Accepted: 17 November 2017

DOI: 10.1111/pai.12839

ORIGINAL ARTICLE

WILEY

Evaluation of a diagnostic therapeutic educational pathway for asthma management in youth

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Abstract

Background: In spite of some evidence for positive effects of patient's education to asthma self-management by randomized clinical trials, there are few studies on the impact of patient' s educational programs in the real world. We aimed to assess the impact of a diagnostic therapeutic educational pathway (DTEP) on asthma control of children and adolescents by comparing frequency of outcomes indicative of asthma control before and after attending the pathway.

Methods: This is a retrospective cohort study including all patients aged 6-11 and 12-17 years who attended the DTEP in 2007-2014. The DTEP includes 3 specialist's evaluations at 8- to 12-week intervals and two follow-up visits. Patients and their parents receive an educational course concerning prevention measures, early recognition of symptoms, and appropriate use of drugs and devices. The rates of hospitalizations, outpatient services, emergency room visits, and drug prescriptions were considered as outcomes and computed as number of events divided by person-time.

Results: A total of 806 patients were enrolled. A statistically significant decrease in rates from before to after DTEP was observed for almost all outcomes, in both age groups, with relative risks ranging from 0.12 to 0.60. The rates of drug prescription showed a statistically significant decrease, from before to after DTEP, for each type of medicine for asthma, in both age groups, from percent difference of −66% to −24.3%.

Conclusions: The positive impact of this program on the outcomes indicative of asthma control in both children and adolescents suggests that it may be valuable for asthma management.

KEYWORDS

asthma, before-after evaluation, children and adolescents, cohort study, educational pathway, GINA guidelines adherence, patient and family empowerment, real life, self-management

1 | INTRODUCTION

Asthma is the most frequent childhood chronic disease and can significantly undermine quality of life in children and their families.[1] GINA guidelines[2] highlight many recommendations leading to optimal management of asthma, which can be summarized in three areas: achieving control of symptoms, maintaining lung function, and patient education.

However, adherence to asthma guidelines has been found to be poor in primary care practices in an US study,[3] and a multicenter European study showed that only 5.8% of children met all GINA guidelines criteria for asthma control.[4] Other recent studies conducted in Italy, and other European countries showed that about a half of treated adult asthma patients had not well-controlled asthma.[5,6]

In a recent systematic meta-review, self-management of asthma, a core component of which was patient's education, improved asthma control and reduced hospitalizations and emergency attendances.[7] A systematic review of randomized clinical trials found that about the half of educational and behavioral interventions achieved reduction in the use of health care and one-third in symptom control.[8]

In spite of the evidence of the positive effects of education of asthmatic patients to self-management of their disease, there is still poor assessment of the impact of patients' educational programs on asthma control in the real world. In our practice, we have adopted current guidelines for asthma control through the development of a diagnostic therapeutic educational pathway (DTEP) called "Io e l'Asma," based on a strong integration between clinicians and therapeutic educators and between specialists and primary care physicians.[9-11] In the present study, we aimed to assess the impact of the DTEP of children and adolescents, by comparing the frequency of outcomes indicative of asthma control before and after attending the pathway.

2 | METHODS

2.1 | Patients

According to the Italian National Health Service, primary health care is provided for each child by a pediatrician or general practitioner, with the support of specialists, in agreement with the GINA guidelines. However, asthmatic patients may fail to be treated properly and lack adequate information for the disease self-management according to some studies.[6] For this reason, a DTEP for asthma management and care in children was established some years ago in the Brescia Spedali Civili Hospital, to give each child the opportunity for homogeneous and standardized levels of care in agreement with GINA guidelines.

The Center "Io e l'Asma" is an outpatient pediatric asthma center which provides a diagnostic therapeutic educational pathway (DTEP) aimed to obtain and maintain the asthma control, to reduce future risk of exacerbations and adverse outcomes, focusing on the autonomy of child and family and relying on a strong collaboration between specialists, primary care physicians, and healthcare assistants.[9,11]

The DTEP includes three specialist's evaluations at the Center, at 8- to 12-intervals from each other, and two follow-up specialist's evaluations 6 and 12 months after the last specialist's evaluation (Figure 1). At first visit, patients and their parents follow a short educational course by a healthcare assistant, on prevention measures, early recognition of symptoms, and appropriate use of drugs and devices. They are also educated on how to maintain a healthy lifestyle and

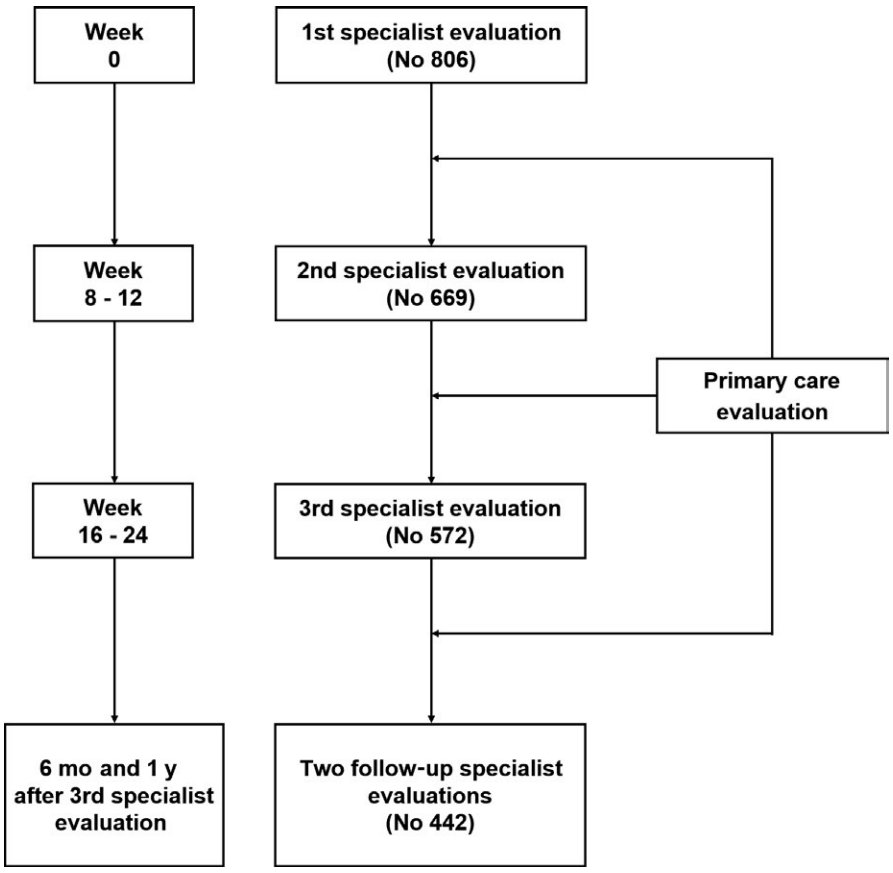

FIGURE 1 "Io e l'Asma" diagnostic therapeutic educational pathway (DTEP)

keep a diary for monitoring symptoms. At second and third visits, the physician evaluates the levels of asthma symptom control and therapy adherence.[2,12] After each specialist's visit, the child is sent to his/her pediatrician for primary care evaluation.

During the follow-up period, the educational course can be repeated in a group session including more than one patient and their parents, to enhance learning through the confrontation between subjects with similar experience.

2.2 | Study design

This is a retrospective cohort study. All children and adolescents attending the Center were included in the study according to the following criteria: a) age between 6 and 17 years; b) at least one access to the Center between September 1, 2007, and December 31, 2014; and c) residence in Brescia Province. We collected demographic and clinical data from the Center database.

The study was approved by the Ethics Committee of Brescia Province (Italy), registration number 2046, on June 15, 2015.

2.3 | Outcome and data record linkage

We performed a record linkage between the Center database and the health database of the Brescia Local Health Agency (LHA) to compare occurrence of events related to asthma control before and after admission to the Center. The Brescia Local Health Agency database is a comprehensive and integrated information system including several databases tracking and listing all the health services provided by the NHS for each individual of the resident population.

The outcomes were the following asthma-related events: a) hospitalizations with primary or secondary discharge diagnosis of dyspnea or respiratory diseases; b) emergency room visits with primary or secondary diagnosis of dyspnea or respiratory diseases; c) outpatient services with spirometry, skin prick test, RAST test, ImmunoCAP or microarray ISAC, PRIST test; and d) drug prescriptions of adrenergic aerosol, glucocorticoid aerosol, systemic leukotriene receptor antagonists, and systemic corticosteroids. More details and related codes are listed in Table S1.

Hospital discharge data were available from September 1, 2007, to December 31, 2014, whereas all the other data were available from January 1, 2010, to December 31, 2014.

2.4 | Data analysis

All the analyses were performed in patients aged 6-11 and 12-17 years separately, because of different types of therapies and challenges in asthma treatment in children and teenagers.

The asthma onset was established as the date at which the first asthma-related event occurred in the study period, whichever it was. The age of children at diagnosis was calculated by the difference between the date of asthma onset and birthdate. Only subjects with the first asthma-related event inside the observation period (incident cases) were included in the analysis.

The rates of hospitalizations, emergency room visits, outpatient admissions, and drug consumption were computed as the number of events divided by the person-time throughout the period, multiplied by 1000 (No. of events per 1000 person-years). The person-years were computed as the sum of the observation times in the period for each subject, from the asthma onset, as previously defined, until the end of the observation period (December 31, 2014). The number of person-years is different for the asthma-related events, because of the different dates in which data were first available. The incidence rates of each outcome before and after attending the DTEP were computed. The 95% CIs of the rates were calculated assuming a Poisson distribution. We also calculated the ratio of after to before DTEP rates for each outcome variable (rate ratio, RR), and the corresponding 95% CI. Two-sided exact significance tests were performed for RRs. All the data analyses were performed using the Stata program, version 14.

3 | RESULTS

A total of 806 patients aged 6-17 years attended the Center "Io e l'Asma" from September 1, 2007, to December 31, 2014, including 635 patients aged 6-11 years (431 males) and 171 patients (95 males) aged 12-17 years. Among them, 572 patients (70.8%) completed the therapeutic educational pathways, attending 3 or more specialist's evaluations (71.2% and 69% among subjects aged 6-11 and 12-17 years, respectively).

Using the hospital discharge data that cover the longest observation period, the follow-up time was 3199.71 person-years for 6- to-11-year-old and 7388.68 person-years for 12- to 17-year-old subjects, with a mean of 5.0 and 4.5 years for each subject, respectively.

The number of health events and the incidence rates before and after DTEP in 6- to 11- and 12- to 17-year-old patients, for each outcome, is set out in Table 1. The percent differences between the after and before DTEP rates and the incidence rate ratios (RRs) are also shown. A statistically significant decrease in all incidence rates from before to after DTEP was observed in both age groups, with RR estimates from 0.12 to 0.60, except for outpatient services in children aged 6-11 years (−1.3%, not statistically significant). The incidence rates percent reduction was higher for each outcome in older (12-17 years) than in younger (6-11 years) patients. No differences were observed between males and females.

The asthma control of patients attending the DTEP was relatively poor at the first visit: those with uncontrolled, partly controlled, and well-controlled asthma were 23.5%, 32.4%, and 35.9%, respectively (for 8.2% patients, no data were available). In the patients who followed the DTEP, the percentages of those with uncontrolled, partly controlled, and well-controlled asthma were 3.2%, 13.7%, and 82.5%, at the third visit, respectively (0.6% patients with missing data) (data not shown in table).

The rates of drug prescription showed a statistically significant decrease from before to after DTEP, for each type of medicine for asthma in both age groups, from percent difference of −66% in 12- to 17-year-old patients to −24.3% in children aged 6-11 years for inhaled

TABLE 1 Frequency of health outcomes before and after attending the diagnostic therapeutic educational pathway (DTEP), % differences of after-before DTEP rates and ratios of after to before DTEP rates (rate ratios, RRs), in 6- to 11- and 12- to 17-y age groups

Outcomes	Age group (y)	Before DTEP		After DTEP		% difference after-before DTEP rates	RR (95% CI) after to before DTEP rates	*P*-value*
		No.	Rate per 1000 (95% CI)	No.	Rate per 1000 (95% CI)			
Hospitalization	6-11	50	52.3 (38.8-69)	39	17.4 (12.4-23.8)	−66.8	0.32 (0.21-0.51)	*P* < .0001
	12-17	4	70.4 (19.2-180.2)	12	16.7 (8.7-29.2)	−76.2	0.23 (0.07-1.01)	*P* = .03
Emergency room visit	6-11	104	130.6 (106.7-158.2)	155	76.6 (65-89.6)	−41.3	0.58 (0.45-0.75)	*P* < .0001
	12-17	12	287.4 (148.5-502)	24	36.9 (23.6-54.9)	−87.2	0.12 (0.06-0.28)	*P* < .0001
Outpatient services	6-11	238	298.8 (262-339.2)	597	295 (271.8-319.6)	−1.3	0.98 (0.84-1.15)	*P* > .1
	12-17	20	478.9 (292.5-739.7)	156	239.6 (203.5-280.3)	−50	0.50 (0.31-0.84)	*P* = .008
Drug prescription	6-11	7308	7707.24 (7531.5-1886)	10182	4694.15 (4603.4-4786.2)	−39.1	0.60 (0.59-0.62)	*P* < .0001
	12-17	566	9968.73 (9164.3-10824.9)	2648	3795.79 (3652.6-3943.2)	−61.9	0.38 (0.34-0.41)	*P* < .0001

DTEP, diagnostic therapeutic educational pathway; CI, confidence interval.
*Exact significance tests (binomial probability).

corticosteroids (Table 2). Again, the reduction was higher among 12- to 17- than 6- to 11-year-old patients for each medicine type. It is noteworthy the decline in prescription of leukotriene receptor antagonist (age 6-11: −44.8%; age 12-17: −58.3%) and in systemic steroid prescription (age 6-11: −46.7%; age 12-17: −64.3%).

Total, per patient, costs of drug prescriptions for asthma per year decreased from before to after DTEP, in children aged 6-11 and 12-17 years, from 160.24 to 91.59 and from 200.33 to 90.55 euro, respectively (data not shown in Table).

No differences in the incidence of all the outcomes were found between patients attending and not attending 3 or more visits at the Center, in both age groups (data not shown in table).

4 | DISCUSSION

To our knowledge, this is the first study which assessed the impact of a diagnostic therapeutic educational pathway (DTEP) on asthma control in children and adolescents using objective outcome measures in the real world.

Our study showed a positive impact of the DTEP on various outcomes indicative of asthma control by a before-after comparison. Similar findings were observed in patients aged 6-11 and 12-17 years, though the reduction in outcome rates was higher in the oldest patients. Also drug prescription declined from before to after the DTEP more among the oldest patients than the youngest, for each type of asthma drugs and antibiotics. Overall, these findings suggest that a better control of the disease was achieved after, with respect to before, attending the DTEP. Also the decline in prescription of leukotriene receptor antagonist (-44.8% and −58.3% in patients aged 6-11 and 12-17 years, respectively) suggests that disease control was obtained with only low doses of inhaled corticosteroid. Accordingly, the decline in systemic steroid prescription (−46.7% and −64.4% in patients aged 6-11 and 12-17 years, respectively) suggests a reduced frequency of severe asthma and wheezing attacks. An analysis of the clinical data collected at the Center confirmed these results, showing an increase in proportion of patients with controlled asthma.

The decrease in incidence rates for all the outcomes assessed in our study probably determined a decrease in both direct and indirect asthma-related costs, although they are difficult to quantify. However, we could compute the costs per patient for drug prescriptions for asthma, which showed a sharp decrease from before to after DTEP, in both children aged 6-11 and those aged 12-17 years, in agreement with a Finnish experience that improvement of asthma care determined a reduction in total costs for the disease, including costs of medication.[13]

These results confirm our preliminary evaluation of the DTEP, which showed clinical improvements as well as a reduction in, or more efficient use of, asthma medication.[10] Accordingly, in another study we showed a significant reduction in the proportion of children with persistent symptoms and of those with maintenance treatment, and a decline of prescription of medication for exacerbations, from before first visit to follow-up.[9]

Evidence from controlled clinical trials shows that asthma control can be substantially improved by self-management, a core component of which is patient's education,[7] although some differences have been noted according to type of approach, outcomes assessed and program providers.[8] An Italian trial showed that an educational program for children with asthma reduced the number of asthma attacks and improved knowledge of the disease.[14] Another study showed that a comprehensive asthma program based on a strong relationship between family, physician, and school carried showed a significant increase in clinical asthma scores.[15]

TABLE 2 Rates of drug prescription before and after attending the diagnostic therapeutic educational pathway (DTEP), % differences of after-before DTEP rates and ratios of after to before DTEP rates (rate ratios, RRs) according to drug, in 6- to 11- and 12- to 17-y age groups

Drugs	Age group (y)	Before DTEP		After DTEP		% difference after-before DTEP rates	RR (95% CI) after to before DTEP rates	*P*-value*
		No.	Rate per 1000 (95% CI)	No.	Rate per 1000 (95% CI)			
Salbutamol	6-11	1432	1510.2 (1433-1590.5)	2289	1055.3 (1012.5-1099.4)	−30.1	0.69 (0.65-0.74)	*P* < .0001
	12-17	105	1849.3 (1512.6-2238.7)	629	901.6 (832.6-975)	−51.2	0.48 (0.39-0.60)	*P* < .0001
Inhaled corticosteroids	6-11	1468	1548.2 (1470-1629.5)	2542	1171.9 (1126.8-1218.4)	−24.3	0.75 (0.70-0.80)	*P* < .0001
	12-17	128	2254.4 (1880.8-2680.5)	534	765.5 (701.9-833.2)	−66	0.34 (0.28-0.41)	*P* < .0001
Combination aerosol therapy	6-11	521	549.5 (503.3-598.7)	453	208.8 (190.1-229)	−62	0.38 (0.33-0.43)	*P* < .0001
	12-17	56	986.3 (745-1280.8)	236	338.3 (296.5-384.3)	−65.7	0.34 (0.25-0.46)	*P* < .0001
Leukotriene receptor antagonists	6-11	471	496 (452.9-543.7)	595	274.3 (252.7-297.3)	−44.8	0.55 (0.48-0.62)	*P* < .0001
	12-17	16	281.80 (161.1-457.6)	82	117.5 (93.5-145.9)	−58.3	0.41 (0.24-0.76)	*P* = .004
Systemic steroids	6-11	388	409.2 (369.5-452)	473	218.1 (198.9-238.6)	−46.7	0.53 (0.46-0.61)	*P* < .0001
	12-17	29	510.8 (342.1-733.5)	127	182.1 (151.8-216.6)	−64.3	0.35 (0.23-0.55)	*P* < .0001
Antibiotics	6-11	3028	3193 (3080.7-3309)	3830	1765.7 (1710.2-1822.6)	−44.7	0.55 (0.52-0.58)	*P* < .0001
	12-17	232	4086.1 (3577.2-4647.1)	1040	1490.8 (1401.6-1584.2)	−63.5	0.36 (0.31-0.42)	*P* < .0001

DTEP, diagnostic therapeutic educational pathway; CI, confidence interval.
*Exact significance tests (binomial probability).

The "Io e l'Asma" pathway applies the internationally recognized guidelines for asthma care (GINA) and is intended to improve adherence to therapeutic pathway and to make the patient proactive in the everyday management, thanks to an open collaboration between specialists and general practitioners. Recently, this model was expanded to include health promotion interventions to address underlying health aspects associated with pediatric asthma, as obesity, smoking habits, bullying, and dietary habits. A pilot study showed significant improvements in asthma exacerbation, activity limitation, and asthma control in an intervention group who participated in this health promotion pathway compared with a group who did not participate.[11]

This study has some limitations. First, the study has a retrospective cohort design, analyzing the impact of an educational program to asthma control in children and adolescents in past years. However, we used objective outcomes for evaluating children's and adolescents' asthma control, taken from the general population database of the LHA, limiting the risk of selection or information bias. Second, the lack of a control group does not allow a comparison between the children and adolescents who participated and those who did not participate in the education program. In a previous study, we found that children participating in the DTEP had a significantly better asthma control than a control group who had been referred to the program but did not participate.[11] In a companion article, we will compare asthmatic children attending and non-attending the "Io e l'Asma" Center.

New, Internet-based approaches have been proposed for more cost-effective interventions of patients' therapeutic education. In one randomized controlled trial on children and adolescents with asthma, both traditional patients' education and case management and an Internet-based home monitoring and education program achieved excellent results in asthma control.[16] In another trial, however, a program for optimizing parents' management of childhood asthma showed considerable interest in website pages but poor intervention uptake and high rates of attrition.[17] A systematic review showed that also serious games caused improvements in children's knowledge but little or no change in behaviors and clinical outcomes.[18] Therefore, an approach based on the newly available technology tools does not seem more effective in asthma control than the traditional approach so far.

In conclusion, the present study provides a medium-term evaluation of the impact of the "Io e l'Asma" pathway for asthma control in children and adolescents using routinely collected data. The positive

impact of this program on almost all the outcomes indicative of asthma control in both children and adolescents suggests that it may be a model for management of asthma and possibly of other chronic diseases.

ACKNOWLEDGMENTS

We thank the primary care physicians group of Brescia to share the pathway and the Associazione Laboratorio Clinico Pedagogico e Ricerca Biomedica Onlus.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

How to cite this article: Guarnaccia S, Quecchia C, Festa A, et al. Evaluation of a diagnostic therapeutic educational pathway for asthma management in youth. *Pediatr Allergy Immunol*. 2017;00:1–6. https://doi.org/10.1111/pai.12839