthma medication. In contrast, 7.9% of those not on regular medication were hospitalized during the study year. Second, acute respiratory infection was the most common trigger for exacerbation of asthma leading to in-patient treatment. Over 60% of the children were hospitalized for infection-induced exacerbation of asthma. Third, regular medication for asthma, in the short

term, seems not to be financially beneficial. In Kuopio province with a child population of 46,000, the total annual costs of regular preventive medication for the children with asthma were about \$0.5 million, compared with \$0.16 million for hospital in-patient treatment and with \$0.05 million for productivity losses of the caregivers. There is an urgent need for studies to evaluate the total cost of asthma and asthma treatment, in children.

The prevalence of asthma in children is 4–4.5% in the Kuopio area (9,10). This means that about 2000 children in the area suffer from asthma and 5% of them were hospitalized during the study year. Regular medication was used extensively in the area: >80% of the children estimated to have asthma were on regular medication. Our admission figure is somewhat higher than that reported in Sweden and in Switzerland, where the asthma prevalence was 6.7% and 7.6%, respectively, and the hospital admission rate 2.6% and 3.4% (12,13). In our study, the proportion hospitalized was similar, about 3%, in children >5 years of age. The re-admission rate in Kuopio province was 19% during the study year, which is lower than the proportion of 29% reported in Baltimore, USA. The high rate may be, at least partly, explained by the follow-up time, which was 12 months from the index admission instead of our calendar year (14). On the other hand, our results are in accordance

Table 5. Costs of maintenance therapies for asthma in the child population, costs of hospital treatment, and costs of estimated productivity losses of the caregivers in relation to the maintenance strategy in Kuopio province in 1998

	Cromone	Inhaled steroid	No maintenance
Number of children with asthma in the population	882	817	394*
Costs of maintenance drugs in the population (\$)	318,000	168,000	No
Number of children hospitalized for asthma (episodes)	28 (30)	47 (68)	31 (38)
Patient-specific costs of hospital treatment (\$)	26,400	92,600	45,400
Patient-specific costs of productivity losses (\$)	9,400	25,800	13,600
Costs/patient/year (\$)†	400	350	150

*Figure estimated based on the asthma prevalence of 4.5% (see references 11, 12 and 13).

†Costs of maintenance drugs, hospital treatment and productivity losses combined.

with the 6-month re-admission probability reported in Canada, where 20% of children <4 years of age and 11.7% >5 years of age were re-admitted (15). The need for intensive care in children with asthma has been very uncommon in Finland during the last two decades, with only 0.8% of the children admitted for asthma needing intensive care (16). In the present study, covering all pediatric asthma cases during a 1-year period in a particular area, intensive care treatment was not needed. This may be a result of the wide use of preventive medication, as discussed in a recent study in Sweden (17).

According to the step-wise treatment policy that we follow, mild-to-moderate cases of asthma (about 70%) are treated by cromones, and moderate-to-severe cases (about 30%), including those not controllable by cromones, by inhaled steroids (2,11,18). However, according to the SII registers, the proportion of children on inhaled steroids in the province has increased from 1994 onwards, reaching 50% today, so we are moving slowly closer to the practice used in other areas of the country. Fewer than 30% of the admitted children were not on regular medication for asthma, in comparison with 48–49% reported in Australia and in Switzerland (8,13). The age-adjusted risk for hospitalization was 5.8% in children on cromones and 5.3% in those on inhaled steroids. The figures are clearly less than the 7.9% risk in children with asthma who are not on regular therapy. To our knowledge, no population-based comparable data have so far been published.

No more than 60% of the children on regular maintenance medication intensified anti-inflammatory therapy at the onset of the infection (despite instructions given beforehand). This compliance rate is higher, albeit sub-optimal, than that reported in Australia, where less than 10% of families who possessed an asthma crisis plan at home actually used it (8). On the other hand, as many as 90% of the children on regular therapy added sympathomimetics at the onset of symptoms; this result is consistent with data published previously (19). Nevertheless, the asthmatic symptoms caused by infections frequently begun so quickly that these measures were insufficient. Moreover, it has been suggested that increasing the dose of inhaled steroids at the onset of an exacerbation of asthma is ineffective (20) and does not influence the need for hospital care (21). In accordance, the use of intermittent inhaled steroids did not reduce the admissions of children on cromones in the present study. Adding inhaled steroid to the regular therapy or doubling the dosage has been common practice in many

centers, despite there being no evidence that these measures are beneficial.

Acute respiratory infection was the most important trigger for the exacerbation of asthma, as has been observed previously (3). Allergic exposure was considered to be the principal reason for admission in 24% of the patients in our study. The proportion was higher than that of 8% suggested previously, at least partly because of age-adjustment (22). As in a previous study conducted in Finland, birch pollen was found to be the most important allergic trigger for admissions (5). A clear time-trend correlation has been found between the rise in admissions for asthma and the rise in counts of grass or other airborne pollens (4,23). Respective data are not available on birch pollen exposure in other Nordic countries. In agreement with results from Norway (24), we did not find grass pollen to be an obvious trigger. Asthma symptoms may be associated with low compliance in the use of regular anti-inflammatory medication, as well as irregular control visits to the doctor, delay in seeking hospital care, and neglect of instructions for the use of medication (6,8,25). Poor compliance was considered to be the sole reason for admission in only 5% of the patients with previously diagnosed asthma. The figure represents fewer than 0.5% of the children with asthma in Kuopio province, supporting previous findings that the treatment balance, on average, is good in this area (11,26).

In the present study, 'new' asthma was diagnosed in 29% of the admitted children. After adjusting by age, the figure was still as high as 21%. During the study year, birch pollen concentrations were high, and 13% of all new diagnoses were made during the last 2 weeks in May. All admitted children with previously diagnosed asthma were on regular medication. This finding is consistent with a recent observation from Australia (8). Therefore, exacerbations in children with asthma, who are not on regular medication can be treated, in most cases, at the out-patient clinics.

The costs for in-patient care represented 1.3% of the total expenditure of the pediatric clinic, and were ≈\$79 for every asthmatic child in Kuopio province. The costs are markedly lower than those reported for the USA or for Switzerland (13,27). Our finding that 7% of admissions to the pediatric ward were because of asthma is consistent with previously published data (22). Indirect costs are difficult to assess, and therefore only the productivity losses of the caregivers were used in the present study. To our knowledge, no regional Finnish or Nordic studies have been published that analyse direct and indirect costs of asthma in

children. Hence, direct comparison with areas that have a similar healthcare system is not possible. Recent observations in the UK suggest that the total costs of asthma rise 3.5-fold if the patient has asthma symptoms necessitating hospital admission (28). The respective rise was clearly higher, eight-fold, in our study. Although the annual average costs were low in children with no regular therapy, this high figure, as well as factors of the quality of life, support regular medication.

The annual expenditure on regular anti-inflammatory medication for pediatric asthma in the Kuopio province is about \$0.5 million. On the basis of the figures of the present study, \$7110 to \$29,200 – depending on the maintenance strategy – are needed to avoid one hospital treatment period for an exacerbation of asthma. Regular therapy with cromones is more expensive, and the NNT value higher than that with inhaled steroids. High prices, and especially frequent dosage (29), may decrease compliance, in particular if the child has only mild symptoms. Furthermore, at the population level, the age-adjusted risk for admittance for asthma was almost the same in children on cromones as in those on inhaled steroids, although cromones are used for mild-to-moderate symptoms. On the other hand, in contrast to inhaled steroids, cromones contribute no risk of systemic side-effects on either adrenal or bone metabolism, and the effectiveness seems to be similar to that of inhaled steroids when the treatment groups are well selected (30).

The strengths of the present study were the strict prospectiveness and representativeness of a certain child population from a geographically defined area. The data on regular anti-inflammatory medication were collected from national registers, including data on the real-time follow-up of the actual consumption of the drugs. On the other hand, the follow-up period was only 12 months, so the hospitalization rates were dependent on viral outbreaks and pollen concentrations, both of which may vary greatly from year to year. The doses of regular medication used in the calculations were average pediatric doses; no diaries were available. In addition, our study design did not allow any exact cost-effectiveness analysis, as no data on out-patient care costs were available.

In summary, 4.5% of the children in Kuopio province have asthma and 3.7% are on regular medication. Half of these children use inhaled steroids, 30% cromones with intermittent inhaled steroids, and 20% cromones alone. The age-adjusted risk for admittance is 5.8% in mild-to-moderate cases treated by cromones, 5.3% in moderate-to-severe cases treated by inhaled ster-

oids, and 7.9% in those with no regular medication for asthma. The principal trigger for asthma, leading to hospitalization, is acute respiratory infection. The initiation of regular anti-inflammatory medication in the 0.8% of asthmatic children with no preventive drug would lead to a reduction of $\approx 30\%$ in the relative hospitalization risk.

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