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## Monitoring the hospital management of acute asthma: the Italian Pediatric Network experience

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### KEY WORDS

asthma; children; hospital management; GSAQ

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### Summary

**Background.** The Study Group on Accreditation and Quality Improvement of the Italian Society of Pediatrics has developed an observational study about the hospital management of pediatric patients affected by severe asthma, in order to evaluate how the Guidelines for severe asthma in childhood are applied in the daily practice. **Methods.** This study included patients between 2 and 17 years, hospitalized or under short intensive observation for acute asthma. The data collection was carried out through the compilation of on-line forms. The statistical technique used was the Chi Square test. **Results.** 409 forms were filled in by 32 Italian Centers. 17% of the patients showed severe asthma, 59% moderate and 24% mild. On arrival at the Emergency Room the oximetry was measured in 95% of the patients, the respiratory rate in 64% while the heart rate in 88% of them. 48% of the children were exposed to chest X-ray. More than half of the children received oxygen therapy, 98.5% received short-acting beta-2 agonists and systemic steroid therapy was given to 82% of children, mainly orally. At discharge only half of the children were provided with written instructions for the management of any subsequent asthmatic episode. The analysis of the collected data highlights that not all the children had their oxygen saturation measured, although this parameter is one of the main indicators of disease severity, as well as the respiratory rate, which was detected in a minimal percentage of cases. The frequency of chest X-ray was extremely high, even though it does not have any indication in the majority of asthma cases. The evaluation of the therapeutic treatment denotes an adequate use of the oxygen therapy according to the oximetry values found on arrival, but an abuse of steroid therapy. Critical issues emerge at discharge: children are not always educated about the home management of the disease and the self-evaluation of the illness seriousness. **Conclusions.** The pediatric network has become an excellent system of monitoring of the clinical management of asthmatic children, highlighting strengths and weaknesses on which to focus actions of improvement.

### Background

During the past years there has been a significant increase in pediatric asthma cases worldwide (1). This epidemiological evaluation was mainly directed by the ISAAC International Study (2,3) through computerized and hard-copy standard questionnaires,

with detection of higher prevalence of asthmatic symptoms in developed countries, but greater symptom severity in developing countries.

This trend prompted the need to draft more and more updated National and International Guidelines for the treatment

and the diagnosis of asthma and to monitor the adherence of pediatricians to the optimal indications in the management of childhood asthma. While many documents (4,5,6) have been published suggesting the various steps to the diagnosis and therapy of asthma and indicating the parameters to evaluate the patient adherence to the medical instructions, little is known on how the national and international Guidelines of pediatric acute asthma management are applied in everyday clinical practice. Since Italy is not exempt from this evident lack of data, the Study Group on Accreditation and Quality Improvement (GSAQ) of the Italian Society of Pediatrics (SIP), in the context of a network of analysis of the various pediatric pathologies, issued an observational study on the hospital management of the pediatric patients with acute asthma.

## Methods

From 2009 to 2013, 2 to 17-year-old patients, either hospitalized or under short intensive observation were recruited. The patients with positive or suspected post-infectious wheezing were excluded, on the basis of medical history and clinical signs of recent or concomitant infection on physical examination.

The data were gathered through the compilation of on-line forms accessible after registration on the Network website (7). The sheet was designed by a team of experts, on the basis of the Italian Guidelines for acute asthma in children (4), directly available at the dedicated link of the Network website. The sheet included several sections, referring to each of the diagnostic-therapeutic steps, starting from the collection of the anamnesis, the vital signs, the clinical management, to the procedures of hospitalization and discharge. To limit the bias raised by the subjective clinical interpretation of any physician, the form included impartial parameters, favoring quantifiable information (blood oxygen saturation, respiratory rate). For the same reason the questions that were not requiring the input of numeric data, in almost all the cases, required simple answers as YES/NO, preventing the possibility of entering free text. In addition, the Network tool offered the Centers the possibility to view the statistical analysis of their own data, and compare them to the ones collected at Regional or National level.

For each Center participating, one or more pediatricians, mainly allergists, were identified, and trained on how to fill in the sheets. They were responsible of data loading both of their own patients and of the ones managed by their colleagues from the same hospital organization, taking the information from the medical records of hospitalization or from short intensive observation. The export of the data from the Network sheets was performed through the portal. The information normalization and the variables definition under examination was carried out using the Microsoft Access database.

## Statistical Analysis

The study was set up as an exploratory investigation, preliminary to further studies focused on specific clinical aspects. The purpose was to identify significant connections between variables that regarded the following aspects: personal data, anamnesis, description of the acute event, therapy and the procedures of hospitalization and discharge. It was possible to represent the variables through contingency tables, since they were measured on nominal range. The proper statistical technique in this case is the Chi Square test for the independence of categorical variables. This test evaluates the general hypothesis that the considered variables are mutually independent, or, in other words, that the correlation between them is equal to zero. This is the null hypothesis, to falsify. First the following assumptions were verified: independence of the observations (meaning to reject variables representing repeated measures in the same patients); presence of not more than 20% of expected frequencies less than 5; no observed frequency equal to zero. In the first stage, the contingency tables were submitted to the Chi Square test as they appeared, without handling the original frequencies. In the following stage, in some cases the variables were aggregated, in order to delete the cells lacking informative content. In the tetrachoric tables, the significance was evaluated also through the Fisher exact test. In the relations showing a p-value < 0.05 the following factors were also evaluated: the strength of the association between the variables, by the Cramér's V coefficient, and the falsity degree of the null hypothesis, utilizing an index of the effect size (Pearson's Phi). Furthermore, the adjusted standardized residuals were analyzed, in order to identify the cells of the contingency table mainly responsible of the association between the variables. With the information referred to a sample of 409 patients and collected into 71 variables, 39 connections were found, on which the analysis was focused.

## Results

### Anamnesis

409 completed forms were collected from 32 Italian Centers. The population considered in the study was 55% males and 45% females; 57% of the patients were in their preschool age (< 6 years) and 43% were 6 to 17 years old. About 48% showed positive personal history of allergic diseases and 66% of asthma. 11% of the patients referred a hospitalization for asthma in the past 12 months. Only a small percentage (16%) was already taking a controller anti-asthmatic medication, while 49% was already under a home therapy for acute episodes before the access to the hospital. 81% of the patients (87.7% in preschool age and 75.3% in school age) arrived to the hospital without a previous consultation with their own Pediatrician or Family Doctor.

### Parameters at entrance

The parameters collected at entrance are shown in **table 1**. An oximetry value below 92% was found in 29% of the cases, above 95% in 22% and an intermediate value in 44% of the cases. 5% of the patients did not have their oximetry value measured at entrance.

The classification of the asthma severity level identified 17% of the cases as severe, 59% as moderate, and the remaining 24% as mild.

**Table 1** - Parameters collection at entrance.

	YES	NO
Oximetry	95%	5%
Respiratory rate	64%	36%
Heart rate	88%	12%

### Clinical management

The data about the clinical management of asthma are summarized in **table 2**. The bronchodilator therapy was administered in 77% of the cases via nebulizer and only in 33% through puff with spacer. The systemic cortisone therapy was mainly administered orally. The children treated with an antibiotic therapy took mainly macrolides.

**Table 2** - Clinical management.

	YES	NO
Oxygen therapy	54%	46%
Short-acting beta 2 agonist	98.5%	1.5%
Systemic steroids	82%	18%
Inhaled steroids	37%	63%
Antibiotic therapy	30%	70%
Chest X-ray	48%	52%

### Discharge and follow up

At discharge (**table 3**) half of the children received written instructions on how to follow the clinical management at home and about the self-assessment of the disease: most of them were patients with a known diagnosis of asthma.

**Table 3** - Discharge and follow up.

	YES	NO
Written instructions	51%	49%
Prophylaxis at discharge	37%	63%

## Discussion

### Anamnesis

In a country like Italy, in which the territorial Family Pediatrician has been available for several years now, the analyzed data still show an excessive number of spontaneous accesses to the Emergency Room (ER) without a previous consultation with the Family Doctor. There seems to be a correlation between the spontaneous entry in ER and the patients' age ( $p < 0.022$ ), in other words the youngest children (3-5 years) are more frequently brought to the hospital without a previous evaluation of the Family Pediatrician.

This issue, in our opinion, is due to the fact that the parents of the youngest children have less experience in the management of this pathology: often it is the first time they have to deal with it, and consequently their greater concern prompts them to look for immediate support at ER. The literature also outlines that in children of pre-school age it is more difficult to classify the type and the severity of acute asthma attacks (8): if it is hard for clinicians, it would be even more difficult for parents. The analyzed data do not point out a significant connection between asthma severity and age range of occurrence: at any age the asthma attack diagnosed at ER could be mild, intermediate or severe.

### Parameters at entrance

The respiratory rate and the oximetry, as stressed in the Guidelines (4), are the fundamental parameters to define the severity of a clinical episode. The analysis of the collected data highlights that the oximetry was not measured in all the cases; even more important is the missing measurement of the respiratory rate in about one third of the patients. However, the allocation in the classification of asthma severity based on the oximetry values, heart and respiratory rate was found to be correct, in accordance with the Guidelines (4).

### Clinical management

Although the frequency of oxygen administration increased with asthma seriousness, our data point out how the oxygen therapy was used not only, as indicated by the Guidelines (4), in the cases with oximetry values below 92%, but also in about

half of the children with oximetry between 92 and 95% and in a fifth of the children with values above 95%.

Similarly, although the frequency of use of systemic corticosteroids increased with asthma severity, the study showed an abuse of this therapy, that should be reserved only to patients with moderate and severe asthma: even if not optimal, our data outlined an adequate administration of systemic steroids to the patients with moderate and severe asthma, but an excessive use in those with mild asthma. Frequent use of steroids therapy by nebulizer was reported as well, which is not suggested by the Guidelines (4) for acute asthma treatment. The adequacy of the correlation of the severity classification with the oxygen saturation values has already been verified, so we do not believe that excessive corticosteroid prescription could be linked to a wrong clinical evaluation but, as for oxygen therapy, to an excessively aggressive approach to the management of this pathology by physicians.

Our data, in line with the literature (9,10), indicate a very high frequency of chest X-ray use, even though this procedure is not indicated for the initial management of an asthmatic patient, but should be reserved to the severe asthma cases not responsive to the therapy. On the contrary, no connection was found between the chest X-ray use and greater asthma severity. The X-ray abuse exposes children to unnecessary radiations and increases the costs of health expenditure. However, we noticed that the chest X-ray at entrance in patients with a diagnosis of asthma is highly diffused, especially in some hospitals compared to others. It is not known if those Centers have specific internal protocols which require this exam: anyway, those indications should be updated as soon as possible.

The spirometry is generally not performed, probably due to objective difficulties, the need of highly qualified personnel, an available instrument, adequate patient compliance, and enough time to dedicate to the exam. This consideration is in accordance with what described in literature (11). However, it is crucial for the patient to be offered specialist assessment and ambulatory spirometry, even after some time (11,12).

Our data show, in any case, that the spirometry during the hospitalization, when carried out, was reserved to the most severe asthma cases.

In line with the American data (9), 30% of the patients received an antibiotic therapy, generally with a drug belonging to the macrolides class. Comparing these data with those related to the chest X-ray it appears clear that the majority of the patients who were not submitted to an X-ray did not receive any antibiotic therapy, while almost half of those who had an X-ray were subsequently given an antibiotic therapy. Since the radiographic reports are lacking, it is not possible to define if the decision of setting up an antibiotic therapy was linked to a specific X-ray result that modified the diagnosis or to another therapeutic abuse.

It is common knowledge that the abuse of antibiotic therapy, in addition to being a useless healthcare resources waste, also favors the development of resistance in the population.

#### *Discharge and follow up*

Our data demonstrate the existence of critical issues at discharge too: only half of the children received written instructions and clear explanations on the home management and about the self-assessment of the pathology. Such information was supplied mainly to family of patients with known asthma and thus already partially educated.

In literature there are some international studies that tried to point out the best and most effective follow up options in the post-discharge period and long term follow up (14). In Indiana, they carried out a trial which provided home visits within few days from the discharge by adequately trained paramedic personnel, in order to avoid new hospitalization within a short time of the newly discharged patients but also to evaluate the effectiveness of the therapy and/or prophylaxis prescribed (15). Other studies outline the patients' difficulty in understanding the instructions received at discharge; benefit could be provided by the use of informative videos to be viewed during the hospitalization and/or at pre-discharge stage to help with the communication, often limited by the lack of time to dedicate to this activity (16,17,18). The hospitalization time could be advantageously used also for health education and instructions, even if the improper hospitalizations for asthma should be reduced through a more adequate outpatient and home management of the patients (19).

#### **Conclusions**

The Pediatric Network has become an excellent system of monitoring of the clinical management of childhood asthma, highlighting strengths and weaknesses on which to focus actions of improvement.

On the basis of the data collected, our purpose is now to propose strategies focused on the health personnel training and indications to support the implementation of the Guidelines in their own local reality by means of specific care pathways creation.

Some time from now, a new data collection will provide a feedback on the real effectiveness of the implemented strategies. For the future, we would like to improve the form with some alerts insertion, that on the basis of the loaded data will alarm the compiler on the possible mistakes made in the management of the patient, thus making the compiling task a formative moment, too. These preliminary data could be enriched through wider children case histories entries, thanks to the participation of other pediatric centers as well, that did not take part in this first edition of the study.

## List of abbreviations

GSAQ: Study Group on Accreditation and Quality Improvement  
SIP: Italian Society of Pediatrics  
ER: emergency room

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## Author Contributions

LP AFD GG RL MTO conceived and designed the trial  
LP gave access to the Pediatric Network and provided the clinical registration form  
AGM MB RB BB analyzed the data and wrote the manuscript  
ADV performed the statistical analysis  
All authors read and approved the final manuscript.

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