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To cite this article: J. M. J. E. Meuwissen, J. Heynens, T. Dauven, L. Crasborn, F. W. J. M. Smeenk, T van der Weijden & J. W. M. Muris (2017): Interprofessional Pulmocheck care pathway: An innovative approach to managing pediatric asthma care in the Netherlands, Journal of Asthma, DOI: [10.1080/02770903.2017.1363893](https://doi.org/10.1080/02770903.2017.1363893)

To link to this article: <http://dx.doi.org/10.1080/02770903.2017.1363893>



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Published online: 13 Oct 2017.



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Interprofessional Pulmocheck care pathway: An innovative approach to managing pediatric asthma care in the Netherlands

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ABSTRACT

Objectives: Under-diagnosis and suboptimal asthma control in children persists. An innovative care pathway was developed by a hospital department of pediatrics with the aim to detect pulmonary problems in children and provide appropriate treatment possibilities through systematic feedback towards the referring primary care physician. Primary care physicians can use this pathway to refer children with asthma-like symptoms for a one-day assessment. Goals are to measure the usage of the pathway by primary care general practitioners (GPs), the outcomes in terms of new diagnoses of asthma, the reduction in regular referrals, generated recommendations/therapy and the adequacy of asthma follow-up. **Methods:** We collected all feedback letters sent to the GP concerning children who underwent the Pulmocheck in 2010, 2011 and 2012. Furthermore, all GPs, who had referred a child to the Pulmocheck in this period and that subsequently was diagnosed with asthma and was further managed in primary care, were sent a follow-up questionnaire in 2014. **Results:** There were 121 referrals from 51 GPs in 3 years to this pathway. In 59.5% of these referrals a new diagnosis of asthma was established. In 90.9% one or more changes in clinical management were advised. The response rate to the follow-up questionnaires was 65.7% of which 4.8% of the children with new established asthma were reviewed four times or more in the follow-up period, 17.4% two times, 65.2% once, and in 8.7% were not followed. **Conclusions:** The specialty pediatric asthma care pathway revealed a high number of children with newly diagnosed asthma, but was also helpful to exclude this diagnosis. However, the referral rate of GPs to this pathway was low, but in the children, that were referred several changes in the clinical management were advised and the frequency of monitoring of the children with diagnosed asthma was not in accordance with the asthma guidelines.

ARTICLE HISTORY

Received 24 February 2017
Revised 7 June 2017
Accepted 31 July 2017

KEYWORDS

Asthma; care pathway; children; primary care

Introduction

In Western Europe asthma is one of the most common chronic disorders in children. In the age group 0–12 years, 4–7% of the children have asthma [1,2]. A Dutch report showed that in 2007, the prevalence of asthma in boys aged 0–14 years was 3.5% and in girls aged 0–14 years 2.3% [3].

The prevalence of respiratory symptoms in children in the Netherlands (age range 4–11 years), like wheezing, shortness of breath and cough respectively, is 9–16%, 4–10% and 1–5% [4]. Especially the variation in occurrence of these respiratory symptoms makes asthma difficult to diagnose [5].

Despite many guidelines and research on asthma, studies worldwide still suggest a persistence of under-diagnosis of asthma in children. [6–9]. A Dutch study confirmed this, but pointed also to over-diagnosis of asthma in children in the Netherlands [10].

In the Netherlands, the general practitioner (GP) is the only general primary care physician and they have a role as gate keeper for access of all patients (including children) to healthcare. In the usual situation, he can refer children for a secondary care advice to the specialty pediatrician. Urgent care for children with asthma is provided by the GP. pediatric doctors are not situated in primary care. A special care pathway for children with chronic res-

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piratory symptoms, called the Pulmocheck was developed in cooperation between primary and secondary pediatric care. An important goal of this pathway is to reduce under-diagnosis of asthma in children. Another important purpose of the Pulmocheck is to enable the pediatrician to give adequate advice about the treatment of respiratory symptoms to the GP. The quality of care appears similar in primary and secondary care in the Netherlands. GP, pediatrician and nurse practitioner were compared in a Dutch study. No significant outcome differences were found at a two-year follow-up [11]. However in some cases the GPs can be uncertain about the diagnosis or treatment in children that are suspected of having asthma. When this is the case, the GP can refer children aged 6–18 years with symptoms of coughing, shortness of breath or wheezing to the Pulmocheck. Parents will receive an intake questionnaire prior to the hospital visit. These children are then scheduled within 10–15 working days for an interview with the nurse practitioner specialized in pediatric pulmonary medicine, followed by additional tests: a flow-volume curve before and after application of a β 2-sympathomimetic, a FeNO measurement (Fractional Exhaled Nitric Oxide) and an allergy test (skin prick test). Finally, that same day a final consultation will take place with the pediatrician and a feedback letter, summarizing the findings, stating diagnosis and the necessary (non-)pharmacological advices, will be sent to the GP.

In the hospital, it is routine to monitor children who use inhaled corticosteroids (ICSs) every 4 months at the outpatient clinic. The Dutch Association of Pediatrics has a policy that children with asthma should be seen at least once annually and depending on the disease severity, the frequency and content of the monitoring can be increased [12]. The guideline of the Dutch College of GPs advises a one-time check-up after 3–6 months in children who use short-acting β 2-sympathomimetics. When using ICS as maintenance a check-up every 3 months within the first year of prescription is recommended [5].

Aim of the study

Through this study we seek to evaluate the process and outcome of the Pulmocheck. We were interested in the extent to which the GPs use the Pulmocheck. Also, we were interested in the diagnostic yield and the changes in the clinical management of the children that were recommended because of the care pathway. Finally, we investigated whether the follow-up frequency of the GPs meets the guideline recommendation. We were not able to identify earlier scientific studies regarding similar pathways. In the Netherlands, only two hospitals (Blaricum and Amersfoort) have a care pathway that is like the

Pulmocheck, without a scientific evaluation in a formal study yet.

Methods

Study design

It concerned a retrospective observational study. The anonymized data were obtained from patient records of the specialist pediatrics department of the Zuyderland Medical Centre in Sittard (secondary care, non-academic hospital). This took place after approval by this department. The data extracted were from the period January 1, 2010 to January 1, 2013. All patients who participated in the Pulmocheck in this period were included in the study. Only the nurse practitioner had access to names and addresses and took care of approaching the parents for the follow-up. The researchers were not given patient-sensitive material/data. The Medical Ethics Committee of the Zuyderland hospital (Heerlen/Sittard) authorized this study.

Study population

The study population consisted of patients from the region of MCC Omnes. This centre coordinates diagnostics for GPs in the centre of the region Limburg in the south of the Netherlands. All children 6–18 years of age with respiratory problems that participated in the Pulmocheck between January 1, 2010 and January 1, 2013, after referral from the GP were eligible for a Pulmocheck. (see Figure 1)

Data collection

The Pulmocheck took place at the department of pediatrics at Zuyderland Medical Center. The feedback letters to the GP were obtained from patient records in the hospital information system (SAP), of all the children who had participated in the Pulmocheck in the period from January 1, 2010 to January 1, 2013.

Feedback letters that were sent to the GPs after the Pulmocheck were extracted and we investigated whether any check-ups, emergency presentations and admissions related to respiratory problems took place until the day of data extraction (04/19/2014). The diagnosis was made by the attending pediatrician who related the patient history, physical examination findings and lung function results to the guideline of the Dutch Association of pediatrics “asthma in children” [12].

Additionally, GPs who referred a child to the Pulmocheck between January 1, 2010 and January 1,

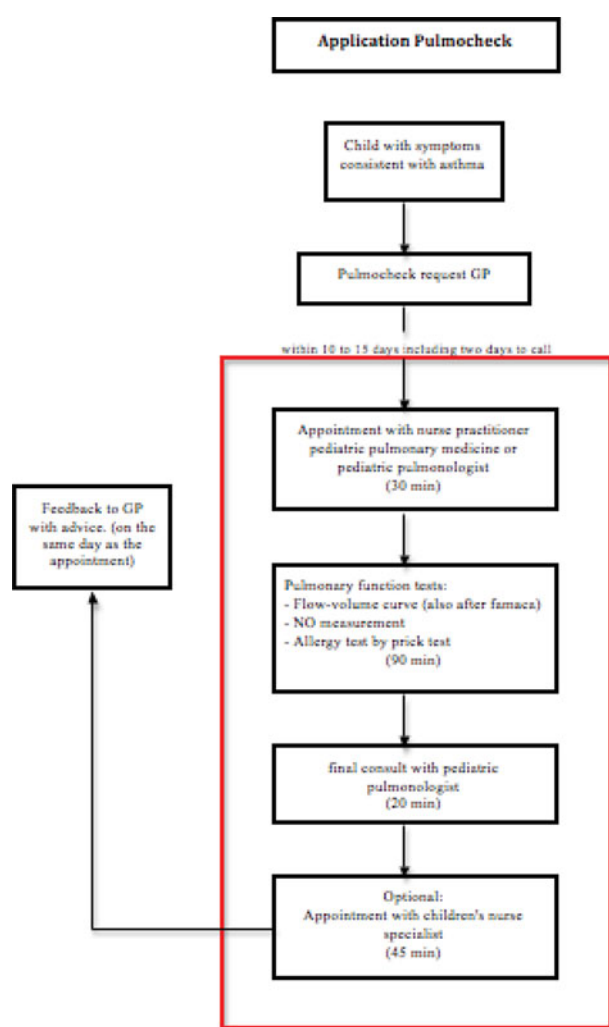


Figure 1. Flow chart Pulmocheck Asthma Care Pathway.

2013, that was diagnosed with asthma and not directly referred to the pediatrics department, received a questionnaire. This questionnaire contained both multiple-choice and open questions about any check-ups and policy/management changes 1 year after the Pulmocheck. The purpose of these letters was to gain more insight in the follow-up performance of the GPs in children with asthma that used ICS on a chronic basis.

Data-analysis

The analysis of the data was performed using SPSS 21. Entering the data was done manually and was randomly checked by a second independent assessor. Descriptive statistics were used to answer our research questions.

Results

Fifty-one different GPs referred 121 children for this pathway from a pool of 97 GPs in the region of the Zuyderland

Table 1. Baseline patient characteristics. (N = 121).

Characteristic	Frequency	Not mentioned
5–9 years	62 (51.2%)	
10–14 years	50 (41.3%)	
15–17 years	9 (7.4%)	
Men	65 (53.7%)	
Women	56 (46.3%)	
Shortness of breath	88 (72.7%)	
Coughing	95 (78.5%)	1 (0.8%)
Wheezing	56 (46.3%)	3 (2.5%)
History of allergy	50 (41.3%)	35 (28.9%)
History of eczema	55 (45.5%)	5 (4.1%)
Smoking parents	35 (28.9%)	
Pets	69 (57.0%)	
Short-acting β_2 -sympathomimetics	71 (58.7%)	
ICS	25 (20.7%)	
Combined medications	15 (12.4%)	
Antihistamine	18 (14.9%)	
Corticosteroid nasal spray	12 (9.9%)	

hospital. (see Table 1 for the baseline characteristics of the children)

Of these children 59.5% could be diagnosed with asthma *de novo* after participating in the pathway, in the remainder asthma could be definitively excluded. In 22% of the asthma patients, non-allergic asthma was reported. In 47.9% one or two other diagnoses, besides the diagnosis of asthma were discovered. Within this group, there were 52 patients (89.7%) with only one other diagnosis and six patients (10.3%) with two other diagnoses. In the remaining (40.5%) of the children a diagnosis of asthma could be refuted and in a significant part of them new diagnoses could be established. (see Table 2).

In 90.9%, the pediatrician recommended one or more clinical management changes that deviated from or added to the care as usual. This could be a pharmacological or non-pharmacological policy change. Referrals to the pediatrics department and other specialized departments were also considered to be a policy change. In total, 77

Table 2. Diagnoses established at Pulmocheck care pathway (N = 121).

Diagnosis	Frequency	Percentage
Asthma (all)	72	59.5
Allergic asthma	47	65.3
Non-allergic asthma	16	22.3
Exercise-induced asthma	4	5.6
Asthma combining two of the above	5	6.9
Asthma with co-morbidity	58	47.9
Asthma with one other diagnosis	52	89.7
Asthma with two other diagnoses	6	10.3
No asthma	49	40.5
One new diagnosis	32	65.3
Two new diagnoses	8	16.3
No diagnosis	9	18.4

Note. The italicized numbers and percentages are based on the bold above frequency.

Other or new diagnoses were for example: Allergy, tonsil/adenoid hypertrophy, faulty breathing technique, vocal cord dysfunction, nasal hyperreactivity, post-viral cough, tic or restrictive pulmonary impairment.

Table 3. Medication changes in subgroups with diagnosed asthma versus no asthma and with regard to receiving respiratory medication or not prior to the Pulmocheck ($N = 121$).

	Asthma + Rmed ⁺⁺ + ($N = 54$)	Asthma + Rmed ⁺⁺ – ($N = 18$)	Asthma – Rmed ⁺⁺ + ($N = 24$)	Asthma – Rmed ⁺⁺ – ($N = 25$)
Advice to changes in medication	39 (72.2%)	18 (100.0%)	14 (58.3%)	6 (24.0%)
Start respiratory medication*	31 (57.4%)	18 (100.0%)	3 (12.5%)	1 (4.0%)
Short-acting β_2 -sympathomimetic	9 (16.7%)	9 (50.0%)	1 (4.2%)	1 (4.0%)
ICS	24 (44.4%)	15 (83.3%)	1 (4.2%)	—
Combined medication	3 (5.6%)	1 (5.6%)	1 (4.2%)	—
Other	2 (24.1%)	—	—	—
Stop R medication*	9 (16.7%)	—	12 (50.0%)	—
Short-acting β_2 -sympathomimetic	5 (9.3%)	—	4 (16.7%)	—
ICS	2 (3.7%)	—	5 (20.8%)	—
Combined medication	3 (5.6%)	—	5 (20.8%)	—
Change of dose	4 (7.4%)	—	—	—

Note. *The italicized numbers and percentages overlap, due to advices for several types of medications per patient. Therefore, they do not add up to 100%.

**Rmed+ = Respiratory Medications + meaning: already using β_2 -sympathomimetic, ICS or combined medication (inhaled corticosteroid/ β_2 -sympathomimetic). Rmed – = not on respiratory medication.

pharmacological changes and 54 non-pharmacological changes were advised. Among them 30.9% got an advice for a pharmacological change only, 12.7% received an advice for a non-pharmacological change only. And in 31.8% both a change in pharmacological as well as a non-pharmacological approach was advised.

A total of 47 patients with newly diagnosed asthma started with a new medication or a change of medication. All children with asthma who had no respiratory medication prior to the Pulmocheck ($N = 18$), were advised to start with respiratory medication. From the group of patients without asthma ($N = 49$) 24 patients had already respiratory medication prior to the Pulmocheck. This could be discontinued in 50.0% of them. (See Table 3)

In 7.4% of the total population a regular referral to the specialty department of pediatrics was advised (however the GP actually referred about 2/3 of this group), while 5.0% were referred to the Ear, Nose, Throat doctor (ENT) doctor and 16.5% to speech therapy or physical therapy. Furthermore, 11.6% were referred to the specialty pediatrics department after the Pulmocheck by the GP. Eight of these were referred, despite the pediatrician's advice. In conclusion: a referral to the specialty department of pediatrics has been avoided by utilizing the Pulmocheck in 80.5% of the cases.

Of the patients with asthma 4.8% were seen four times in the year after the Pulmocheck by their GP, 17.4% were seen 2 times ($N = 8$), 65.2% were seen once ($N = 30$) and in 8.7% never ($N = 4$). Two patients (4.5%) were only advised to use a short-acting β_2 -sympathomimetic,

Table 4. Frequency of follow-up visits with the general practitioner, in children with diagnosed asthma and advice of using ICS or combined medication ($N = 42$).

Frequency of ICS or combined medication follow-up	Prior to Pulmocheck ICS or combined medication ($N = 15$)
0	2 (13.3%)**
1	13 (86.7%)**
2	—
3	—
4	—

Note. *One patient had the advice to maintain ICS/combined medication, another patient had to switch to another type ICS/combined medicine.

**Seven patients had the advice to maintain ICS/combined medication, two patients had to start another kind of ICS/combined medication and three patients had to increase the dose/frequency of the current prescribed ICS/combined medication.

42 patients (95.5%) received advice to use an ICS alone or combined with a short-acting β_2 -sympathomimetic (SABA). Of the latter group, only two patients (4.8%) were seen four times for a check-up in the first year after the Pulmocheck (see Table 4). In 17.4% ($N = 8$) in the first year after the Pulmocheck a medication change took place and in 26.1% ($N = 12$) an emergency contact occurred in the general practice in this same period. Finally, 13.0% ($N = 6$) of the asthma patients were referred to specialty secondary care in the first year after the Pulmocheck.

Discussion

Main findings

In 59.5% of cases a new diagnosis of asthma was established, which means that in about 40% of children where the GP was considering asthma, this diagnosis could be excluded. In more than 90% of all children a change in the clinical management (pharmacological/non-pharmacological) was advised. Out of 97 GPs only 50 GPs in the region have used the care pathway. The number of referrals per practitioner ranged from 1 to 13 over a period of 3 years. In 80.5% of the cases, a referral to the specialty department of pediatrics has been avoided. Only 2.4% of GPs saw the child with asthma four times or more in the first year after starting ICS. The Pulmocheck was helpful since it changed several diagnostic and therapeutic plans for the children.

Strengths and limitations of this study

Limitations included the lack of a formal chart review with the diagnostic findings of the GP. To get a more complete picture with respect to change in the number of referrals it would have been valuable to have data on the number of referrals to the pediatrics department before the start of the Pulmocheck. However, these data were

not available. Finally, no patient or family satisfaction was measured. A strength of the study is that this care pathway occurred in a real clinical practice situation, meaning that the participants were not included in a formal trial setting, that could have influenced their adherence (intentional effect). A further strength is that Dutch GPs have one national guideline on asthma in children [5].

Interpretation of findings in relation to previously published work

The incidence of asthma in children aged 0–14 years in Dutch general practice in 2007 was 13.46 per 1,000 for boys and for girls 9.23 per 1,000 [3,5,13]. In contrast to these incidence figures only half of the GPs in the south of the Netherlands referred the children to Pulmocheck, and the average number of referrals per GP was only 2.4 children, in a time frame of 3 years. Perhaps the GPs were not fully aware of the existence of the pathway. In accordance with this we found that after a lecture about the Pulmocheck in a postgraduate course for GPs there was in fact an increase in the number of referrals to the Pulmocheck immediately after this training. Another reason for the low referral rate could be that it might be a manifestation of under-diagnosis. Another assumption might be that the GPs have the perception that they successfully treat the majority of children with asthma, and did not feel the urge to refer to Pulmocheck. To obtain further insight into this problem we advise to conduct qualitative research through interviews with GPs who have experience with Pulmocheck and GPs who never have used this care pathway.

As mentioned above, asthma is under- and over-diagnosed worldwide [6–10]. The PIAMA study and a study of Riekert et al. showed that there is both under- and over-treatment of asthma [14,15]. Table 3 shows that, in our study population, the vast majority of the children with asthma already had received respiratory medication from their GPs before Pulmocheck participation. However, there were still 18 children who had asthma, but had not used respiratory medication. On the other hand, in the group of children without asthma, 49.0% used respiratory medication, without a clinical indication. So, in the Pulmocheck population there also was under- and over-treatment, and therefore also under- and over-diagnosis.

The frequency of the follow-up / monitoring should be based on the level of asthma control. It can vary from once a year in children with asthma that is completely under control to every 3 months in children with asthma that is not sufficiently controlled and in whom the treatment goals or optimal medical treatment are not reached [12,16,17]. The Dutch guideline for GPs recommends to review the children once every 3 months in the first year of usage of ICS as a maintenance medication [5].

Although this recommendation is largely opinion-based, not evidence-based, it is of clinical importance given the side effects that ICS usage can have. It can slow down growth in height in children and in order to overcome this in a timely manner, it is important to frequently monitor this [18]. It must also be taken into consideration that asthma as a chronic disease, when poorly controlled, can cause growth inhibition [19]. From the questionnaires we received back from GPs, we concluded that the monitoring frequency is lower than expected. Of the 42 patients who used ICS, only two were seen by the GP for follow-up four times in the first year after Pulmocheck. The majority was only seen once (69%) and there were even three patients (7.1%) who were not seen at all for follow-up after the Pulmocheck. The cause of this low follow-up frequency is not clear, although some GPs did communicate that parents and patients did not show up at control appointments. However, the low follow-up frequency may also have been partly due to not following the guidelines or that the workload of GPs was too heavy to provide all children with an adequate follow-up. A solution may have been to have someone else, such as a practice nurse, to follow up the children with asthma.

Conclusions/key findings

Based on the many medication and other management changes there appears to be an under-diagnosis, over-diagnosis, under- and over-treatment in this population, even in a country where a recent guideline on asthma in children is available. Implementation of the Pulmocheck care pathway provides good support to GPs when in doubt concerning diagnosing or managing children with chronic respiratory problems. However the awareness among GPs concerning this asthma care pathway is lower than we expected. Qualitative research might determine the underlying reason for this low referral rate. The referral to Pulmocheck is helpful since it changed several diagnostic and therapeutic plans in children.

Acknowledgements

Special thanks to the pediatrics department of the Zuyderland Medical Centre Sittard-Geleen, the Netherlands, for their cooperation.

Funding

The work has been funded through an internal unrestricted educational grant by Maastricht University.

Competing financial interests

None.

Contributions

J. Meuwissen collected collection, set up the database and drafted the manuscript. T. van der Weijden carried out the methods and reviewed the manuscript. J. Heynens initiated the Pulmocheck pathway, gave expert opinion and reviewed the manuscript. T. Dauven initiated the Pulmocheck pathway, gave expert opinion, collected data and reviewed the manuscript. L. Crasborn gave expert opinion and reviewed the manuscript. F. Smeenk gave expert opinion and reviewed the manuscript. J. Muris gave expert opinion, recruitment advice, reviewed the manuscript and served as a guarantor.

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