

From THE DEPARTMENT OF WOMEN'S AND CHILDREN'S
HEALTH

Karolinska Institutet, Stockholm, Sweden

EVIDENCE-BASED PRACTICE FOR CHILDREN WITH ASTHMA IN PRIMARY CARE – QUALITY OF MANAGEMENT AND EFFECTS OF LEARNING

Maria Ingemansson



**Karolinska
Institutet**

Stockholm 2016

All previously published papers were reproduced with permission from the publisher.

Cover illustration by Rebecka Lagercrantz

Published by Karolinska Institutet.

© Maria Ingemansson, 2016

ISBN 978-91-7676-193-9

Printed by E-print AB 2016

Evidence-based practice for children with asthma in
primary care – quality of management and effects of
learning
THESIS FOR DOCTORAL DEGREE (Ph.D.)

By

Maria Ingemansson

Principal Supervisor:

Associate professor Anna Kiessling
Karolinska Institutet
Department of Clinical Sciences,
Danderyd Hospital
Division of Cardiovascular Medicine

Co-supervisors:

Associate professor Eva Wikström Jonsson
Karolinska Institutet
Department of Medicine, Solna
Division of Clinical Epidemiology

Professor Gunilla Hedlin
Karolinska Institutet
Department of Women´s and Children´s Health
Division of Astrid Lindgrens Children´s Hospital

Opponent:

Professor Minna Kaila
University of Helsinki
Faculty of Medicine

Examination Board:

Associate professor Ellen Vinge
Lund University
Department of Clinical Chemistry and Pharmacology
Division of Laboratory Medicine

Professor Eva Rönmark
University of Umeå
Division of Public Health and Clinical Medicine

Professor Margareta Troein Töllborn
Lund University
Department of Clinical Sciences, Malmö
Division of Family medicine

I dedicate this thesis to all general practitioners and nurses who work hard to give children with asthma a high quality of care.

The best way to solve a problem and to fight against war is through dialogue

- Malala Yousafzai

ABSTRACT

Background: Asthma is the most common chronic disease among children in Sweden. Many school-aged (7-17 years), but also preschool (0-6 years) children with asthma are managed in primary care. Evidence-based guidelines have been developed to support the use of current best clinical evidence in practice and to ensure high quality care. However, there is a gap between the actual care provided for children with asthma and the recommendations stated in the guidelines.

Aim: To investigate the evidence-based practice for children with asthma in primary care. We wanted to evaluate the potential influence of quality of management and effects of learning to apply the evidence-based guidelines in routine care.

Methods: In study I register data regarding dispensed prescriptions was collected. Dispensed prescriptions were followed over 24 consecutive months for all children (0-16 years) visiting 14 primary health care centres (PHCs) and initiated on anti-asthmatic drugs during one year (n=1033). In study II physicians and nurses participated in interactive education in these PHCs. 14 PHCs served as controls. Register data was collected regarding dispensed prescriptions and recorded diagnosis during 24 months before and after the intervention. Data was included from all children (0-17 years) (n=114 175) listed at the 28 PHCs 2006-2012. Focus group interviews (FGIs) were used in study III to evaluate how general practitioners (GPs) approach, learn from and use evidence-based guidelines in their decision-making. Qualitative content analysis was used. 22 GPs participated. In study IV quality of care was assessed as a composite of quality indicators (CQI). Adherence to quality indicators was retrieved by scrutinising electronic health care records at 14 PHCs. By using the multivariate regression analysis orthogonal projection to latent structures (OPLS) the relationship between CQI and contextual features was evaluated.

Results: In study I 54% of the school-aged children had only one prescription dispensed and 50% of them were initiated on short-acting beta2-agonist (SABA) as monotherapy. In study II 66% of the school-aged children with a recorded diagnosis of asthma were dispensed SABA as well as an anti-inflammatory anti-asthmatic drug before the intervention. There was no significant statistical difference between the intervention and control group at baseline or at follow-up. Approximately one-fourth of all children who were dispensed anti-asthmatic drugs did not have a recorded diagnosis of asthma. In study III three themes were conceptualised in the evaluation of the guidelines: Learning to use guidelines by contextualised dialogues; Learning that establishes confidence to provide high quality care; Learning by the use of relevant evidence in the decision-making process. In study IV more scheduled time for asthma care, lower age-limit for performing spirometry, lower duty-grade for GPs and higher activity at the educational seminars were the contextual features with highest influence on CQI.

Conclusion: Most GPs show good adherence to evidence-based guidelines regarding pharmacological treatment in children with a recorded diagnosis of asthma. Correct diagnosis of asthma is crucial to enable use of evidence-based guidelines. To achieve this, spirometry needs to be performed more often. Contextualised dialogue, based on own experience, feedback on own results and easy access to short guidelines that were perceived as trustworthy, were important aspects for the use of the guidelines. To allocate time, interprofessional collaboration and to create an organisational structure with opportunities for engagement in asthma care, are contextual features that have the potential to facilitate evidence-based practice for children with asthma.

LIST OF SCIENTIFIC PAPERS

- I. **Ingemansson M**, Wettermark B, Wikström Jonsson E, Bredgard M, Jonsson M, Hedlin G, Kiessling A. Adherence to guidelines for drug treatment of asthma in children: potential for improvement in Swedish primary care. *Qual Prim Care*. 2012;20(2):131-9.
- II. **Ingemansson M**, Dahlén E, Wikström Jonsson E, Wettermark B, Kiessling A. Evidence-based management of childhood asthma in Swedish primary care: a controlled educational intervention study. (Manuscript)
- III. **Ingemansson M**, Bastholm-Rahmner P, Kiessling A. Practice guidelines in the context of primary care, learning and usability in the physicians' decision-making process – a qualitative study. *BMC Fam Pract*. 2014. Aug 20; 15(1):141. doi: 10.1186/1471-2296-15-141
- IV. **Ingemansson M**, Jonsson M, Henriksson P, Hedlin G, Kull I, Wikström Jonsson E, Krakau I, Kiessling A. Influence of contextual circumstances on quality of primary care in children with asthma. (Submitted)

Related paper

Jonsson M, Egmar A-C, Kiessling A, Ingemansson M, Hedlin G, Krakau I, Kull I. Adherence to national guidelines for children with asthma at primary health centres in Sweden: potential for improvement. *Prim Care Respir J*. 2012;21(3):276-282

CONTENTS

1	Introduction.....	7
2	Background.....	8
2.1	Definition of asthma and asthma criteria.....	8
2.2	Evidence-based guidelines and quality of care.....	8
2.3	Evidence-based management of asthma and level of care.....	11
2.4	Effects of learning and organisation of care on evidence-based practice.....	13
3	Aims.....	15
4	Ethical considerations.....	16
5	Methods.....	17
5.1	Overview of the thesis.....	17
5.2	Study material.....	17
5.2.1	Primary health care centres (I-IV).....	17
5.2.2	Physicians (I-IV) and nurses (IV).....	18
5.2.3	Children (I, II, IV).....	18
5.3	Procedures.....	19
5.3.1	Educational seminars (II, IV).....	19
5.3.2	Quality assessment (I, II, IV).....	20
5.3.3	Quality assessment of pharmacological treatment (I, II).....	21
5.3.4	Approach to, learning from and use of evidence-based guidelines explored by focus group interviews (III).....	23
5.3.5	Evaluation of the influence of contextual features on quality of care (IV).....	23
5.4	Statistics.....	24
6	Main results.....	26
6.1	Pharmacological treatment (I, II).....	26
6.1.1	Dispensed anti-asthmatic drugs for initiation of treatment (I).....	26
6.1.2	Dispensed anti-asthmatic drugs in children with a recorded diagnosis of asthma (II).....	27
6.1.3	Documentation of asthma diagnosis in all children that were dispensed anti-asthmatic drugs prescribed in primary care (II).....	29
6.2	Approach to, learning from and use of evidence-based guidelines in the context of primary care (III).....	30
6.3	The influence of contextual features on quality of care (IV).....	32
6.3.1	Quality of care.....	32
6.3.2	The influence of contextual features.....	33
7	Discussion.....	35
7.1	Evidence-based practice and pharmacological treatment (I, II).....	36
7.2	Evidence-based guidelines - approach to, learning from and usability in the decision-making process (III).....	37
7.3	Influence of contextual features on evidence-based practice (IV).....	39
7.4	Methodological considerations.....	41

8	Conclusions.....	45
9	Clinical implications and future perspectives.....	46
10	Sammanfattning på svenska	47
11	Acknowledgements	51
12	Financial support	54
13	References	55

LIST OF ABBREVIATIONS

ATC	Anatomical therapeutical chemical
CNI	Care need index
CQI	Composite quality indicator
EBM	Evidence-based medicine
EBP	Evidence-based practice
et al.	et alii (and others)
FGI	Focus group interview
GINA	Global initiative for asthma
GP	General practitioner
ICD	International statistical classification of diseases and related health problems
ICS	Inhaled corticosteroids
i.e.	id est (that is)
LABA	Long-acting beta2-agonist
PEF	Peak expiratory flow
PHC	Primary health care centre
SABA	Short-acting beta2-agonist

1 INTRODUCTION

Asthma is today the most common non-communicable disease among children worldwide [1]. More than 30% of the preschool children (0-6 years) have had episodes of wheeze, often in association with viral respiratory infections [2]. These symptoms are usually resolved by school-age (7-17 years) [3]. Still, one study has shown a prevalence of 7.4% physician-diagnosed asthma among Swedish 7-8 years old children [4]. Another Swedish study has shown a prevalence of 9.5 % physician-diagnosed asthma among adolescents (16-20 years) [5]. In school-aged children with perennial allergy and asthma the disease should be considered as chronic [6-8]. Sensitisation to airborne allergens occurs in 60-80% of school-aged children with asthma [8, 9]. Even if they get symptoms mainly at exercise, it is important to have the knowledge that these children should be treated continuously with anti-inflammatory anti-asthmatic drugs [10].

Unlike many other chronic diseases asthma often starts early in life and persists into adulthood [11]. Asthma is one of the most common diseases managed in Swedish primary care [12]. It is also a disease that can have a great impact on a patient's quality of life.

Swedish health care differs from health care in many other countries since the general practitioners (GPs) do not have a gatekeeper function. Patients are thus often free to seek care also from other providers [13, 14]. Nevertheless, the health care system is based on the presumption that the patients should have all relevant basal investigations performed and evaluated in primary care before referral to secondary care.

The formal requirements to qualify as a GP in Sweden, are equivalent regard to years in training and acquired competence as to the requirements for any specialist in secondary care [15]. Consequently, there are high expectations on GPs to investigate and manage a wide spectrum of diseases in primary care. However, while evidence-based guidelines are designed to guide the treatment of separate diagnoses, many patients in primary care have multiple health problems which makes implementation of guidelines in primary care a complex task [16].

2 BACKGROUND

2.1 DEFINITION OF ASTHMA AND ASTHMA CRITERIA

Asthma is defined by airway inflammation and bronchial hyperresponsiveness causing completely or partly reversible airway obstruction [6]. It is a heterogeneous disease with variable symptoms such as cough, wheezing, shortness of breath and/or reduced physical activity [6]. Diagnosing asthma in preschool children is difficult, especially in children younger than three years of age. The following criteria for asthma have been suggested by the Global initiative for asthma (GINA) in children younger than three years of age:

- Symptoms (wheeze, heavy breathing) for >10 days during viral respiratory infections
- More than three episodes per year, or severe episodes and/or night worsening
- Cough, wheeze or shortness of breath/heavy breathing between episodes of viral respiratory infections
- Symptoms (wheeze, heavy breathing) for <10 days during viral respiratory infections **and** atopy or family history of asthma.

One or more of the criteria should be fulfilled for the diagnosis of asthma in this age-group. In children three years and older, wheeze or heavy breathing during a viral respiratory infection should always be considered as a potential diagnosis of asthma with the need for follow-up [6].

In children older than five years the GINA guidelines have suggested the following criteria for the diagnosis of asthma:

- A history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary in intensity and over time **and**
- Variable expiratory airflow limitation

In this age-group it is usually possible to measure the airflow limitation by lung function tests, preferably spirometry.

2.2 EVIDENCE-BASED GUIDELINES AND QUALITY OF CARE

Rapid advances in medicine set high requirements on physicians to keep a high quality of care. Management of childhood asthma is no exception. The concept of evidence-based medicine (EBM) was developed in the 1990s and could be described as “the conscientious, explicit and judicious use of current best evidence in making decisions of the care of individual patients” [17]. However, to find the best evidence for the specific patient is a process in several steps [18]. The first step is to define a clinical question. The next step is to search for information in a structured way in available databases. The third step is to evaluate the data obtained. Randomised controlled trials (RCT) that evaluate different treatments in two equivalent groups are considered to have the highest level of evidence. Yet, patients included in these studies are usually within a certain age-span and have only one specific

disease. The data obtained may therefore not be applicable for children or for old patients with multiple diseases, which are common patient groups in primary care. The fourth and last step is therefore to evaluate if the evidence is usable in a specific health care context. Further, if it is so, to apply the evidence in this local routine practice.

To use the process for EBM in daily routine practice is not possible. However, evidence-based guidelines have been developed to support the use of the best clinical evidence in practice. There are international as well as national and regional guidelines [6, 7, 10]. The purpose of the national and regional guidelines is to adapt the international guidelines to the Swedish health care context in order to facilitate adherence. These guidelines are therefore developed in collaboration with specialists in the area, for example paediatric allergologists, GPs and asthma nurses. Still, the guidelines do not consider the local context at each primary health care centre (PHC) which in turn will affect the final evidence-based practice (EBP). Figure 1 shows how EBM is mediated via evidence-based guidelines to EBP at the PHCs.

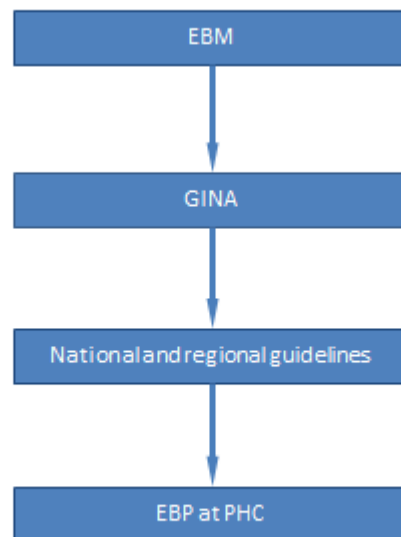


Figure 1. Flowchart of how evidence-based medicine is mediated via evidence-based guidelines to evidence-based practice at the primary health care centres.

The local context has high influence on the decision-making process. Decision-making is a core fundament for evidence-based clinical practice in primary care. To make correct decisions that are adapted to the individual patient as well as to the health care system is a prerequisite for quality of care. Decision-making is complex and there are several theories on the process of decision-making and how to optimise the process depending on the context. Norman et al. [19] have in a review on clinical reasoning or decision-making concluded that there are three major approaches to solve problems in clinical routine practice. In the first approach, hypo-deductive reasoning the clinician has gathered extensive amounts of

knowledge. In each patient encounter the physician rules out the hypotheses that will not fit in and reach a decision. In the second approach, schema induction, decision-making is built on schemas for example decision trees that begin with clinical presentations and end with specific diagnoses. In the third approach, pattern recognition by earlier experience is central. None of the approaches fits all clinical situations and there is no gold standard for decision-making in clinical routine practice.

During the past years the Dual Process Theory has become a dominant model for understanding the complex process underlying human decision-making [20-22]. According to this theory the decision-making process is a balance between a fast intuitive system built on pattern recognition and a slower analytic system built on theoretical analysis of data. Either system may override the other, and there is a tendency in the system to strive for the least cognitive effort in the decision-making process.

Evidence-based guidelines are developed to increase quality of care and to provide evidence-based safe and effective use of diagnostic and therapeutic technologies [23, 24]. Quality of care can be defined as "the extent to which health services increase the likelihood of desired health outcomes and how close they (the health services) adhere to professional knowledge" [18]. Quality of health care can be divided in three major components: *structural* aspects of care such as credentials of GPs, *processes* of care that indicate what was done and *outcomes* of care that reflect the short or long-term results of services. It may also include the patient satisfaction with care [18].

There are different reasons for why and how quality should be assessed in health care. It could be a way for clinicians to obtain objective information about their practices. Further, it could be a way for patients to know about quality of care available [25]. One way to assess quality in a practice is as a measurement of results over time, i.e. to measure quality enhancement. This can either be performed as measurement of own results or as a comparison of other care-givers. Activities to stimulate enhancement of quality are performed between the measurements.

In order to assess quality, quality indicators have been developed. The original definition of a health care quality indicator was proposed by Lawrence and Olesen in 1997 as "a measurable element of practice performance for which there is evidence or consensus that it can be used to assess the quality, and hence change in the quality, of care provided" [26]. Recommendations about diagnosis and treatment in a given guideline can be synthesised into algorithms which can be used as quality indicators. By determining how well a health care provider meets these quality indicators can be a way to measure quality of care [23]. Quality indicators are thus important tools to improve quality of care [27]. They can be used from different perspectives. In the regional guidelines for the county council of Stockholm the following perspectives have been suggested [7]:

- The care-giver can use the quality indicators to develop an optimal quality of care
- The health care principals can use the quality indicators as an aid when deciding how the resources should be used and distributed in primary and secondary care.
- The patient can use the quality indicators to ensure a good quality of care

For a global assessment of quality it is desirable to combine quality indicators to a composite – a composite quality indicator (CQI) [28]. Composite scores also have the advantage that much smaller samples or records are required to give reliable scores than are required for single quality indicators [29]. There are several methods described how to generate a composite score for a group of quality indicators depending on what is to be compared [27, 28]. However, there is no gold standard regarding method.

2.3 EVIDENCE-BASED MANAGEMENT OF ASTHMA AND LEVEL OF CARE

There is no single test to diagnose asthma. The diagnosis of asthma is based on the clinical history and lung function testing. According to evidence-based guidelines, spirometry is the lung function test that should be used in diagnostics of, as well as in follow-up of asthma [6, 7, 10]. However, spirometry is usually not possible to perform in preschool children. The diagnosis of asthma in this age-group is often based on clinical history and the response of the child to pharmacological treatment.

Management of asthma includes awareness of, and as far as possible, elimination of worsening factors. Active as well as passive smoking should be avoided in all children [30]. Testing for allergy should be offered for all school-aged children with asthma and on wide indications for younger children [10]. School-aged children with allergic asthma often have a chronic inflammation in the airways due to regular exposure to animal dander in school dust [31, 32].

Pharmacotherapy is the cornerstone in the treatment of asthma [6, 7, 10, 33]. Most of the school-aged children with asthma need regular treatment with anti-inflammatory anti-asthmatic drugs. The purpose with the maintenance treatment is that the children should be free from symptoms in their daily life and have a good asthma control [6, 7, 10].

Most of the anti-asthmatic drugs are administered by inhalation. Inhalation therapy can be administered by pressurised metered dose inhalers (pMDIs) with or without spacers, dry powder inhalers (DPIs) or by nebulisers. Consequently, there are many different types of devices. To demonstrate and to follow up the inhalation technique for the prescribed device is therefore necessary [6, 7, 33].

School-aged children with mild to moderate asthma could preferably be treated in primary care [7, 34]. In preschool children, asthma that only appears in connection with respiratory infections is usually managed in primary care [7]. Children with asthma that do not respond to the recommended basic treatment or need regular treatment with anti-asthmatic drugs should be referred to a paediatrician [7, 10]. This is especially important in children aged < 2 years since the evidence regarding treatment of asthma in this age-group is limited. The recommendations for treatment of asthma in this age-group are mainly based on extrapolations of studies on older children and expert opinions [34]. The different levels of treatment of asthma in the two age-groups and recommended level of care are shown in tables 1 and 2.

Table 1. Swedish recommendations for treatment and level of care in children ≤ 6 years

Level of treatment	Asthma symptom	Recommended treatment
1	Asthma symptoms only in association with viral respiratory infections	<i>Mild symptoms:</i> SABA ¹ (preferably inhaled with spacer) as monotherapy <i>Moderate symptoms:</i> Montelukast 4 mg/day or ICS ² in a predefined dosing regimen in 10 days. SABA ¹ as needed
2	Continuous symptoms or severe symptoms in association with infections	Regular treatment with ICS ² in low to moderate dose (100-200 microg/day). Montelukast 4 mg/day is an alternative in mild symptoms. SABA ¹ as needed
3	Uncontrolled symptoms despite treatment at level 2	ICS ² in low to moderate dose+ montelukast 4 mg/day. LABA ³ can be added from age 4. SABA ¹ as needed
4	Uncontrolled symptoms despite treatment at level 3	ICS ² in high dose (>200 microg/day) + montelukast 4 mg/day. LABA ³ can be added from age 4. SABA ¹ as needed.

¹SABA denotes short-acting beta2-agonists ²ICS denotes inhaled corticosteroids, in this table only fluticasone
³LABA denotes long-acting beta2-agonists.

The gray-shaded area indicates that primary care is recommended level of care. This table is based on the recommendations of the Swedish Medical Products Agency [34].

Table 2. Recommendations for treatment and level of care in children > 6 years

Level of treatment	Asthma symptom	Recommended treatment
1	Mild/intermittent asthma symptoms	SABA ¹ as monotherapy
2	Recurrent effort-induced symptoms/need of SABA > 2 times/week	ICS ² in low to moderate dose (200-400 microg/day). Montelukast 5-10 mg/day is an alternative in mild symptoms. SABA ¹ as needed
3	Uncontrolled symptoms despite treatment at level 2	ICS ² in low to moderate dose (200-400 microg/day) + montelukast 5-10 mg/day and/or LABA ³ (or as fixed combination). SABA ¹ as needed
4	Uncontrolled symptoms despite treatment at level 3	As in step 3 but with ICS ² in high dose (>400 microg/day)
5	Uncontrolled symptoms despite treatment at level 4	Highly specialised treatments such as omalizumab, Airsonett, theophylline, azitromycine, oral steroids.

¹SABA denotes short-acting beta2-agonists ²ICS denotes inhaled corticosteroids, in this table budesonide and fluticasone ³LABA denotes long-acting beta2-agonists.

The gray-shaded area indicates that primary care is recommended level of care. The table is based on the recommendations of the Swedish Medical Products Agency [34].

The concept management has several, partly dependent interpretations [35]. In health care it could be interpreted as how a disease should be handled (management of asthma) or as the

head and leadership of an organisation (the management for a PHC). These two interpretations are partly dependent on each other. Thus, the resulting quality of the management of a disease might be more or less dependent on the quality of the management of the organisation where the disease is handled.

2.4 EFFECTS OF LEARNING AND ORGANISATION OF CARE ON EVIDENCE-BASED PRACTICE

Adherence to evidence-based guidelines is known to be low, in routine practice of childhood asthma as well as in many other areas [36-42]. Core prerequisites to perform evidence-based practice require adequate medical knowledge and skills. Transfer of knowledge is traditionally associated with a one-way communication from a more knowledgeable person to a less knowledgeable one. This knowledge can be transmitted from a teacher to a student or from textbooks to a physician. However, to perform evidence-based practice knowledge is insufficient. A second step is needed: to achieve competence to apply the knowledge in practice. This step includes an adaption to the specific situation and the experiences of the receiver. The receiver can be seen as an expert on possibilities and limitations in the local context. Learning can thus be defined as “a process that takes place through the active behaviour of the student: it is what *he* does that he learns, not what the teacher does” [43]. The process of learning includes acquiring information, applying it to the context and having time for reflection [44]. If this process is fulfilled it results in deep own knowledge and may change behaviour [44].

It has been shown that written educational material alone is not sufficient to provoke change of the behaviour of health care professionals [36]. Furthermore, educational meetings based on lectures are unlikely to change professional practice [45]. However educational research indicates that methods including interactive learning and active participation have the potential to increase knowledge and skills and to change behaviour [46]. Case-method learning is based on decision-making [47]. A case in case-method learning includes analytical, conceptual and presentation dimensions [47]. These dimensions could be divided into three levels of difficulties. Cases in clinical practice are all complex in the analytical and conceptual dimensions. There is no obvious decision and the discussion of the cases requires that the participants have knowledge and skills not supplied in the case. This model has previously been shown to support evidence-based practice in primary care [48, 49]. The purpose of guidelines is to evoke changes in management towards evidence-based practice in primary care and thus change of the behaviour of health care professionals. The implementation strategy of guidelines is therefore crucial.

There are many ways to communicate evidence-based guidelines. To use internet-based guidelines is becoming increasingly common. This facilitates the process to get quick access to a large amount of updated knowledge. Yet, the vast amount of information available could also be a barrier in sorting out the important information. Furthermore, the limited possibilities for interactivity offered in the internet-based guidelines may impair the learning process. Figure 2 shows how information could be handled in the learning process by GPs in primary care. There is thus an important difference between surface knowledge, which could

be expressed as “knowledge for the moment” and deep knowledge when the information is processed and reflected.

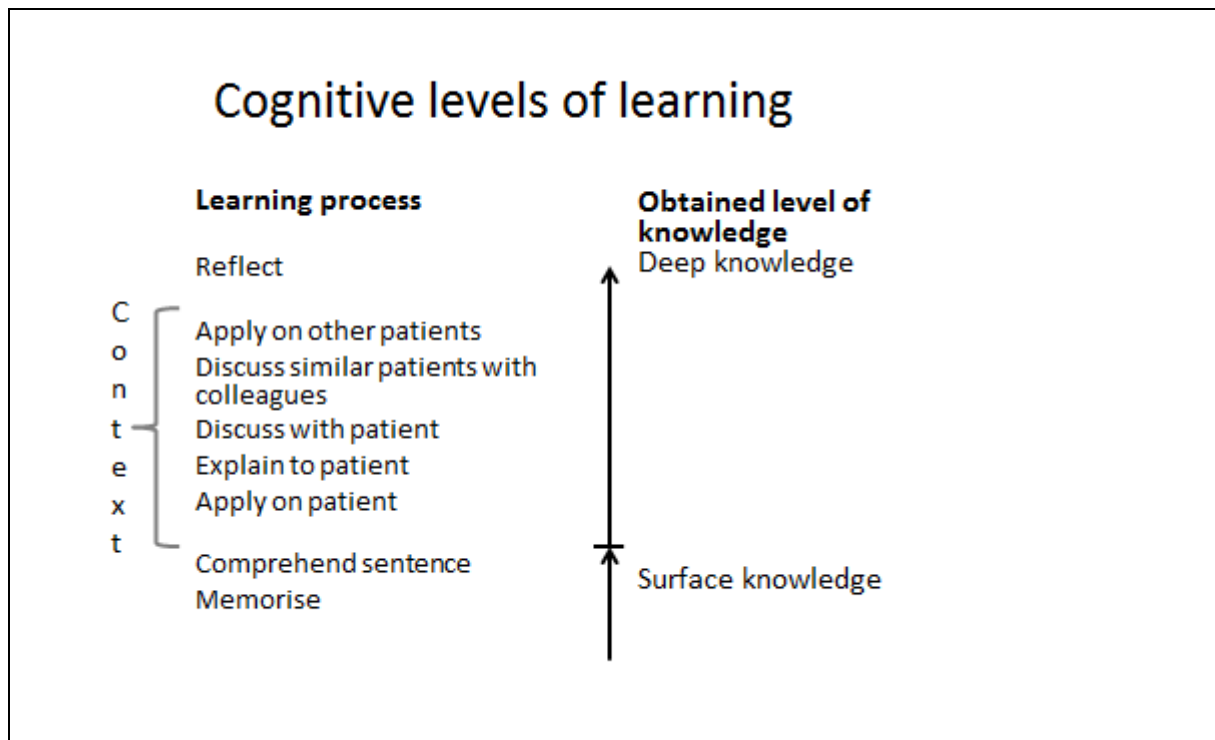


Figure 2. Cognitive levels of learning applicable in the learning process for GPs in clinical practice. This figure is inspired by John Biggs and Catherine Tang [44].

The management, organisation and structure of health care are important if evidence-based care should be obtained. An effective basic service has indeed been associated with greater patient satisfaction than easily accessible secondary care [50]. However, a high workload for GPs was associated with a lower adherence to evidence-based guidelines [51]. Financial incentives lead to a feeling of lower professional autonomy, which in turn made physicians rate a lower quality of care [52]. Further, leadership quality has been considered a necessary factor in reducing work pressure and protecting the organisation of the health care unit, for example a PHC [52].

Yet, in order to evaluate adherence to evidence-based guidelines it is important to evaluate the adequate study population. RCTs are considered as the gold standard when evaluating evidence-based medicine. They are designed to test whether an intervention works under optimal conditions. However, in order to evaluate what affects adherence to evidence-based guidelines, the studies must be pragmatic. Pragmatic trials are designed to evaluate the effectiveness of interventions in real-life routine practice [53-55]. Further, to be able to improve adherence it is necessary to understand facilitating and hindering aspects in the decision-making process and to evaluate which contextual factors that are most important in high quality care.

3 AIMS

The overall aim of the thesis was to investigate the evidence-based practice for children with asthma in primary care. We wanted to evaluate the potential influence of quality of management and effects of learning to apply the evidence-based guidelines in routine care.

The specific aims were:

- To explore the pattern of dispensed anti-asthmatic drugs to children in relation to the evidence-based guidelines
- To investigate the effect of an educational intervention on adherence to evidence-based guidelines regarding diagnosis and dispensed anti-asthmatic drugs to children treated in primary care.
- To explore how general practitioners approach, learn from and use evidence-based guidelines in their day-to-day decision-making process in the primary care context.
- To evaluate the influence of contextual features on the PHCs' adherence to the quality indicators stated in the evidence-based guidelines for treatment of asthma in children.

4 ETHICAL CONSIDERATIONS

All investigations conform to the principles outlined in the “Declaration of Helsinki; 1964”. The Regional Ethical Review Board in Stockholm, Sweden approved all included studies. Register numbers for the permits are: Study I: 2007/1497-31/4, study II: 2013/1126-31/5, study III: 2007/1497-31/4 and 2011/1071-32, study IV: 2007/1497-31/4.

The managements of each of the 14 PHCs actively participating in all four studies were informed about the studies and gave their written consent to participate. The 14 additional PHCs forming the control group in study II, were not informed about the study. The reason for this was that we only retrieved anonymised register data from these PHCs and our study did not in any way affect the clinical practice for the physicians or the care of the children. In study III all GPs and residents in family medicine working at the included 14 PHCs received written information about the study. The GPs and residents that participated had thus made an active choice to participate in the focus group interviews. Each individual participant gave their written consent and the transcribed data was coded. We performed the interviews either during day-time or in the evening depending on what was most suitable for the physicians and their clinical practice.

Study IV included studies of electronic health care records. Studies of health care records can be an ethical dilemma since the physicians may perceive that their professional skills are questioned. However, it was the behaviour of the physicians we studied and the electronic health care records were only tools for this. For practical reasons it was not possible to anonymise the health care records for the research nurses that scrutinised them. However, the two nurses had no other connection to the study and the collected data was anonymised to the rest of the research group. We did not retrieve consent from the children concerned or their parents. Since the purpose of the study was to follow up the quality of care there was no legal requirement for consent from them. Further, all data was presented at group levels which eliminated the risk for identification of an individual physician or patient. Finally, to obtain objective data it is important to get a representative material. Excluding some physicians or patients from the PHCs would have decreased the chance of objective data and thus decreased the validity of the study.

5 METHODS

5.1 OVERVIEW OF THE THESIS

A summary of the studies in the thesis and how they relate to each other is shown in table 3.

Table 3. Overview of the four included studies

	Study I	Study II	Study III	Study IV
Design	Retrospective observational study	Controlled educational intervention study	Qualitative interview study	Cross-sectional study
Procedures studied	Dispensed anti-asthmatic drugs at baseline	Dispensed anti-asthmatic drugs before and after intervention	Use of evidence-based guidelines	Influence of contextual features on quality of care
Material	Physicians and children at 14 PHCs ¹	Physicians and children at 14 PHCs ¹ + 14 PHCs ²	22 GPs ³ selected from 14 PHCs ¹	Physicians, nurses and children at 14 PHCs ¹
Number of children included	1033 (included by registerdata)	114 175 (included by registerdata)	-	559 (included by data from health care records)
Study period	2005-2009	2006-2012	2011	2008-2012

¹Primary health care centres that received educational intervention. ²Primary health care centres that served as matched controls. ³General practitioners

5.2 STUDY MATERIAL

The physicians, mainly general practitioners (GPs), and nurses were studied at group level. Electronic health care records of children were studied. The health care records of the children were included (study I, II and IV) with the purpose to study the physicians' clinical practice.

5.2.1 Primary health care centres (I-IV)

GPs and nurses from all primary health care centres (PHCs) in the northwestern part of Stockholm, Sweden were invited to a seminar in paediatric asthma. In total, GPs and nurses from 49 PHCs were invited and participants representing 20 of these PHCs attended the seminar. Of these 20 PHCs, 14 agreed to participate in a survey of contextual features and

documentation of quality indicators as a measure of quality of care in the electronic health care records (**study II and IV**). GPs and nurses in these 14 PHCs were also interested in further interactive education in pediatric asthma (**study II and IV**). These 14 PHCs that thus had active interest in pediatric asthma were included in all four studies.

In study II, 28 PHCs were included. The added 14 PHCs in this study were retrieved from the regional census register of Stockholm County Council which has complete information on listing status for all inhabitants in the region. These 14 PHCs were individually matched by; number of listed people, proportion of the listed population who were children aged 0-17 years, if the PHCs were run by public or private actors, and care need index (CNI), a social deprivation index based on socio-economic factors [56] (table 4). CNI is described in detail in section 5.3.3.

Table 4. Characteristics of the primary health care centres (PHCs) included in the thesis.

Characteristic	Intervention group	Control group
Number of PHCs	14	14
Type of ownership (public/private)	9/5	8/6
Number of listed people¹	11751 (5552-20339)	9670 (5508-19984)
Number of listed children, 0-17 years¹	2336 (906-4233)	1882 (1145-3971)
Proportion of listed children, 0-17 years¹	0.20 (0.14-0.25)	0.22 (0.15-0.27)
Care need index (CNI)¹	1.09 (0.74-1.89)	0.89 (0.58-1.67)

¹Data presented as median (total range). CNI is described in detail in section 5.3.3

The data presented is from 2012.

5.2.2 Physicians (I-IV) and nurses (IV)

In study I and II all physicians working at the PHCs during the study period were included. We also included physicians in secondary care when we compared dispensed anti-asthmatic drugs prescribed from PHCs and secondary care respectively.

In study III all GPs and residents in family medicine from 14 PHCs (in total 132 physicians at this specific point of time in 2011) were invited to participate in the focus-group interviews. In total 22 physicians (16 GPs and six residents in family medicine) representing seven PHCs agreed to participate. The participating physicians had a median of seven years of experience in primary care (interquartile range 3-14 years) and 16 of them were women.

In study IV the documentation of the quality indicators in the electronic health care records could have been performed by any of the physicians working at the PHCs during the study period. However, the contextual data gathered concerned mainly GPs, residents in family medicine and nurses working at the PHCs as described in section 5.3.5.

5.2.3 Children (I, II, IV)

In study I and II the data of the children's asthma medication was retrieved from registers.

In study I, all children aged 0-16 years with at least one dispensed prescription of anti-asthmatic drugs between July 2006 and June 2007, following a one-year period without any

prescribed anti-asthmatic drugs were included. The children were followed for 24 consecutive months regarding dispensed anti-asthmatic drugs. All children had at least one of the prescriptions issued from one of the included 14 PHCs. In total data from 1033 children was included in this study.

In study II all children aged 0-17 years, i.e. all people born 1989-2012, listed in any of the included 28 PHCs at any point in time between 2006 and 2012 were included. In total data from 114 175 children was included.

In study IV electronic health care records from 20 children with a recorded diagnosis of asthma (ICD-10 code J45) and 20 children with a recorded diagnosis of either obstructive bronchitis (ICD-code J22) or cough (ICD-code R05) were included from each of the 14 included PHCs. The children should be between six months and sixteen years old and have had at least one visit at one of the included PHCs with the specified diagnosis during any time in the electronic health care records. The children with a recorded diagnosis of asthma should in addition have had at least one visit with this diagnosis during the year the electronic health care records were scrutinised. In total, health care records from 279 children with asthma and 280 children with obstructive bronchitis or cough were included. Data from these children were also included **in study II** in order to identify specific needs in the educational seminars.

5.3 PROCEDURES

5.3.1 Educational seminars (II, IV)

The 14 PHCs in the intervention group were offered seminars based on case-method learning at their own PHC. Since decision-making is crucial in clinical practice in primary care, case-method learning was suitable as an educational method. However, for practical reasons it was not possible for the physicians and nurses to prepare the cases in advance. We therefore used a simplified model of case-method learning and presented the cases and finished the discussions at each seminar. The cases were based on the two main questions: What? and How? These questions were usually followed up by: Who? When? and Why?

A good management of asthma in children is best obtained by team-based interprofessional care [57-60]. Physicians and asthma nurses together were invited to the seminars. Three seminars of 1-1½ hours were held at each PHC within 5-10 months. Physicians were represented at all the seminars. Median attendance rate for physicians participating in all three seminars was 66 % (interquartile range 52-78 %). Nurses were represented in 80 % of the seminars. In 57 % of the PHCs, nurses were represented in all three seminars. A specialist in paediatric allergy (the author) and a nurse with special education in allergy led the seminars. The first seminar was based on the same case for all the PHCs (see appendix 1 for a summary of the case).

- The case in the first seminar was focused on patient education.
- The case in the second seminar was focused on areas of paediatric asthma depending on specific needs and desires for each PHC. The specific needs were identified by surveys of the electronic health care records for documentation of the prioritised quality indicators stated in table 6. The cases focused on pharmacological treatment of

asthma and inhalation technique, the importance of team-based interprofessional care or diagnostic difficulties. Some PHCs discussed more than one topic.

- The third seminar aimed to follow up and discuss the specific areas with need for improvement identified for each PHC. The purpose was to discuss how to implement changes in the context of the PHC.

To manage children with asthma is a challenge for interprofessional collaboration. The focus of our seminars was thus to present cases that stimulated interactive discussion between the participants. To further stimulate engagement and interactivity the discussions started with small group discussion with two to three people and continued in the whole group.

Engagement and interactivity at the seminars were scored in three levels, based on structured field notes. These levels are shown in table 5.

The assessed level at the seminars was used **in study IV** as a proxy for interactive culture at the PHC.

Table 5. Level of engagement at the seminars.

Level of engagement	Definition
Low (1)	The participants are listening to the seminar leader but only a minority of the participants talk to the seminar leader and there is no interaction between the participants.
Medium (2)	The participants interact and discuss with the seminar leader but not with each other.
High (3)	Interactivity and discussion between the participants. The seminar leader supports the discussion.

5.3.2 Quality assessment (I, II, IV)

Adherence to evidence-based guidelines was assessed as fulfilment of the quality indicators stated in table 6 [23, 26, 61]. The ones with an assigned value of 1 have been stated by the Swedish National Board of Health and Welfare as prioritised to ensure a high quality of care [62]. The ones with an assigned value of 0.5 were based on consensus and local practice guidelines and considered important to add in order to obtain a high quality of asthma care in children [7].

Table 6. Quality indicators according to the evidence-based guidelines

Quality indicator	Value	Age-group to be considered
Diagnostic criteria for asthma fulfilled	1	All ages
Documentation in patient history:		
History of allergy	0.5	All ages
Heredity of asthma and allergy	0.5	All ages
Exposure to furred pets	0.5	All ages
Exposure to tobacco	1	All ages
Diagnostics and patient support:		
PEF¹ performed	0.5	≥ 5 years
Spirometry performed	1	≥ 9 years
Inhalation technique demonstrated	1	All ages
Patient education offered	1	All ages
Pharmacological treatment/Consultation		
Treatment with inhaled corticosteroids or paediatrician consulted	1	All ages

¹PEF denotes peak expiratory flow.

5.3.3 Quality assessment of pharmacological treatment (I, II)

Registers were used to investigate the patterns of dispensed anti-asthmatic drugs (**study I and II**) and to investigate their relation to the diagnosis of asthma (**study II**). Registers were also used to retrieve socio-demographic factors (**study II**).

In the first part of study II the main purpose was to compare dispensed anti-asthmatic drugs prescribed in the intervention and control group by primary care *only*, before and after the intervention. Data was collected regarding dispensed anti-asthmatic drugs to children with a recorded diagnosis of asthma. However, we also collected data regarding dispensed drugs prescribed by secondary care only, during the same periods of time. Secondary care included all specialties but the dispensed anti-asthmatic drugs were in more than 95 % prescribed by paediatric out-patient clinics. The children included were all listed at the 28 PHCs in the study. When comparing primary and secondary care the primary care intervention and control group were merged. **In the second part of study II** data was collected regarding dispensed anti-asthmatic drugs prescribed by primary care to all children that were listed at the 28 PHCs. The proportion of these children that had a recorded diagnosis of asthma was then calculated. **In both parts of study II** data collection was performed before and after the educational intervention. The children were split in two age-groups: ≤ 6 years (preschool) and > 6 years (school-age) according to the guidelines regarding pharmacological treatment (study I and II) [6, 7, 10].

The following anti-asthmatic drugs were included **in study I and II**:

1. *Short-acting beta2-agonists (SABA)*: salbutamol (ATC-code R03AC02, R03CC02), terbutaline (ATC-code R03AC03, R03CC03)
2. *Long-acting beta2-agonists (LABA)*: salmeterol (ATC-code R03AC12), formoterol (ATC-code R03AC13)
3. *Inhaled corticosteroids (ICS)*: beclometasone (ATC-code R03BA01), budesonide (ATC-code R03BA02), fluticasone (ATC-code R03BA05)
4. *Fixed combinations*: salmeterol+ICS (ATC-code R03AK06), formoterol+ICS (ATC-code R03AK07)
5. *Leukotriene receptor antagonist*: montelukast (ATC-code R03DC03)

The oral solutions of salbutamol (R03CC02) and terbutaline (R03CC03) were not included in study I. All the anti-asthmatic drugs were classified according to the Anatomical Therapeutic Chemical system [63]. Data was collected from the following registers:

- Data on dispensed anti-asthmatic drugs including care-giver and prescription date was collected from the Swedish Prescribed Drug register. This register was established in 2005 and contains data on dispensed prescription drugs in ambulatory care for the entire Swedish population (99.8% population coverage) [64].
- Data on recorded diagnoses was collected from the regional data warehouse on health care consumption, GVR/VAL, held by the Stockholm County Council. All appointments and diagnoses are reported and stored in GVR/VAL [65].
- Data on listed people was collected from the regional census register. This is an electronic service in which the PHCs register the patients that they have listed. The PHCs check and update the register regularly since the listing status at the PHCs is a cornerstone in the financial compensation for the PHCs.
- Data on socio-demographic characteristics was based on the care need index (CNI) for the geographic area where the PHC was situated. CNI is based on the following sociodemographic factors: elderly people (> age 64) living alone, children under age 5, unemployed people (aged 16-64 years), single parents with children aged 17 years and younger, high mobility (people ≥ 1 year who have moved to the area during the past year and foreign born people from southern and eastern Europe, Asia, Africa and South America. Average CNI for Stockholm as well as for the rest of Sweden is 1.0. A CNI >1.0 indicates that people living in the area have higher rates of psychiatric hospital admissions and cardiovascular risk factors than average.

An overview for the registers used in the different studies is shown in table 7

Table 7. An overview of the registers and the studies they were included in

Register	Study I	Study II	Study III	Study IV
The Swedish Prescribed Drug register	X	X	-	-
The GVR/VAL	-	X	-	-
The regional census register	-	X	-	X
The CNI	-	X	-	X

X= included, - = not included

5.3.4 Approach to, learning from and use of evidence-based guidelines explored by focus group interviews (III)

Qualitative research aims to *interpret the meaning* of the collected data which usually consists of observations, interviews or written documents [66]. The interpretation is performed by analysing the content. Focus group interviews (FGIs) focus on a specific subject, in this study the use of evidence-based guidelines in decision-making. A structured interview guide was prepared in advance. The interview guide consisted of an opening question, three core questions and finally a closing question. Probe questions or questions for clarification were prepared to be used if needed [67, 68]. The interview guide is shown in appendix 2. The author conducted the interviews and a behavioral scientist acted as an observer in order not to miss any data. Between three and eight physicians participated in each FGI. By performing group interviews, there were discussions between the participants as well as with the interviewer and thus a rich amount of data was obtained [69]. We performed in total four FGIs. In the fourth FGI no new data was obtained and thus no more interviews were performed.

The interviews were recorded and transcribed verbatim by the author. Qualitative content analysis was then performed by using the methods described by Graneheim and Lundman and by Krueger [70, 71]. First, meaning units in the transcripts were identified and sorted by content and meaning [71]. Second, meaning units were condensed and labelled with codes while still preserving the core [70]. Codes that belonged together were grouped to form categories [70]. In the last step, the content in the categories was interpreted and themes were created [70]. In interpreting and discussing the themes the Dual Process Theory was applied [20-22]. The Dual Process Theory was applied since decision-making was central in this study.

5.3.5 Evaluation of the influence of contextual features on quality of care (IV)

Quality of care for children with asthma at each PHC was defined as a composite quality indicator (CQI) of all the quality indicators shown in table 6 [28]. The CQI was calculated by

taking the proportion of documentation of each quality indicator and then multiplying it with its assigned value. The obtained numbers were then summarised. The possible range for each PHC was thus 0-8 points.

The influence of the separate contextual features on CQI was then assessed.

Predefined checklists, personal contacts with the managements of the PHCs, questionnaires and levels of engagement and interactivity at the educational intervention were used to collect data regarding contextual features at the PHCs. Registers were used for socio-demographic characteristics (table 7).

The predefined checklist that was filled in by each of the participating PHCs is shown in appendix 3. The checklists were filled in one month after the seminars were completed. At this point in time the author and the nurse who led the seminars also contacted the management for the PHCs by e-mail or telephone. This was done in order to collect data regarding mean duty-grade of the physicians (GPs and residents in family medicine), vacancies and change of medical software during the period of the seminars. Further, questionnaires were distributed to the GPs and residents in family medicine. The questionnaires dealt with the physicians' perceptions of their adherence to the evidence-based guidelines regarding paediatric asthma including barriers and facilitators. However, very few questionnaires were completely filled in. The results could therefore not be interpreted in a reliable way, why the response rate instead was used as a measure of engagement.

The assessed level of engagement at the seminars that was used as a proxy for interactive culture is shown in table 5.

5.4 STATISTICS

For all comparisons a two-tailed probability of ≤ 0.05 was considered significant.

In paper I standard descriptive statistics (number and proportions) were used to describe the study cohort and the utilisation pattern of the drugs. The obtained data was processed in Microsoft Excel v.2003, SYSTAT II v.2004 (SYSTAT software, Richmond, CA, USA) and SAS v. 9, 1.3 SP 3, 2004 (SAS Institute, Cary, NC, USA).

In paper II standard descriptive statistics (number, proportions, median and total range) were used to describe the study cohort. Pearson Chi-square test for categorical data with two variables was used to compare the intervention and control group in primary care regarding: patterns of dispensed anti-asthmatic drugs, proportion of children dispensed anti-asthmatic drugs that had a recorded diagnosis of asthma and prevalence of asthma. This test was also used to compare the patterns of dispensed drugs in primary and secondary care.

In paper IV median and interquartile ranges or proportions were calculated for all variables. Chi-square test and Fisher's exact test were used for comparison of categorically variables of the groups of PHCs with low versus high CQI. Mann-Whitney U tests (for non-normally distributed data) and unpaired t-tests (for normally distributed data) were used for comparison of continuous variables between the groups of PHCs.

The statistical software IBM, SPSS version 22 (IBM, Chicago, IL, USA) was used for these

analyses in paper II and IV.

In addition in paper IV, a multivariate regression analysis was performed by Orthogonal Projection to Latent Structures regression (OPLS) using the non-linear iterative partial least squares (NIPALS) algorithm that allows analysis of wide data matrices i.e. many variables (items) in comparison to number of subjects. OPLS uses a decline in Q² (predictive fraction) to determine the number of independent (orthogonal) components to extract to avoid over-fit. Q² is calculated by cross-validation [72, 73]. Variables of Importance for the Projection (VIPs) were listed. VIP is the sum over all model dimensions of the contributions VIN (variable influence). VIP with a value exceeding 0.8 with a confidence interval not including zero was considered to have influence on the projection. With multivariate methods, it is possible to investigate relations between all variables in a single context. When fitting an Orthogonal Partial Least Squares (OPLS) Projection to Latent Structures model, OPLS finds the linear (or polynomial) relationships between a matrix Y (response variables) and a matrix X (predictor variables) [74]. The significance testing was based on an ANOVA of the cross-validated residuals (CV-ANOVA). The statistical software SIMCA P+©, version 12.0.1.0, Umetrics Ltd, Umeå, Sweden, was used.

6 MAIN RESULTS

6.1 PHARMACOLOGICAL TREATMENT (I, II)

6.1.1 Dispensed anti-asthmatic drugs for initiation of treatment (I)

A total of 1033 children aged 0-16 years were initiated on anti-asthmatic drugs between July 2006 and June 2007. Slightly more than half of the children (51 %) were aged 0-6 years. Most children (89 %) were initiated on SABA as monotherapy or SABA in combination with ICS. Among the preschool children (0-6 years), the majority (64 %) were initially dispensed a combination of SABA and ICS. SABA as monotherapy was most common among the school-aged children (in this study 7-16 years), where it was initially dispensed in 50 % of the children. Anti-asthmatic drugs other than SABA and ICS were dispensed in fewer than 8 % of the children. Table 8 shows the pattern of dispensed drugs for initiation of treatment.

Table 8. Number of children with their first anti-asthmatic drugs dispensed between July 2006 and June 2007 after a one-year drug-free wash-out period.

Drugs	Children 0-6 years n (%)	Children 7-16 years n (%)	All children 0-16 years n (%)
SABA¹ monotherapy	159 (30)	250 (50)	409 (40)
SABA¹ and ICS²	338 (64)	165 (33)	503 (49)
SABA¹ and fixed combination³	1 (<1)	37 (7)	38 (4)
ICS monotherapy	24 (5)	24 (5)	48 (5)
LABA⁴ monotherapy	0 (0)	15 (3)	15 (1)
LABA⁴, ICS² and SABA¹	0 (0)	7 (1)	7 (<1)
Montelukast, monotherapy	2 (<1)	2 (<1)	4 (<1)
Other combinations⁵	6 (1)	3 (1)	9 (1)
All patients initiated on therapy	530 (100)	503 (100)	1033 (100)

¹SABA denotes short-acting beta2-agonists, ²ICS denotes inhaled corticosteroids, ³Fixed combination of ICS and LABA, ⁴LABA denotes long-acting beta2-agonists, ⁵Other combinations of the above mentioned drugs.

Asthma treatment was initiated in primary care for 42 % of the preschool children and in a paediatric outpatient clinic for 52 %. Among the school-aged children 72 % received their asthma treatment from primary care while 16 % had their asthma treatment initiated in a paediatric outpatient clinic. Other health care providers such as hospital-based specialists or

school health care initiated asthma treatment in 6 % of the preschool children and in 12 % of the school-aged children.

A total of 42 % of the children were only dispensed one prescription whereas 13 % had more than four prescriptions dispensed. The school-aged children had in general fewer prescriptions dispensed than the preschool children. Figure 3 shows the number of anti-asthmatic drug prescriptions dispensed to each patient during the 24-month follow-up period.

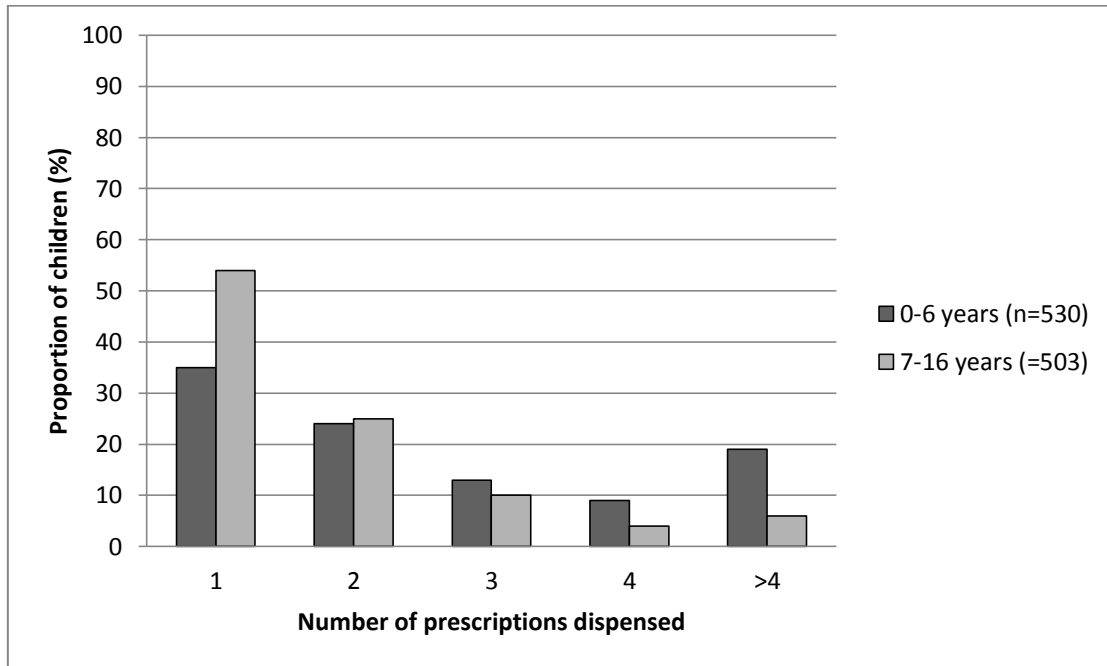


Figure 3. Number of anti-asthmatic drugs prescriptions dispensed to each child over a 24-month period

6.1.2 Dispensed anti-asthmatic drugs in children with a recorded diagnosis of asthma (II)

In total there were 2638 children aged 0-17 years during the baseline period and 2806 children during the follow-up period with a recorded diagnosis of asthma that were dispensed anti-asthmatic drug treatment prescribed from primary care. The PHC intervention group was slightly larger than the control group. Figure 4 shows how the children with a recorded diagnosis of asthma that were dispensed anti-asthmatic drugs were allocated in the different groups.

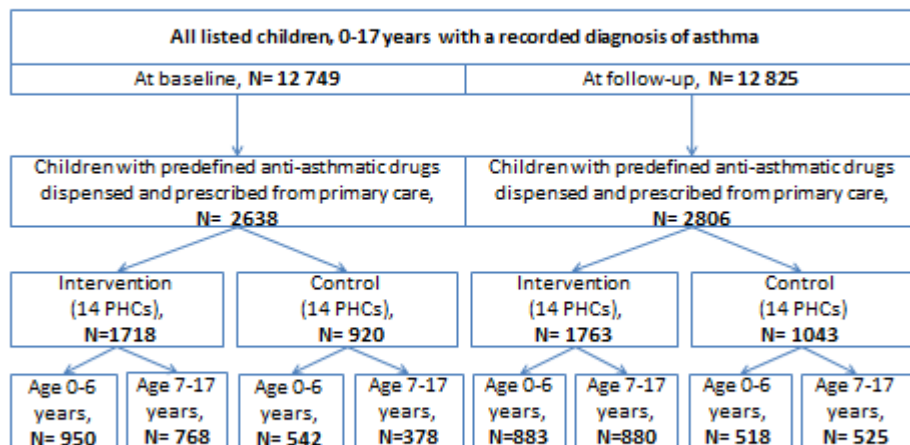


Figure 4. Flowchart of children with asthma at the 28 included PHCs at baseline and follow-up. Some children may be included during both periods.

There were no statistically significant differences in dispensed anti-asthmatic drug treatment between the intervention- and control group either at baseline or at follow-up. The majority of children with a recorded diagnosis of asthma were dispensed both SABA and an anti-inflammatory anti-asthmatic drug (ICS, fixed combination or montelukast) (table 9).

Table 9. Primary health care centres (PHCs) before and after intervention. Data compared are number of children with dispensed anti-asthmatic drugs prescribed from included PHCs

Age-group	Drug	Children ⁵ at baseline		Children ⁵ at follow-up	
		N(%)		N(%)	
		<i>Intervention</i>	<i>Control</i>	<i>Intervention</i>	<i>Control</i>
		<i>PHCs</i>	<i>PHCs</i>	<i>PHCs</i>	<i>PHCs</i>
0-6 years	SABA ¹ monotherapy	277(29)	163(30)	214(24)	125(24)
	SABA ¹ and ICS ²	588(62)	304(56)	538(61)	306(59)
	SABA ¹ and fixed combination ³	3(<1)	7(1)	0(0)	1(<1)
	SABA ¹ and montelukast	62(7)	51(10)	112(13)	70(14)
	Other monotherapies or combinations ⁴	20(2)	17(3)	19(2)	17(3)
	Total 0-6 years	950(100)	542(100)	883(100)	518(100)
	7-17 years				
SABA ¹ monotherapy	SABA ¹ monotherapy	158(21)	62(16)	164 (19)	86(16)
	SABA ¹ and ICS ²	349(45)	150(40)	456(52)	267(51)
	SABA ¹ and fixed combination ³	120(16)	69(18)	89(10)	68(13)
	SABA ¹ and montelukast	45(6)	22(6)	85(9)	43(8)
	Other monotherapies or combinations ⁴	96(12)	75(20)	86(10)	61(12)
	Total 7-17 years	768(100)	378(100)	880(100)	525(100)

¹SABA denotes short-acting beta2-agonists, ²ICS denotes inhaled corticosteroids, ³Fixed combination of ICS and LABA (long-acting beta2-agonists), ⁴Other combinations of the above mentioned drugs.

⁵Children listed at included PHCs.

A comparison of dispensed anti-asthmatic drugs prescribed by physicians in primary care versus other specialists in secondary care showed statistically significant differences in all drugs in both age-groups ($p < 0.05$) except for SABA and ICS in preschool children and other monotherapies or combinations in both age-groups. The children treated by specialists were in general dispensed less SABA as monotherapy, less SABA and ICS (school-aged children) and more SABA and fixed combinations and SABA and montelukast. This difference was shown both during the baseline period and the follow-up period.

6.1.3 Documentation of asthma diagnosis in all children that were dispensed anti-asthmatic drugs prescribed in primary care (II)

A diagnosis of asthma was recorded in 80 % of the children in the intervention group and in 75 % of the children in the control group among all the preschool children that were dispensed anti-asthmatic drugs during the baseline period. Among the school-aged children the numbers were 70 % in the intervention group and 64 % in the control group. However, there was a statistical significant difference ($p < 0.001$) between the intervention and control group in both age-groups at baseline. An evaluation of the intervention could thus not be done regarding this parameter. Among children who were dispensed anti-asthmatic drugs, the observation that a lower proportion of school-aged children than preschool children had a recorded diagnosis of asthma remained during the follow-up period.

Results in summary

Treatment with anti-asthmatic drugs was mainly initiated in paediatric specialist clinics in preschool children and in primary care in school-aged children. Children of all ages with a recorded diagnosis of asthma were dispensed anti-asthmatic drugs according to the evidence-based guidelines at baseline as well as at follow-up. The educational intervention did not have any effect. The majority of the children with a diagnosis of asthma were thus dispensed SABA as well as anti-inflammatory anti-asthmatic drugs. However, approximately one-fourth, among school-aged children even more, was dispensed anti-asthmatic drugs without having a recorded diagnosis of asthma. More than 50 % of the school-aged children were mainly dispensed SABA at one single occasion when there was no connection to diagnosis.

6.2 APPROACH TO, LEARNING FROM AND USE OF EVIDENCE-BASED GUIDELINES IN THE CONTEXT OF PRIMARY CARE (III)

When the FGIs were analysed three themes were conceptualised that described how GPs approach and learn from the guidelines in their daily practice. These themes and the categories that supported them are shown in figure 5.

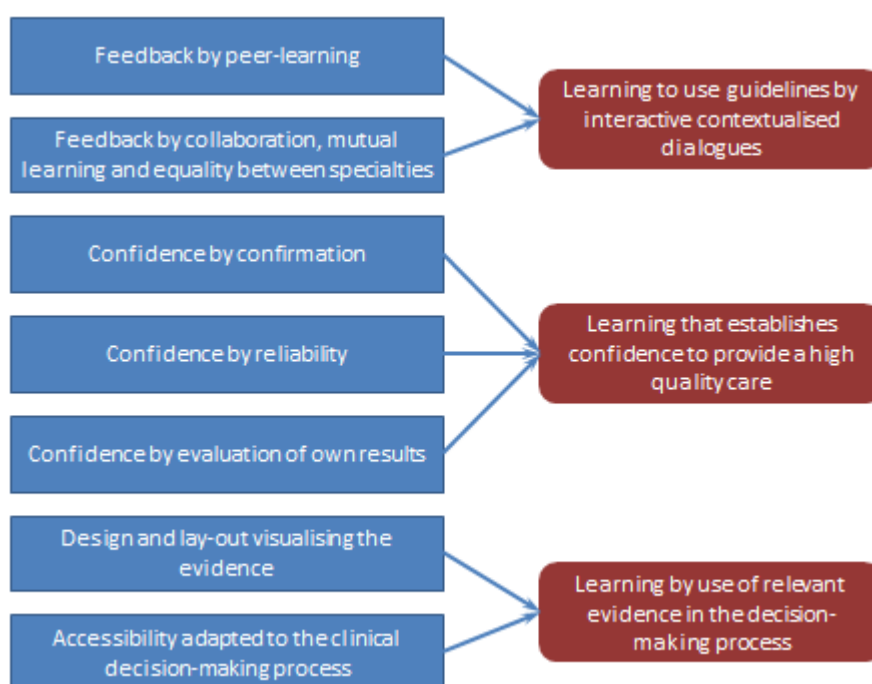


Figure 5. Categories identified during the content analysis and the corresponding interpreted themes.

Learning to use guidelines by interactive contextualised dialogues. Collaboration and learning by dialogue with colleagues at the own PHC as well as with secondary care was considered as the optimal way to assess knowledge. Learning obtained by interaction and thus encouraging reflection was perceived by the GPs to give a better quality of care. The GPs also felt that group-dialogues created power in decision-making. A more developed

cooperation between primary and secondary care when developing the guidelines was suggested as a way to make the guidelines more supportive and open to individualisation depending on the clinical situation. This can be exemplified by the citation:

“ When the guidelines were to be updated all the GPs were invited to a meeting...They explained the guidelines and why they have updated them, how we should handle the patients, when to refer them to secondary care and planned follow-up. It was a short presentation followed by a long dialogue...” - Female

Learning that establishes confidence to provide high quality care. Confidence was a central aspect for the GPs in using guidelines. To feel confident in own knowledge by confirming it in guidelines was important for the GPs in the decision-making process. However, an important aspect was also that they could confirm that their decision was evidence-based for the patient and thus had a potential to increase the patients' motivation and knowledge.

A prerequisite for using the guidelines was that the GPs felt that they could rely on them. The GPs felt the greatest reliability from consulting someone they knew personally. Reliability in internet-based or printed guidelines was strongly dependent on the source being well known and the guidelines being continuously updated.

When new guidelines were established the GPs wished for individualised follow-ups from secondary care on how their use of the guidelines actually improved the care of the patients. The GPs meant that an evaluation of the individualised results in an audit-like model would be stimulating and strengthen confidence in the guidelines. This can be exemplified by the citation:

“ I would like to see results. I think that one reason for not following the guidelines is that we never have follow-ups. I want follow-ups, personal follow-ups. We hardly ever get feedback on what we do. The client health care organisation has organised follow-ups which I think is good because then you get feedback. If I never get feedback on what I am doing... why should I care ??” - Female

Learning by use of relevant evidence in the decision-making process. A major problem in using the guidelines was to find the relevant information for the decision in each specific clinical situation.

Printed or internet-based guidelines should be short and concise with a clear over-view and a pedagogic lay-out. There should be links or references to in-depth literature to consider later if needed. Furthermore, guidelines sorted by symptoms instead of diagnoses would be more appropriate for decision-making. Lectures should be arranged in small groups.

The GPs have a clinical situation where their working- days usually are fully booked with patient-visits. The patients present a wide spectrum of diseases which sets high requirements for accessibility of guidelines. Slow electronic systems and insufficient information retrieval skills made many GPs prefer short printed brochures, easily accessible lying on the desk. Phone consultations with secondary care, if accessible only during certain times of the days were not used. However, GPs who had free access to phone consultations perceived them as

the most valuable form of guidelines in difficult cases. The importance of easily accessible guidelines could be exemplified by the citation:

“ I feel that the biggest problem with internet is lack of time. I lose control of time when I am searching for information on the internet and then I feel stressed having to keep track of time.”Oh God there is so much information, where should I start” ...” - Female

Results in summary

The possibilities of learning when using guidelines for interactive contextualised dialogues and learning that provides confidence in high quality care were emphasised by participating GPs as important aspects to consider in their approach to the guidelines. A prerequisite for using the guidelines was that they should allow access to relevant evidence in the decision-making process.

6.3 THE INFLUENCE OF CONTEXTUAL FEATURES ON QUALITY OF CARE (IV)

6.3.1 Quality of care

The documentation of the quality indicators shown in table 6 varied between the PHCs. Documentation of fulfilled asthma criteria for children with a recorded asthma diagnosis was present in all electronic health care records in all PHCs. Documentation of pharmacological treatment or consultation with a paediatrician was also documented in most children with a recorded diagnosis of asthma. Documentation of other quality indicators showed a large variability which resulted in a widespread distribution of CQI between the PHCs. Table 10 illustrates the documentation of quality indicators and how it affected CQI.

Table 10. Quality indicators documented in the electronic health care records and the corresponding calculated CQI.

	All PHCs n=14	The PHC with the lowest CQI n=1	The PHC with the highest CQI n=1
CQI	4.04 (3.14-4.72)	2.75	7.34
Contribution of the indicators of quality to CQI			
Diagnostic criteria for asthma fulfilled	1.00 (1.00-1.00)	1	1
Documentation in patient history:			
History of allergy	0.42 (0.39-0.48)	0.40	0.50
Heredity of asthma and allergy	0.42 (0.39-0.48)	0.40	0.50
Exposure to furred pets	0.23 (0.20-0.28)	0.05	0.48
Exposure to tobacco	0.20 (0.05-0.30)	0.05	0.80
Diagnostics and patient support:			
PEF performed	0.36 (0.23-0.40)	0.10	0.46
Spirometry performed	0.26 (0.10-0.52)	0	1.00
Patient education offered	0.20 (0.04-0.25)	0	0.80
Inhalation technique demonstrated	0.18 (0.10-0.26)	0	0.80
Patient education offered	0.20 (0.04-0.25)	0	0.80
Pharmacological treatment/Consultation:			
Treatment with inhaled corticosteroids or paediatrician consulted	0.82 (0.75-0.91)	0.75	1

Values for all PHCs are given as median (interquartile range)

6.3.2 The influence of contextual features

The OPLS analysis identified ten contextual features with influence on CQI. The following contextual features were associated with the highest positive influence on CQI:

- Lower reported age-limit for performing spirometry
- More reported time scheduled for asthma care
- Lower reported duty-grade for GPs
- Higher activity level at seminars

All the ten features and their influence on CQI are shown in figure 6.

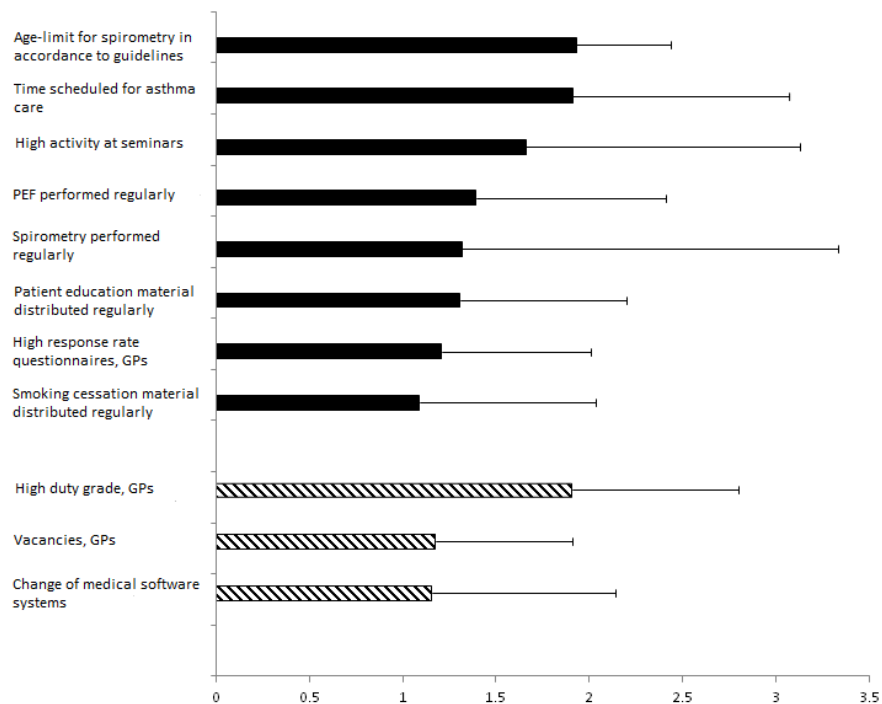


Figure 6. Contextual features with influence on CQI. Black bars indicate positive and striped bars indicate negative influence.

Possession of equipment to perform lung function tests (PEF-meter, spirometer) or performing spirometry regularly in children did not have any influence on CQI. Nor did having inhaler devices for demonstration or patient education material or material regarding smoking cessation.

PEF performed regularly had influence on CQI while spirometry performed regularly had not. The variable “spirometry performed regularly” had a value exceeding 0.8 and is shown in figure 6 but the confidence interval for this variable included zero and this variable could thus not be considered as having influence on CQI.

A GP or nurse with assigned responsibility for asthma care did not have any influence on CQI, neither did attendance rate at the seminars.

Sociodemographic factors did not have any influence on CQI.

Results in summary

We found ten contextual features that influenced the PHCs adherence to the evidence-based guidelines for children with asthma. An evidence-based care of children with asthma was found to require allocated time, interprofessional collaboration and an organisational structure supporting engagement and professional development adjusted to the local conditions.

7 DISCUSSION

This thesis focuses on potential influence of quality of management and learning on evidence-based practice for children with asthma in primary care as shown in figure 7.

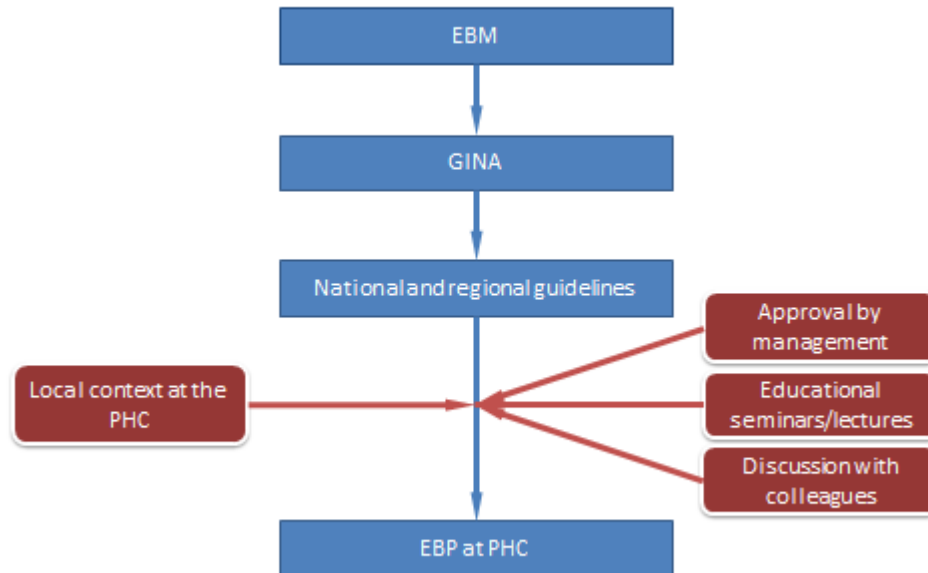


Figure 7 . The process from evidence-based medicine (EBM) to evidence-based practice (EBP) and factors that influence this process.

In study I we showed that physicians initiating school-aged children on anti-asthmatic drugs had poor adherence to the evidence-based guidelines. However, **in study II** when we only included children with a recorded diagnosis of asthma, the adherence to the guidelines regarding pharmacological treatment was good. Still, especially among the school-aged children, a large proportion of all children that were dispensed anti-asthmatic drugs did not have a recorded diagnosis of asthma.

Even if evidence-based guidelines are based on a diagnosis of asthma, pharmacological anti-asthmatic treatment was apparently not exclusively given to children that had an asthma diagnosis. **In study III** we therefore wanted to explore the GPs' attitude to guidelines in general. We found three themes to consider, regarding how GPs approach, learn from and use evidence-based guidelines in their daily decision-making process. The themes emphasised the importance of: 1. Learning to use guidelines by interactive contextualised dialogues. 2. Learning that establishes confidence to provide a high quality care. 3. Learning by use of relevant evidence in the decision-making process.

The implementation of evidence-based guidelines in the complex context of primary care is thus a challenge. **In study IV** we identified ten contextual factors with influence on quality of care.

7.1 EVIDENCE-BASED PRACTICE AND PHARMACOLOGICAL TREATMENT (I, II)

Evidence-based guidelines presuppose a diagnosis [6, 7, 10]. Yet, in many studies that show a poor adherence to the guidelines, the children did not, in similarity with study I, have a recorded diagnosis of asthma [75-78]. Children in these studies were mainly prescribed [75-77] or dispensed [78] short or long-acting beta2-agonists as monotherapy. However, there are studies that show poor adherence to the guidelines with an under-use of anti-inflammatory anti-asthmatic drugs, even when the children had a recorded diagnosis of asthma [79, 80]. In both these studies the study periods were short, only 12 months. Such a short study period may result in the confounder that the children still are able to use drugs prescribed and dispensed before the study period. Asthma as well as other atopic diseases runs in families [81]. Another confounder could thus be that members in a family may use each other's medicine which in turn may lead to fewer own dispensed anti-asthmatic drugs if the observation period is not long enough. A Swedish study performed in adolescents (11-14 years) has shown that an 18-month period was needed when using dispensing data to study the use of anti-asthmatic drugs [82].

In study II when the children had a recorded diagnosis of asthma and were followed for 24 months, more than 65 % of the children were dispensed SABA and an anti-inflammatory anti-asthmatic drug. We have thus shown that physicians in primary care, treating children with a recorded diagnosis of asthma have a good adherence to pharmacological evidence-based guidelines. The good adherence to the evidence-based guidelines already at baseline probably also explains why the educational intervention did not have any effect on the pharmacological treatment.

The difference in dispensed anti-asthmatic drugs between children treated in primary and secondary care in study II was expected. Our experience is that the main purpose of treating children in secondary care is that the asthma is too severe to be managed in primary care. Consequently children treated in secondary care should need a higher level of treatment (table 1 and 2).

In the second part of study II, we showed that a large proportion of all children that were dispensed anti-asthmatic drugs prescribed in primary care did not have a recorded diagnosis of asthma. This observation was especially obvious among the school-aged children. A possible explanation to this could be that SABA was used partly as a diagnostic tool. This hypothesis has also been proposed in other studies [83]. Still, SABA as a diagnostic tool for asthma should rather have been expected in preschool children since the possibilities to perform lung function tests in this age-group are more limited than in school-aged children. On the other hand, preschool children usually have more obvious symptoms of the disease of asthma than school-aged children [2, 31].

These arguments are supported by our findings in study I. In this study there was no connection to diagnosis and it could thus be expected that both children with and without a diagnosis of asthma were included. In this study we showed that only 47 % of all the school-aged children that were initiated on anti-asthmatic drugs were initiated on any kind of anti-inflammatory anti-asthmatic drug. Less than 10 % had more than four prescriptions of anti-

asthmatic drugs dispensed during the 24 months the pattern of dispensed drugs was followed. More than 50 % were mainly dispensed SABA at one single occasion. In preschool children 65 % were initiated on anti-inflammatory anti-asthmatic drugs. Almost 20 % had more than four prescriptions of anti-asthmatic drugs dispensed during the 24 months the pattern of dispensed drugs was followed.

We excluded SABA administered as oral solution in study I and in the second part of study II. It is our experience that oral solutions of SABA often are used as antitussive medication or as a diagnostic tool for asthma in preschool children. Still, SABA administered by inhalation was included. To administer anti-asthmatic drugs by inhalation is more complicated in preschool than in school-aged children. This may also be a reason for the lower proportion of children with a reported diagnosis of asthma among the school-aged children.

Our hypothesis was thus that dispensed anti-asthmatic drugs without a recorded diagnosis of asthma consisted mainly of SABA as monotherapy, dispensed at one single occasion as a diagnostic tool. Consequently, it is reasonable to believe that some of the school-aged children that were dispensed SABA as monotherapy at one single occasion did not have a diagnosis of asthma. However, according to the evidence-based guidelines spirometry should be performed as far as possible to diagnose asthma in school-aged children [10].

Other studies [84-86] have shown that asthma medication may function as a proxy for asthma diagnosis. In all these studies SABA as oral solutions were excluded. Further, in order to serve as a proxy for asthma diagnosis, the anti-asthmatic drugs should have been dispensed at least twice [85, 86] or should have been redeemed according to very strict regulations [84]. Even if dispensed drugs reflect patient use better than prescribed drugs do, it does not mean that the patients actually take their medication. A qualitative interview study with children and adults with asthma has explored barriers and facilitators to adherence to long-term daily maintenance treatment for asthma [87]. The study concluded that factors could be interpreted as barriers or facilitators depending on the context. Patient education was an example of this. Good knowledge about the medication was pointed out as the key facilitator in adherence to drugs prescribed. Poor knowledge about the medication instead lead to feelings of uncertainty regarding effects and side-effects and thus to poor adherence. Crucial for adherence to anti-asthmatic drug treatment was the quality of the patient-physician interaction and the health care system accessibility.

7.2 EVIDENCE-BASED GUIDELINES - APPROACH TO, LEARNING FROM AND USABILITY IN THE DECISION-MAKING PROCESS (III)

To make correct clinical decisions for each individual patient is the goal for all physicians in their daily practice. The three conceptualised themes could in different ways be linked to the decision-making process according to the Dual Process Theory [20-22] shown in figure 8.

The importance of dialogue in the decision-making process in clinical practice was the main finding in the first theme “- Learning to use guidelines by interactive contextualised dialogues”. Pattern recognition is central in the dialogue as shown in figure 8. Applied to the Dual Process Theory as described by Croskerry [20] the dialogue could enhance the

repetitive process of the analytic system and increase the process of pattern recognition. Pattern recognition thus enables a future fast, but still evidence-based decision-making process [20-22]. The opposite, strictly detailed instructions without possibilities for reflections, may instead hinder the learning process.

The importance of professional networks and feedback in decision-making has been pointed out in other studies [19, 88]. Further, evidence-based guidelines designed as rigid, detailed instructions were perceived by the GPs as assignments instead of being part of a continuous learning process. Other studies have shown that physicians' attitudes towards guidelines are strongly correlated with access to professional networks [88]. Dialogue, feedback and time for reflection are thus central to determine whether the evidence-based guidelines should be perceived as facilitators or barriers [37, 38, 42, 89, 90].

Dialogue and feedback were essential in GPs' approach to the guidelines in the decision-making process. Still, a prerequisite for using evidence-based guidelines at all was that the GPs perceived them as trustworthy. Otherwise there was an apparent risk that the GPs would rely on experience rather than on guidelines in the decision-making process.

To obtain a balance between the fast intuitive system and the slower analytic system in the decision-making process was central in the second theme “- Learning that establishes confidence to perform a high quality of care”. Confidence could be obtained by confirmation of own knowledge if the source was perceived as reliable. Further, if the GPs had the possibility to evaluate own results this could lead to a positive attitude towards the guidelines and promote behavioural changes. Previous studies have shown that to get feedback and to feel confident in own competence strengthen intrinsic motivation and promote behavioural changes [91]. Thus, if the GPs felt confident in the use of the analytic system they could switch between the two systems as needed. Confidence thus promotes a decision-making process that strives towards evidence-based practice.

To feel confidence in the evidence-based guidelines is necessary for the GPs in order to learn from them and to integrate them in their decision-making. Yet, there is a vast amount of information available while lack of time is a reality in clinical practice. To find relevant information was therefore the main finding in the third theme “- Learning by use of relevant evidence in the decision-making process”. The guidelines should be easily accessible with a clear design and lay-out. Further, they should be short, simple and preferably include patient leaflets. The guidelines should also include references to in-depth literature. Easy access to relevant guidelines encourages the use of the analytic system in the decision-making process and thus promotes a high quality of care. Previous studies have pointed out the importance of accessibility [92] and that evidence-based guidelines must be designed to facilitate the decision-making process [93, 94].

To use the least cognitive effort,” the cognitive miser” [20-22], in the decision-making process was a necessary strategy for the GPs in their clinical routine practice where a high efficiency is required. However, too little cognitive effort increases the risk of diagnostic errors. A previous study has also shown that diagnostic errors are common [95, 96]. Most

common were diagnostic reasoning errors when the physicians were not aware that their actions were incorrect. We think that it is important to consider the decision-making process when developing and implementing evidence-based guidelines. Further, we found that the contextual features of primary care are highly important in how GPs approach, learn from and use the guidelines in their daily clinical routine practice.

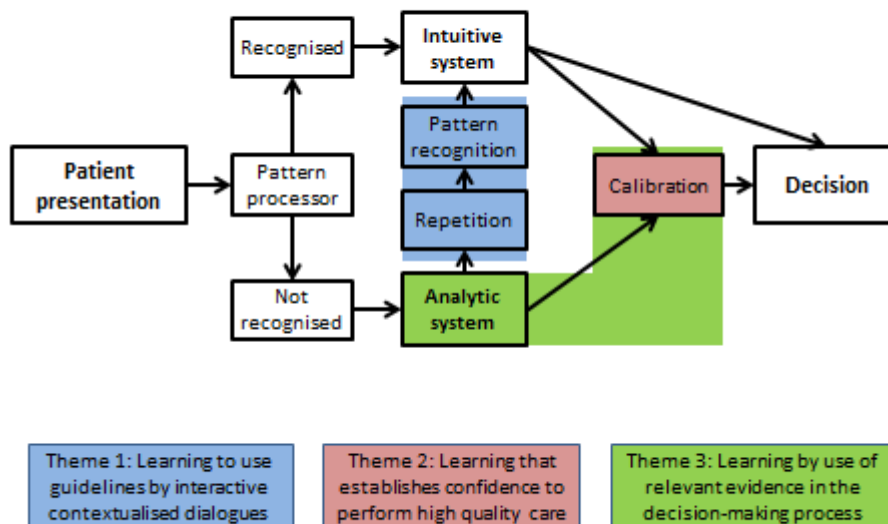


Figure 8. The decision-making process with the phases reinforced by the themes marked.

Intuitive system here includes general practitioners earlier experience and the context of the primary health care centres.

Analytic system here includes evidence-based guidelines, consultations and evaluation of own results

This figure is inspired by Patrick Croskerry [20].

7.3 INFLUENCE OF CONTEXTUAL FEATURES ON EVIDENCE-BASED PRACTICE (IV)

To understand the influence of contextual features is essential in understanding how the guidelines are used in clinical practice. We studied in total 26 contextual features in primary care. By using the OPLS method [72-74], a multivariate regression analysis, it was possible to evaluate the influence of contextual features on quality of care defined as CQI. We could identify ten contextual features with influence on quality of care, thus reflecting adherence to evidence-based guidelines to paediatric asthma. These features included organisational characteristics as well as engagement in asthma care but no socio-demographic characteristics.

Reported hours scheduled for asthma care, duty grade for GPs, activity at seminars and reported lower age-limit for performing spirometry were all contextual features with a high influence on CQI. All these features represent a well structured organisation and/or engagement. A management that supports interprofessional collaboration and engagement is necessary to make scheduled time for asthma care possible [97, 98]. Further, allocated time

for asthma care is important which also has been shown in other studies [60]. Simply having a GP and/or nurse with assigned responsibility for asthma care was not enough to influence CQI. A high duty grade influenced CQI negatively. The financial reimbursement system in Swedish primary care is built on productivity [13, 99]. GPs working fulltime or almost fulltime in clinical practice could thus be expected to have little time for reflection which could explain the negative influence on quality of care. Being very preoccupied with clinical routine practice could also make the GPs less prepared for organisational demands and engagement [51]. Activity level at seminars reflected engagement in asthma care as well as a local workplace culture with interactivity both uni- and interprofessionally. Interprofessional education in general has been shown to stimulate collaborative practice. It optimises the skills of the professions and may lead to improved health outcomes [100]. To perceive that the own PHC regularly performed spirometry in children from age nine had an influence on CQI. We interpreted this as a marker of local knowledge and engagement in asthma care which in turn indicated a supportive management.

There could have been several possible reasons that the other six contextual features had less influence on quality of care. Influence, but during a limited period of time, such as change of medical software and vacancies could be one reason. Contextual features requiring engagement from only one single GP or nurse, such as distribution of patient education material and smoking cessation material could be another reason.

In contrast to other studies [101-103] socio-demographic features did not have any influence on quality of care. However, these studies used individual data while we only had access to data on group level which could be a possible explanation.

Primary care is a complex part of health care. There are demands from the health care principals as well as from secondary care. Further, primary care collaborates with many different units in secondary care which in turn have different requirements and expectations. There is a substantial gap between actual care provided in primary care and evidence-based guidelines [41]. This gap is especially prominent regarding non-pharmacological treatment. In this study 58 % of the study population was treated with ICS while only 14 % had patient education and demonstration of inhalation technique documented. Unlike patient education and demonstration of inhalation technique, prescription of pharmacological treatment is not dependent on contextual features. Consequently, pharmacological treatment is less complicated to discuss. It was also our experience from the educational seminars that pharmacological treatment initially was the subject that most of the PHCs wished to discuss. However, to consider contextual features is necessary in order to apply evidence-based guidelines to clinical routine practice. It is thus important with a management that is aware of and creates opportunities to improve important contextual features with high influence on quality of care. Further, it is also important that evidence-based guidelines are designed as frameworks that can be adapted to the different contextual features at the individual PHCs.

7.4 METHODOLOGICAL CONSIDERATIONS

One important factor to consider in research is that the study material is representative. Health care professionals from 20 primary health care centres had shown an active interest in paediatric asthma by attending a seminar. Six of these PHCs declined to participate in the study with the motivation that they did not agree to let us study their documentation of the quality indicators in the electronic health care records. The remaining 14 PHCs that were included in all our studies could thus be expected to have a genuine interest in improving the quality of care of children with asthma. There was thus a selection bias, i.e. the association between exposure and interest of paediatric asthma may have differed between those PHCs who participated, and those PHCs who did not participate in the study [104].

However, there was no difference in dispensed anti-asthmatic drugs in children with a diagnosis of asthma in these 14 PHCs and the 14 PHCs that were matched controls **in study II**. These 14 PHCs were selected from registers where we had no reason to expect bias. We cannot exclude influence of selection bias in the remaining three studies. Still, in that case it is reasonable to believe that adherence to evidence-based guidelines in children with asthma should rather be worse in primary care in general than our studies show.

Another important factor to consider is if the study material remains stable when different aspects are studied or compared. **In study II** we excluded PHCs from being selected to the control group if any of the GPs in the 14 PHCs in the intervention group had switched to them during the period of, or after the intervention. There were only two GPs that switched to a PHC outside the intervention group during the study period. It was not possible to check if other physicians such as residents had switched between the two groups. There were few children that switched PHCs between the groups during the study. These few children were excluded.

More than half of all the physicians at the PHCs participated in all three educational seminars. Still, there could also have been other physicians documenting the quality indicators in the electronic health care records (**study IV**).

Not having a stable study material can lead to a confounding bias [104]. However, our studies were performed in clinical routine practice and it is a reality in routine practice that neither physicians nor listed children remain unchanged over time. Clinical studies like ours must often be pragmatic with practical circumstances and consequences considered [53-55].

To investigate evidence-based practice in primary care is a challenge with many different aspects. Therefore we have chosen to combine several methods and to use different quantitative methods **in study I, II and IV** and a qualitative method **in study III**.

Using register-data as we did **in study I and II** give very reliable data regarding dispensed drugs, connection to diagnoses and possibilities to follow children over time.

In these studies we got data regarding dispensed anti-asthmatic drugs from the Swedish Prescribed Drug register which has more than 99% coverage of all dispensed drugs [64]. In both studies, but especially **in study II** a large number of children were included which should make our results representative for primary care. Still, we did not have data on prescribed or used drugs. Not having data regarding prescriptions may underestimate

prescribers' decision-making and thus adherence to guidelines. However dispensed drugs provide a better picture of patient use than data on issued prescriptions since it also reflects patient behaviour.

Besides very few exceptions, all encounters and diagnoses in primary care are reported and stored in GVR/VAL [65]. Still, it is important to be aware of that the diagnostic accuracy may vary between different practices and over time and there is no information on how diagnostic criteria are followed. Furthermore, data retrieved from registers is secondary data, which means that the data is not collected for the specific research purpose [105]. This may cause a possible bias in recording of diagnoses and thus variability in data quality.

The socio-demographic characteristics were compared as CNI [56]. However, CNI is based on the characteristics in the geographic area while people in the Stockholm region since 2008 have a free choice of primary care [13].

In study II when looking at the pattern of dispensed drugs *over time* it seemed as a difference regarding some of the drugs in both the intervention and control group (table 9). However, this was a pragmatic study and individual children may have been included both during the baseline and the follow-up period. There was thus no suitable statistical method available to compare the groups over time. In general SABA and montelukast were more dispensed in preschool children in both groups during the follow-up period. In school-aged children SABA and ICS were more dispensed while SABA and fixed combinations as well as other therapies and combination were less dispensed in both groups at follow-up. Given the design of the study we cannot explain the observed difference. Our observation period was quite long, between 2006 and 2012. During this period of time there were new treatment recommendations that introduced montelukast as an alternative to ICS in low dose. Further, there were financial incentives as well as specific education that emphasised the prescription of SABA and ICS before trying SABA and fixed combination.

In study IV we assessed information of quality of care documented in electronic health care records. These data assessed what was documented, which does not necessarily reflect exactly what was performed. We might therefore have assessed a low quality of documentation in addition to a low quality of care. However, documentation of asthma criteria was fulfilled in all children with a diagnosis of asthma, which is not in accord with a low quality of documentation.

Data regarding contextual features was mainly retrieved with help of predefined checklists. One person with good knowledge of the routines at each PHC was assigned to fill in the checklist. Still this approach might result in under- as well as overestimation of the contextual features.

It is a real challenge to measure quality of care. If the quality indicators had been assessed separately, the material of a single PHC would have been too small to assess. Scores for individual quality indicators require very large samples for a reliable assessment according to Kirk [29]. In our study there would have been a risk for significant differences by chance if multiple quality indicators had been compared between the PHCs. By combining single quality indicators into a composite quality indicator (CQI) much smaller samples are required

to give reliable data [29].

The traditional statistical methods often focus on comparisons of single factors. The OPLS analysis enabled us to make an overall evaluation of which of all the contextual features that had an influence on CQI.

In study III the purpose was to explore how GPs feel, think and act when they use evidence-based guidelines. Qualitative research methods should be applied to explore research questions like this.

In qualitative research it is important to collect enough data i.e. until no more *new* data is gained. It is therefore important to choose a method applicable to the study material. We chose focus group interviews since this is a suitable method to get a rich amount of data when there is a group of people with the same background [106]. Further, FGIs have proven to be a useful method to explore thoughts and feelings underlying behaviour [107, 108].

We performed four focus group interviews with between three and eight participants in each FGI. The ideal size of a FGI for noncommercial topics is five to eight persons [106]. The disadvantage of smaller groups is that the range of experiences is limited. Smaller groups can on the other hand make the participants feel more comfortable which facilitates discussing in-depth topics as we did. In the two FGIs with the lowest number of participants (three and four respectively) all the participants were GPs with special interest in paediatric asthma and the discussions were vivid. We performed FGIs until we did not gain any new data. It is thus reasonable to believe that the qualitative data we collected in the topic was representative for GPs in primary care.

The interviewer (moderator) was known to the participants while the observer was not. It is recommended to have a moderator that shares the same characteristics as the participants in order to make them feel more comfortable [109] when discussing in-depth topics. To have an interviewer that is known to the participants could increase the risk for valuing the data during the interviews and missing key-points. To have an objective observer that assisted in summarising the key-points at the end of the discussion should have minimised that risk.

It is important to be aware that interviews only give data regarding what people say they do, not what they do in practice. To increase the validity between “saying and doing”, questions can be asked that reflect the participants’ way of acting [68]. We did this in our interviews by frequently using probing follow-up questions where we asked for concrete examples.

Content analysis is a suitable method in analysing qualitative data when the research questions are defined and not too extensive [110] as it is in a focus group interview. Since we had a large amount of data we considered an inductive content analysis [110] as the most suitable where the categories and themes are derived from the data collected. Content analysis according to Graneheim and Lundman [70] is an example of this.

To evaluate the results in qualitative research one must ensure the trustworthiness of the data [111]. This means that the data obtained should have emphasis on authenticity by being balanced, fair and conscientious in taking account of multiple perspectives, interests and realities [112]. In order to obtain trustworthiness the aspects of credibility and dependability and transferability should be considered [70]. Credibility deals with the focus of the research

and how well data and processes of analysis address the intended focus [111]. Dependability deals with instability i.e. to which extent data change over time. A large amount of data collected over a long period of time increases the risk for inconsistency and thus decreases the dependability [112]. Transferability includes a careful description of the sample setting, data collection and analysis process in order to make the findings transferrable to similar groups of GPs [111].

There are several aspects that contribute to the trustworthiness of this study. The GPs were selected from PHCs that had an active interest in paediatric asthma and further education. Even if two of the FGIs were performed day-time at the PHCs the participation in the FGIs was voluntary. The sampling procedure should thus have been purposive in order to obtain rich and illuminative information [113]. All the FGIs were performed within seven months which should increase the dependability [112]. To ensure credibility all the authors, who had different backgrounds and perspectives, performed the content analysis and discussed categories and themes until consensus was obtained. Quotations were selected from the original interviews to illustrate the results and to further improve the credibility of the study. Finally the sample setting, data collection and process of analysis were carefully described in order to ensure transferability. Results from qualitative studies are not generalisable to other areas. However, included physicians represented a wide range in years in profession in primary care and men as well as women were represented. Further, they represented PHCs run by private as well as public actors and the PHCs had a wide-spread range of size and socio-demographic characteristics measured as care need index. The transferability of our results to PHCs in other regions of Sweden could therefore be expected to be good.

8 CONCLUSIONS

Based on the results of this thesis we have made the following conclusions regarding GPs' adherence to evidence-based guidelines for children with asthma:

- GPs' have a good adherence to the evidence-based guidelines regarding pharmacological treatment for children with a recorded diagnosis of asthma. It is important that studies regarding adherence to the guidelines for children with asthma are based on a study population with a recorded diagnosis. Anti-asthmatic drugs are partly used as diagnostic tools. To use spirometry more often in children from school-age could be a way to minimise this.
- The children with asthma received an anti-asthmatic treatment according to the guidelines already at baseline. An effect of the educational intervention could thus not be evaluated.
- The following aspects are important when developing and implementing evidence-based practice: Contextualised dialogue, based on the GPs' own experiences, feedback on own results and easy access to short guidelines perceived as trustworthy. Dialogue and interactivity, both within primary care and between specialties encourage reflection which is necessary in the process of learning.
- Evidence based care in children with asthma could be facilitated by allocating time, by improved interprofessional collaboration and by creating an organisational structure that gives opportunities for engagement in asthma care. To support these contextual features is important in order to obtain a high quality of management of children with asthma.

9 CLINICAL IMPLICATIONS AND FUTURE PERSPECTIVES

For a majority of the school-aged children and a large proportion of the preschool children their treatment with anti-asthmatic drugs is initiated in primary care. It is therefore important to establish an evidence-based practice in paediatric asthma in primary care. First, it is necessary, as far as possible, to aim for a diagnosis in the management of asthma. All PHCs should perform spirometry routinely on wide indications in all children from school-age. A management that supports interprofessional collaboration and provides allocated time is a prerequisite for performing spirometry routinely. A structure supporting these contextual features at each PHC could in turn facilitate fulfilment also of other important quality indicators. Examples of such quality indicators are: discussing smoking cessation/tobacco exposure, demonstrating inhaler device and providing patient education.

Secondly, a shared knowledge-base for physicians and nurses is important. We have identified important aspects with potential to increase learning and usability of the evidence-based guidelines. Contextualised dialogues, feedback and confidence could be obtained by encouraging and allocating time for regular meetings focused on peer-learning at the PHCs. Modern technology such as video-conferences regularly could facilitate for GPs and nurses to participate in educational meetings arranged by secondary care. This could in turn encourage dialogue between primary and secondary care.

Evidence-based guidelines should preferably be gathered at one common site and have a clear design and lay-out. They should be designed as frameworks emphasising important key-points instead of giving strict instructions. This could make them easier to adapt to the local context and could inspire the GPs to reflect in the decision-making process.

GPs need to play a part continuously through the process of developing, implementing and updating the evidence-based guidelines. Their expertise in the feasibility of the guidelines is necessary to implement evidence-based medicine into evidence-based practice.

The future perspectives, based on this thesis, are that studies are needed to further increase the understanding of effective learning strategies to integrate evidence-based guidelines in the decision-making process. Our learning strategy, case-method learning, could not be evaluated in this study since adherence to the quality indicator that we wanted to evaluate was good already at baseline. However, using the case method learning strategy to evaluate quality indicators with poor adherence at baseline, such as discussing smoking cessation/ tobacco exposure or performing spirometry could be an interesting future project.

We have identified contextual features that influence evidence-based quality of care and we have seen that some features have more influence than others. A future perspective is to study how contextual features may affect each other. Further studies are thus needed to explore the relationship between contextual features and evidence-based practice in more detail.

10 SAMMANFATTNING PÅ SVENSKA

Bakgrund

Astma är den vanligaste kroniska sjukdomen hos barn i Sverige. Man uppskattar att 8-10 % av alla barn i skolåldern har astma. Astma hos förskolebarn (0-6 år) respektive hos skolbarn (7-17 år) ter sig olika både avseende symtom och prognos. Förskolebarn får ofta tydliga symtom enbart i samband med förkylningar. Astman har då god prognos och kan växa bort, ofta redan i 3-4 årsåldern. Detta gäller de barn som inte har några allergier. Barn i skolåldern med astma har i hög utsträckning en bakomliggande allergi, ofta mot perenna luftvägsallergener, t. ex pälsdjur eller kvalster. Dessa barn kan ha mer diffusa symtom i form av trötthet eller dålig fysisk ork. Astmasymtom i form av andningsbesvär, hosta eller ”pip i bröstet” kommer vanligtvis i samband med ansträngning och astman kan därför lätt feltolkas som enbart ansträngningsastma. Hos alla barn med andningsbesvär i någon form bör man i sjukhistorien och vid kroppsundersökningen därför efterforska tecken på allergier. Hos alla skolbarn med misstänkt astma och på vida indikationer hos förskolebarn bör allergiutredning utföras. Från skolåldern bör även lungfunktionsundersökning i form av spirometri utföras i diagnostiskt syfte. Detta är viktigt, då astma med samtidig allergi mot perenna luftvägsallergener ska betraktas som en kronisk sjukdom med behov av förebyggande underhållsbehandling med anti-inflammatoriska läkemedel mot astma. I handläggningen av barn med astma ingår också utvärdering av försämrande faktorer såsom tobaksexponering och pälsdjursexponering. Ett högkvalitativt omhändertagande av barn underlättas av en interprofessionell samverkan, vanligen mellan läkare och sjuksköterska.

De flesta skolbarn med lindrig till måttligt svår astma men även många förskolebarn med lindrig astma handläggs inom primärvården. För att upprätthålla en hög vårdkvalitet finns evidensbaserade behandlingsriktlinjer utarbetade för primärvården.

Behandlingsriktlinjerna är vanligtvis utformade som diagnosspecifika instruktioner, ofta tillgängliga via internet men även som broschyrer eller regelrätta skriftliga vårdprogram. Behandlingsriktlinjerna uppdateras regelbundet. Trots att behandlingsriktlinjerna är väl underbyggda har tidigare studier visat att följsamheten till dem generellt är låg.

Det övergripande syftet med avhandlingen var att undersöka det evidensbaserade omhändertagandet av barn med astma i primärvården. Vi ville utvärdera kvaliteten på omhändertagandet samt effekter av lärande på följsamheten till de evidensbaserade behandlingsriktlinjerna.

Avhandlingen är baserad på följande fyra studier:

Studie I: Adherence to guidelines for drug treatment of asthma in children; potential for improvement in Swedish primary care.

Syfte: Att studera utköpsmönstret av astmaläkemedel för barn med astma i relation till de evidensbaserade behandlingsriktlinjerna.

Metod: En retrospektiv observationsstudie. Receptutköpsdata för alla barn 0-16 år som vid minst ett tillfälle hade besökt någon av de 14 inkluderade vårdcentralerna och fått astmaläkemedel förskrivet inkluderades. Barnen skulle ha initierats på astmabehandling

mellan juli 2006 och juni 2007 och följdes sedan avseende ytterligare utköp under 24 månader via Läkemedelsregistret. Barnen (totalt 1033 barn) delades in i två åldersgrupper, förskolebarn (0-6 år) och skolbarn (i denna studie 7-16 år) beroende på olika behandlingsrekommendationer för dessa åldersgrupper. De huvudsakliga utfallsmåtten var: vilken vårdnivå som initierade behandlingen, i vilken utsträckning barnen köpte ut läkemedel i enlighet med behandlingsrekommendationerna samt antal utköp av respektive astmaläkemedel under observationsperioden.

Resultat: Astmabehandling initierades inom primärvården hos 42 % av förskolebarnen respektive hos 72 % av skolbarnen. Den vanligaste läkemedelsbehandlingen som användes vid initieringen av astmabehandlingen hos förskolebarn var symtomlindrande läkemedel kombinerat med förebyggande anti-inflammatoriskt läkemedel. Detta köptes ut av 64 % av förskolebarnen. Av skolbarnen köpte 50 % enbart ut symtomlindrande läkemedel vid initieringen av astmabehandlingen. De flesta barnen, 35 % av förskolebarnen och 54 % av skolbarnen gjorde bara ett utköp av astmaläkemedel under observationsperioden.

Studie II: Evidence-based management of childhood asthma in Swedish primary care – a controlled educational intervention study

Syfte: Att undersöka om distriktsläkares följsamhet till de evidensbaserade behandlingsriktlinjerna kan förbättras genom en utbildningsintervention

Metod: En kontrollerad interventionsstudie. Distriktsläkare och sjuksköterskor vid de 14 vårdcentralerna i studie I deltog i interaktiva utbildningsseminarier avseende evidensbaserat omhändertagande av barn med astma. 14 andra vårdcentraler, matchade till storlek, ägarform och socioekonomiska faktorer utgjorde kontrollgrupp. Data avseende läkemedelsutköp samt diagnos inhämtades via register (Läkemedelsregistret samt gemensamma vårdregistret GVR/VAL) under en 24-månaders period före respektive efter interventionen. Alla barn 0-17 år listade på de 28 vårdcentralerna någon gång under perioden 2006-2012 inkluderades (totalt 114 175 barn). Ur denna kohort studerades först utköpsmönstret av astmaläkemedel hos barn med diagnosen astma. Därefter beräknades andelen barn med diagnosen astma av alla barn som köpt ut astmaläkemedel. Barnen delades in i två åldersgrupper, förskolebarn (0-6 år) respektive skolbarn (7-17 år).

Resultat: I den första delen av studien såg vi att barn med astmadiagnos i båda åldersgrupperna köpte ut astmaläkemedel enligt behandlingsriktlinjerna såväl före som efter interventionen. Det förelåg ingen statistisk skillnad mellan interventions- och kontrollgrupp före eller efter interventionen. Vid en sammanslagning av interventions- och kontrollgrupperna fann vi att 73 % av förskolebarnen respektive 72 % av skolbarnen köpte ut både symtomlindrande och anti-inflammatoriskt astmaläkemedel efter interventionen. Liknande siffror sågs före interventionen. I den andra delen av studien såg vi att av alla barn i hela kohorten som köpt ut astmaläkemedel utgjorde andelen barn med astmadiagnos hos förskolebarnen 80 % i interventionsgruppen respektive 75% i kontrollgruppen. Hos skolbarnen var siffran 70 % i interventionsgruppen respektive 64 % i kontrollgruppen. En statistisk säkerställd skillnad ($p < 0.001$) mellan interventions- och kontrollgrupp förelåg i båda åldersgrupperna såväl före som efter interventionen. Eftersom interventions- och

kontrollgruppen inte var jämförbara före interventionen kunde någon utvärdering av interventionen inte göras i denna del av studien.

Studie III: Practice guidelines in the context of primary care, learning and usability in the physicians' decision-making process – a qualitative study

Syfte: Att utforska distriktsläkares attityd till behandlingsriktlinjer samt hur de lär sig av och använder behandlingsriktlinjer i den dagliga beslutsprocessen på en vårdcentral.

Metod: En kvalitativ studie där fokusgruppsintervjuer användes som metod för att utforska hur distriktsläkare använder behandlingsriktlinjerna i sin beslutsprocess, faktorer som påverkar besluten, hur de närmar sig/deras attityder till riktlinjerna samt hur riktlinjerna kan uppmuntra till en lärandeprocess i det kliniska rutinarbetet. Totalt deltog 22 distriktsläkare med i genomsnitt sju års erfarenhet av primärvårdsarbete. Distriktsläkarna kom från sju av de inkluderade vårdcentralerna. Intervjuerna transkriberades ordagrant och en kvalitativ innehållsanalys av materialet genomfördes.

Resultat: Tre teman med underliggande kategorier kunde utkristalliseras: **1.** Lärande från riktlinjer i form av interaktiva kontextualiserade dialoger. Detta tema understöddes av följande kategorier: **a.** Återkoppling genom diskussion med kollegor (på vårdcentralen) **b.** Återkoppling genom samarbete med andra specialister. **2.** Lärande som etablerar ett förtroende och en tilltro till att förmedla vård av hög kvalitet. Detta tema understöddes av följande kategorier: **a.** Förtroende genom bekräftelse **b.** Förtroende genom pålitlighet. **c.** Förtroende genom utvärdering av egna resultat. **3.** Lärande genom att använda relevant vetenskapligt underlag i beslutsprocessen. Detta tema understöddes av följande kategorier: **a.** Design och lay-out som åskådliggör evidens/ information. **b.** Tillgänglighet anpassad till den kliniska beslutsprocessen som ett krav för användning av riktlinjerna.

Studie IV: Influence of contextual circumstances on quality of primary care in children with asthma

Syfte: Att utvärdera om kontextuella faktorer/funktioner har något inflytande på vårdcentralernas följsamhet till behandlingsriktlinjerna för handläggningen av barn med astma inom primärvården.

Metod: En tvärsnittsstudie som utfördes på de 14 vårdcentralerna i studie I. Kontextuella faktorer/funktioner inkluderade: 1. Socio-demografiska karakteristika 2. Organisatoriska karakteristika. 3. Indikatorer på engagemang inom astmavård. Data avseende kontextuella faktorer/funktioner insamlades via checklistor, enkäter samt via personlig kontakt med verksamhetschefen. Aktivitetsgrad på utbildningsseminarierna i studie II utgjorde ett mått på engagemang. Vårdkvalitet bedömdes genom att först granska journaler på vårdcentralerna avseende dokumentation av definierade kvalitetsindikatorer. Därefter gjordes en sammanslagning av kvalitetsindikatorerna till ett kvalitets-index, ”composite quality indicator” (CQI) för varje vårdcentral. Genom att utföra en multivariat regressionsanalys, ”orthogonal projection to latent structures” (OPLS) kunde en relation mellan CQI och de kontextuella faktorerna/funktionerna beräknas.

Resultat: Med hjälp av OPLS-analysen kunde tio kontextuella faktorer/funktioner med inflytande på CQI identifieras. En lägre åldersgräns för att utföra spirometri, mer schemalagd

tid för astmavård, lägre tjänstgöringsgrad för distriktsläkare samt en högre aktivitetsgrad på utbildningsseminarierna var de kontextuella faktorerna/funktionerna med störst inflytande på CQI.

Slutsats av de fyra studierna

Evidensbaserade behandlingsriktlinjer är diagnosbaserade och distriktsläkare har god följsamhet till behandlingsriktlinjerna avseende läkemedelsbehandling *om barnen har en astmadiagnos*. I studie I förutsatte vi att barnen som köpte ut astmaläkemedel också hade en astmadiagnos. Vår slutsats efter studie I och II var dock att symptomlindrande läkemedelsbehandling för astma, framför allt hos skolbarn, delvis används i diagnostiskt syfte. En ökad diagnostik av astma bör därför eftersträvas hos skolbarn innan läkemedelsbehandling inleds. En ökad användning av lungfunktionsmätning i form av spirometri kan vara ett sätt att uppnå detta. Eftersom läkemedelsbehandlingen visade en god överensstämmelse med behandlingsriktlinjerna redan före interventionen kunde ingen utvärdering av interventionens effekt göras. För att vara ett stöd i den dagliga beslutsprocessen bör behandlingsriktlinjerna vara lättillgängliga, koncisa och inge förtroende. Kontextualiserade dialoger baserade på distriktsläkarnas egna erfarenheter är viktiga liksom, återkoppling på egna resultat. Slutligen kan en evidensbaserad vård av barn med astma underlättas av: särskilt avsatt tid, en förbättrad interprofessionell samverkan och en struktur på vårdcentralerna som ger möjlighet för engagemang i astmavård.

11 ACKNOWLEDGEMENTS

First of all, my sincere thank you to my three supervisors. I am truly convinced that I have had the best team of supervisors a PhD-student can wish for!

My main supervisor **Anna Kiessling**. You have a unique ability to go straight to the core of a problem, no matter in what area, and suddenly make it seem so easy. You always show such an engagement, no matter if we discuss a research problem or model of hiking boots. Thank you so much for all your guidance, support and never-ending optimism during my years as a PhD-student.

My co-supervisor **Gunilla Hedlin**. Your patience with me and my research has been remarkable! You are my role model as a researcher and as a clinician but maybe most of all because you always care.

My co-supervisor **Eva Wikström Jonsson**. For me you are Confidence personified. My need to control facts completely disappears when I have heard something from you. Besides that, it is always such a pleasure to discuss research as well as other things in life with you.

Annika Janson My external mentor. Our nice lunches have been occurring more seldom the past year since we both have been busy but I have always known that you will be there if I need it.

Marina Jonsson We started our research career together and I could not have had a better colleague that now also has become a dear friend. You are an extremely skilled nurse and your research is so important for our common field of interest, the management of children with asthma.

Björn Wettermark My informal supervisor. Although you are a very busy man you are always so kind and never get upset when I harass you with my pharmaco-epidemiological questions. Thank you for all your wise advices and comments.

Pia Bastholm-Rahmner My companion in the focus group interviews and my guide into qualitative studies. Thank you for sharing your deep knowledge and for your pedagogic explanations. You certainly caught my interest for this necessary field of research.

Peter Henriksson You make statistics seem easy and fun. You have shown a deep engagement in my research and always with the same kindness even if some parts are quite far away from your area. For me you are the true researcher! Thank you!

Elin Dahlén Thank you for your new ideas and never-ending optimism in the controlled educational intervention study. Your positive attitude has been worth so much!

Ann Berglind You are the perfect research nurse! You have helped me in two projects and you always remember the important things that I forget. We have had many talks about everything and life has been so much easier with you.

Inger Kull and Ingvar Krakau Co-authors in study IV. Thank you for all your good advices and comments.

The staff, especially **Marie Källberg and Eva Fjällgren** at the Karolinska University hospital medical library for invaluable help in finding scientific literature and for introducing me into the world of reference systems. You share your deep knowledge with such joy!

All my colleagues at Sollentuna BUMM. **Ulrika Berg, Freddy Serapio-Tobar, Erica Bonns, Frida Lönngren, Susanne Olofsson, Anneli Åslund, Ellionór Huss, Anna Khalifa, Annica Sjöbrand, Inger Larsson and Christer Nordwall.** You are all such wonderful colleagues! Besides, this thesis would not have been possible without you! My research has given you all extra workload during several years but especially during the past months. Despite this you have never complained just encouraged me. My deep and honest thank you to you all!

Leena Oscarson Former colleague at Sollentuna BUMM. You have always supported me both in my research and my work and still do, even if we are not colleagues for the moment. You also keep me updated regarding other important things in life besides research and health care.

Anders Lindfors You are a true clinician and one of the best pediatricians and pediatric allergologists I know. You are always updated and are so devoted to your patients. What a doctor!

Sten-Erik Bergström You are mr 100% in everything you do: clinics, research, your family your sailing-boat etc. You are a wonderful colleague that always has time and answers for my questions in pediatric pulmonology.

Nora Nilsson You have many skills as a pediatrician but your skills and research in pediatric food-allergy are extremely valuable in the Lung and Allergy department. We have had so many nice discussions about many things in life and you always know when I am in a desperate need of a piece of chocolate!

Henrik Ljungberg, Daiva Helander, Päivi Söderman, Catarina Almquist-Malmros, Jon Konradsen, Anna Asarnej, Wille Zetterqvist, Katarina Stenberg, Maria Dimou, Anna-Karin Eklund, Heléne Olsson, Helena Feldt, Ashraf K. Persia and Björn Nordlund My colleagues at the Lung and Allergy department. Thank you for good discussions and collaboration and for many good laughs.

Rebecka Lagercrantz You are a skilled pediatrician and a fantastic artist. Thank you for the beautiful cover illustration!

Jan Ejderhamn My former boss at the pediatric outpatient clinics. We have known each other for many years, you once were my mentor when I was doing my residence in pediatrics. Thank you for giving me the opportunity to do my research despite the lack of pediatricians at “BUMM”.

Lena Hjelte My former boss at the Lung and Allergy department. Thank you for encouraging me in my research!

Johan Kaarme Head of the “barnmedicin 2” department. Thank you for signing and reading research programs and research certificates, many times with short notice !

All my friends. You can never manage hard work without having friends to relax with!

Eva Wenker my oldest friend, since 47 years! **Eva Micski and Göran Johansson** Dear friends as well as the party fixers! We have had so much fun! **Anne Nordgren** My very good friend since “gymnasiet”. You have also introduced me to the mysterious world of horses.

Marie and Jouko Sedvall and Marie and Johan Rydén. **Marie and Marie** , my dear friends all through the medical studies and since then. We have shared both joy and sorrow through the years. I would not have been the physician or the person I am today without you. Besides, **Marie S**, as a GP you have also given valuable input and support to my research.

Jouko and Johan Thank you for your friendship through the years. **Ninni, Lennart and Fredrik Ossmark.** **Fredrik** and our daughter Louise were best friends at “dagis”. This was the start of a long friendship for our families. We have had so many nice ski-holidays and good dinners together! I am so happy for our friendship!

Gerd my mother and **Svante** my late father. You have always given me your full support. You have taught me the importance of always doing your best and to treat all people equal.

All other friends and relatives: Thank you for being there!

Louise My daughter. You are such a wise and nice person with a wonderful sense of humour! Besides that you have been a great help in revising the language in my manuscripts and your computer skills have been invaluable. I am so extremely proud of you!

Dag My husband. You are always there for me when I need it. You are simply the love of my life and my best friend!

12 FINANCIAL SUPPORT

Financial support to my doctoral studies have been received from:

- Centre for Allergy Research, Karolinska Institutet
- Samariten Foundation
- Konsul Th C Bergh Foundation
- Queen Silvia Anniversary Foundation
- Kerstin Hejdenbergs Minnesfond

13 REFERENCES

1. **10 facts on children's environmental health**
[www.who.int/features/factfiles/children_environmental_health/facts/en/index2.html]
2. Taussig LM, Wright AL, Holberg CJ, Halonen M, Morgan WJ, Martinez FD: **Tucson Children's Respiratory Study: 1980 to present**. *The Journal of allergy and clinical immunology* 2003, **111**(4):661-675; quiz 676.
3. Bacharier LB, Boner A, Carlsen KH, Eigenmann PA, Frischer T, Gotz M, Helms PJ, Hunt J, Liu A, Papadopoulos N *et al*: **Diagnosis and treatment of asthma in childhood: a PRACTALL consensus report**. *Allergy* 2008, **63**(1):5-34.
4. Bjerg A, Sandstrom T, Lundback B, Ronmark E: **Time trends in asthma and wheeze in Swedish children 1996-2006: prevalence and risk factors by sex**. *Allergy* 2010, **65**(1):48-55.
5. Wennergren G, Ekerljung L, Alm B, Eriksson J, Lotvall J, Lundback B: **Asthma in late adolescence--farm childhood is protective and the prevalence increase has levelled off**. *Pediatric allergy and immunology : official publication of the European Society of Pediatric Allergy and Immunology* 2010, **21**(5):806-813.
6. **The global strategy for asthma management and prevention**
[<http://www.ginasthma.org/>]
7. Kihlström A, Sigurdbrandsdottir A: **Regionalt vårdprogram: Astma och allergi hos barn och ungdomar (Local practice guidelines: Allergy and asthma in children)**. Stockholm: Stockholms läns landsting (Stockholm county council); 2006.
8. Kjellman B, Hesselmar B: **Prognosis of asthma in children: a cohort study into adulthood**. *Acta paediatrica* 1994, **83**(8):854-861.
9. Kjellman B, Gustafsson PM: **Asthma from childhood to adulthood: asthma severity, allergies, sensitization, living conditions, gender influence and social consequences**. *Respiratory medicine* 2000, **94**(5):454-465.
10. **Nationella riktlinjer för vård vid astma och KOL (in Swedish)**
[<https://www.socialstyrelsen.se/publikationer2015/2105-11-30>]
11. To T, Wang C, Guan J, McLimont S, Gershon AS: **What is the lifetime risk of physician-diagnosed asthma in Ontario, Canada?** *American journal of respiratory and critical care medicine* 2010, **181**(4):337-343.
12. Carlsson AC, Wandell P, Osby U, Zarrinkoub R, Wettermark B, Ljunggren G: **High prevalence of diagnosis of diabetes, depression, anxiety, hypertension, asthma and COPD in the total population of Stockholm, Sweden - a challenge for public health**. *BMC public health* 2013, **13**:670.
13. Anell A: **The public-private pendulum--patient choice and equity in Sweden**. *The New England journal of medicine* 2015, **372**(1):1-4.
14. [<https://www.socialstyrelsen.se/healthcare-visitors-sweden/where-go-medical-care-sweden/who-what-swedish-healthcare>]

15. [<https://www.socialstyrelsen.se/ansokaomlegitimationochintyg/bevis,specialistkompetens/malbeskrivningar-lakarnas-st>]
16. Boulet LP, Bourbeau J, Skomro R, Gupta S: **Major care gaps in asthma, sleep and chronic obstructive pulmonary disease: a road map for knowledge translation.** *Canadian respiratory journal : journal of the Canadian Thoracic Society* 2013, **20**(4):265-269.
17. Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS: **Evidence based medicine: what it is and what it isn't.** *Bmj* 1996, **312**(7023):71-72.
18. Lohr KN, Eleazer K, Mauskopf J: **Health policy issues and applications for evidence-based medicine and clinical practice guidelines.** *Health policy* 1998, **46**(1):1-19.
19. Norman G: **Research in clinical reasoning: past history and current trends.** *Medical education* 2005, **39**(4):418-427.
20. Croskerry P: **Clinical cognition and diagnostic error: applications of a dual process model of reasoning.** *Advances in health sciences education : theory and practice* 2009, **14** Suppl 1:27-35.
21. Croskerry P: **Context is everything or how could I have been that stupid?** *Healthcare quarterly* 2009, **12** Spec No Patient:e171-176.
22. Croskerry P, Petrie DA, Reilly JB, Tait G: **Deciding about fast and slow decisions.** *Academic medicine : journal of the Association of American Medical Colleges* 2014, **89**(2):197-200.
23. Califf RM, Peterson ED, Gibbons RJ, Garson A, Jr., Brindis RG, Beller GA, Smith SC, Jr., American College of C, American Heart A: **Integrating quality into the cycle of therapeutic development.** *Journal of the American College of Cardiology* 2002, **40**(11):1895-1901.
24. Pearson KC: **Role of evidence-based medicine and clinical practice guidelines in treatment decisions.** *Clinical therapeutics* 1998, **20** Suppl C:C80-85.
25. Brook RH, McGlynn EA, Cleary PD: **Quality of health care. Part 2: measuring quality of care.** *The New England journal of medicine* 1996, **335**(13):966-970.
26. Lawrence M, Olesen F: **Indicators of Quality in Healthcare.** *Eur J Gen Pract* 1997, **3**:103-108.
27. Campbell SM, Braspenning J, Hutchinson A, Marshall MN: **Research methods used in developing and applying quality indicators in primary care.** *Bmj* 2003, **326**(7393):816-819.
28. Reeves D, Campbell SM, Adams J, Shekelle PG, Kontopantelis E, Roland MO: **Combining multiple indicators of clinical quality: an evaluation of different analytic approaches.** *Medical care* 2007, **45**(6):489-496.
29. Kirk SA, Campbell SM, Kennell-Webb S, Reeves D, Roland MO, Marshall MN: **Assessing the quality of care of multiple conditions in general practice: practical and methodological problems.** *Quality & safety in health care* 2003, **12**(6):421-427.
30. Ferrante G, Antona R, Malizia V, Montalbano L, Corsello G, La Grutta S: **Smoke exposure as a risk factor for asthma in childhood: a review of current evidence.**

Allergy and asthma proceedings : the official journal of regional and state allergy societies 2014, **35**(6):454-461.

31. Lonnkvist K, Hallden G, Dahlen SE, Enander I, van Hage-Hamsten M, Kumlin M, Hedlin G: **Markers of inflammation and bronchial reactivity in children with asthma, exposed to animal dander in school dust.** *Pediatric allergy and immunology : official publication of the European Society of Pediatric Allergy and Immunology* 1999, **10**(1):45-52.
32. Munir AK, Einarsson R, Schou C, Dreborg SK: **Allergens in school dust. I. The amount of the major cat (Fel d I) and dog (Can f I) allergens in dust from Swedish schools is high enough to probably cause perennial symptoms in most children with asthma who are sensitized to cat and dog.** *The Journal of allergy and clinical immunology* 1993, **91**(5):1067-1074.
33. Papadopoulos NG, Arakawa H, Carlsen KH, Custovic A, Gern J, Lemanske R, Le Souef P, Makela M, Roberts G, Wong G *et al*: **International consensus on (ICON) pediatric asthma.** *Allergy* 2012, **67**(8):976-997.
34. **Behandlingsrekommendationer vid astma (in Swedish)**
[<https://lakemedelsverket.se>]
35. **Merriam-Webster** [<http://www.merriam-webster.com/dictionary/management>]
36. Bero LA, Grilli R, Grimshaw JM, Harvey E, Oxman AD, Thomson MA: **Closing the gap between research and practice: an overview of systematic reviews of interventions to promote the implementation of research findings. The Cochrane Effective Practice and Organization of Care Review Group.** *Bmj* 1998, **317**(7156):465-468.
37. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR: **Why don't physicians follow clinical practice guidelines? A framework for improvement.** *JAMA : the journal of the American Medical Association* 1999, **282**(15):1458-1465.
38. Carlsen B, Kjellberg PK: **Guidelines; from foe to friend? Comparative interviews with GPs in Norway and Denmark.** *BMC health services research* 2010, **10**:17.
39. Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, Whitty P, Eccles MP, Matowe L, Shirran L *et al*: **Effectiveness and efficiency of guideline dissemination and implementation strategies.** *Health technology assessment* 2004, **8**(6):iii-iv, 1-72.
40. Gustafsson PM, Watson L, Davis KJ, Rabe KF: **Poor asthma control in children: evidence from epidemiological surveys and implications for clinical practice.** *International journal of clinical practice* 2006, **60**(3):321-334.
41. Jonsson M, Egmar AC, Kiessling A, Ingemansson M, Hedlin G, Krakau I, Hallner E, Kull I: **Adherence to national guidelines for children with asthma at primary health centres in Sweden: potential for improvement.** *Primary care respiratory journal : journal of the General Practice Airways Group* 2012, **21**(3):276-282.
42. Lugtenberg M, Zegers-van Schaick JM, Westert GP, Burgers JS: **Why don't physicians adhere to guideline recommendations in practice? An analysis of barriers among Dutch general practitioners.** *Implementation science : IS* 2009, **4**:54.

43. Tyler RW: **How can learning experiences be selected which are likely to be useful in attaining these objectives?** In: *Basic Principles of Curriculum and Instruction*. edn. Chicago: University of Chicago Press; 1969: 63.
44. Biggs J, Tang C: **Teaching for Quality Learning at University**. Berkshire: Open University Press; 2011.
45. Thomson O'Brien MA, Freemantle N, Oxman AD, Wolf F, Davis DA, Herrin J: **Continuing education meetings and workshops: effects on professional practice and health care outcomes**. *The Cochrane database of systematic reviews* 2001(2):CD003030.
46. Forsetlund L, Bjorndal A, Rashidian A, Jamtvedt G, O'Brien MA, Wolf F, Davis D, Odgaard-Jensen J, Oxman AD: **Continuing education meetings and workshops: effects on professional practice and health care outcomes**. *The Cochrane database of systematic reviews* 2009(2):CD003030.
47. Mauffette-Leenders Louise: **Learning with cases**, 4 edn. Canada: Ivey Publishing; 2007.
48. Kiessling A, Henriksson P: **Efficacy of case method learning in general practice for secondary prevention in patients with coronary artery disease: randomised controlled study**. *Bmj* 2002, **325**(7369):877-880.
49. Kiessling A, Lewitt M, Henriksson P: **Case-based training of evidence-based clinical practice in primary care and decreased mortality in patients with coronary heart disease**. *Annals of family medicine* 2011, **9**(3):211-218.
50. Yasaitis L, Fisher E, Mackenzie TA, Wasson J: **Healthcare intensity is associated with lower ratings of healthcare quality by younger adults**. *The Journal of ambulatory care management* 2009, **32**(3):226-231.
51. Tsigas E, Panagopoulou E, Sevdalis N, Montgomery A, Benos A: **The influence of time pressure on adherence to guidelines in primary care: an experimental study**. *BMJ open* 2013, **3**(4).
52. Forsberg E, Axelsson R, Arnetz B: **The relative importance of leadership and payment system. Effects on quality of care and work environment**. *Health policy* 2004, **69**(1):73-82.
53. Patsopoulos NA: **A pragmatic view on pragmatic trials**. *Dialogues in clinical neuroscience* 2011, **13**(2):217-224.
54. Roland M, Torgerson DJ: **What are pragmatic trials?** *Bmj* 1998, **316**(7127):285.
55. Williams HC, Burden-Teh E, Nunn AJ: **What is a pragmatic clinical trial?** *The Journal of investigative dermatology* 2015, **135**(6):e33.
56. Sundquist K, Malmstrom M, Johansson SE, Sundquist J: **Care Need Index, a useful tool for the distribution of primary health care resources**. *Journal of epidemiology and community health* 2003, **57**(5):347-352.
57. Boulet LP, Boulay ME, Gauthier G, Battisti L, Chabot V, Beaudesne MF, Villeneuve D, Cote P: **Benefits of an asthma education program provided at primary care sites on asthma outcomes**. *Respiratory medicine* 2015, **109**(8):991-1000.

58. Kull I, Johansson GS, Lisspers K, Jagorstrand B, Romberg K, Tilling B, Stallberg B: **[Efficient care in asthma/COPD primary health care clinics]**. *Lakartidningen* 2008, **105**(42):2937-2940.
59. Lindberg M, Ahlner J, Ekstrom T, Jonsson D, Moller M: **Asthma nurse practice improves outcomes and reduces costs in primary health care**. *Scandinavian journal of caring sciences* 2002, **16**(1):73-78.
60. Lisspers K, Stallberg B, Hasselgren M, Johansson G, Svardsudd K: **Primary health care centres with asthma clinics: effects on patients knowledge and asthma control**. *Primary care respiratory journal : journal of the General Practice Airways Group* 2010, **19**(1):37-44.
61. Campbell SM, Hann M, Hacker J, Burns C, Oliver D, Thapar A, Mead N, Safran DG, Roland MO: **Identifying predictors of high quality care in English general practice: observational study**. *Bmj* 2001, **323**(7316):784-787.
62. Swedish National Board of Health and Welfare: **Guidelines for asthma and chronic obstructive lung disease**. In.; 2004.
63. **WHO collaborating centre for drug statistics methodology** [www.whocc.no]
64. Wettermark B, Hammar N, Fored CM, Leimanis A, Otterblad Olausson P, Bergman U, Persson I, Sundstrom A, Westerholm B, Rosen M: **The new Swedish Prescribed Drug Register--opportunities for pharmacoepidemiological research and experience from the first six months**. *Pharmacoepidemiology and drug safety* 2007, **16**(7):726-735.
65. Wandell P, Carlsson AC, Wettermark B, Lord G, Cars T, Ljunggren G: **Most common diseases diagnosed in primary care in Stockholm, Sweden, in 2011**. *Family practice* 2013, **30**(5):506-513.
66. Patton MQ: **The Nature of Qualitative Inquiry**. In: *Qualitative Research and Evaluation Methods*. 3 edn. Edited by Patton MQ. London: SAGE; 2002: 4-5.
67. Krueger RA, Casey MA: **Developing a Questioning Route**. In: *Focus groups : a practical guide for applied research*. 4. [updated] edn. Edited by Krueger RA, Casey MA. Thousand Oaks, Calif.: Sage Publications; 2009: 35-62.
68. Patton MQ: **Qualitative interviewing**. In: *Qualitative research & evaluation methods*. 3. edn. Edited by Patton MQ. London: SAGE; 2002: 372-374.
69. Patton MQ: **Qualitative Interviewing**. In: *Qualitative research & evaluation methods*. 3. edn. Edited by Patton MQ. London: SAGE; 2002: 385-386.
70. Graneheim UH, Lundman B: **Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness**. *Nurse education today* 2004, **24**(2):105-112.
71. Krueger RA, Casey MA: **Analyzing Focus Group Results**. In: *Focus groups : a practical guide for applied research*. 4. [updated] edn. Edited by Krueger RA, Casey MA. Thousand Oaks, Calif.: Sage Publications; 2009: 118-122.
72. Eriksson L, Johansson E, Kettaneh-Wold N, Trygg J, Wikström C, Wold S: **Multi- and Megavariate Data Analysis. Part I : Basic Principles and Applications.**, 2 edn. Umeå: Umetrics AB; 2006.

73. Eriksson L, Johansson E, Kettaneh-Wold N, Trygg J, Wikström C, Wold S: **Multi- and Megavariate Data Analysis. Part II : Advanced Application and Method Extensions.**, 2 edn. Umeå: Umetrics AB; 2006.
74. Wold S, Eriksson L: **PLS-regression: A Basic Tool of Chemometrics.**, vol. 58: Chemometric and Laboratory Systems; 2001.
75. Casares-Alonso I, Cano-Garcinuno A, Blanco-Quiros A, Perez-Garcia I: **Anti-asthmatic prescription variability in children according to age.** *Allergologia et immunopathologia* 2015, **43**(4):383-391.
76. Chen CY, Chiu HF, Yeh MK, Chang CC, Yang CY: **The use of anti-asthmatic medications among pediatric patients in Taiwan.** *Pharmacoepidemiology and drug safety* 2003, **12**(2):129-133.
77. de Vries TW, Tobi H, Schirm E, van den Berg P, Duiverman EJ, de Jong-van den Berg LT: **The gap between evidence-based medicine and daily practice in the management of paediatric asthma. A pharmacy-based population study from The Netherlands.** *European journal of clinical pharmacology* 2006, **62**(1):51-55.
78. Santos DB, Cruz AA, de Magalhaes Simoes S, Rodrigues LC, Camargos PA, Coelho HL, Barreto ML: **Pattern of asthma medication use among children from a large urban center in Brazil.** *European journal of clinical pharmacology* 2012, **68**(1):73-82.
79. Butz AM, Tsoukleris M, Donithan M, Hsu VD, Mudd K, Zuckerman IH, Bollinger ME: **Patterns of inhaled antiinflammatory medication use in young underserved children with asthma.** *Pediatrics* 2006, **118**(6):2504-2513.
80. Uijen JH, van der Wouden JC, Schellevis FG, Willemsen SP, van Suijlekom-Smit LW, Bindels PJ: **Asthma prescription patterns for children: can GPs do better?** *Eur J Gen Pract* 2011, **17**(2):109-115.
81. Kaiser HB: **Risk factors in allergy/asthma.** *Allergy and asthma proceedings : the official journal of regional and state allergy societies* 2004, **25**(1):7-10.
82. Dahlen E, Almqvist C, Bergstrom A, Wettermark B, Kull I: **Factors associated with concordance between parental-reported use and dispensed asthma drugs in adolescents: findings from the BAMSE birth cohort.** *Pharmacoepidemiology and drug safety* 2014, **23**(9):942-949.
83. Zuidgeest MG, van Dijk L, Smit HA, van der Wouden JC, Brunekreef B, Leufkens HG, Bracke M: **Prescription of respiratory medication without an asthma diagnosis in children: a population based study.** *BMC health services research* 2008, **8**:16.
84. Furu K, Skurtveit S, Langhammer A, Nafstad P: **Use of anti-asthmatic medications as a proxy for prevalence of asthma in children and adolescents in Norway: a nationwide prescription database analysis.** *European journal of clinical pharmacology* 2007, **63**(7):693-698.
85. Moth G, Vedsted P, Schiøtz P: **Identification of asthmatic children using prescription data and diagnosis.** *European journal of clinical pharmacology* 2007, **63**(6):605-611.
86. Ortvist AK, Lundholm C, Wettermark B, Ludvigsson JF, Ye W, Almqvist C: **Validation of asthma and eczema in population-based Swedish drug and patient registers.** *Pharmacoepidemiology and drug safety* 2013, **22**(8):850-860.

87. Pelaez S, Lamontagne AJ, Collin J, Gauthier A, Grad RM, Blais L, Lavoie KL, Bacon SL, Ernst P, Guay H *et al*: **Patients' perspective of barriers and facilitators to taking long-term controller medication for asthma: a novel taxonomy.** *BMC pulmonary medicine* 2015, **15**:42.
88. Mascia D, Cicchetti A, Damiani G: **"Us and Them": a social network analysis of physicians' professional networks and their attitudes towards EBM.** *BMC health services research* 2013, **13**:429.
89. Carlford S, Lindberg M, Bendtsen P, Nilsen P, Andersson A: **Key factors influencing adoption of an innovation in primary health care: a qualitative study based on implementation theory.** *BMC family practice* 2010, **11**:60.
90. Sola I, Carrasco JM, Diaz Del Campo P, Gracia J, Orrego C, Martinez F, Kotzeva A, Guillamon I, Calderon E, de Gaminde I *et al*: **Attitudes and Perceptions about Clinical Guidelines: A Qualitative Study with Spanish Physicians.** *PloS one* 2014, **9**(2):e86065.
91. Nantha YS: **Intrinsic motivation: how can it play a pivotal role in changing clinician behaviour?** *Journal of health organization and management* 2013, **27**(2):266-272.
92. Duran-Nelson A, Gladding S, Beattie J, Nixon LJ: **Should we Google it? Resource use by internal medicine residents for point-of-care clinical decision making.** *Academic medicine : journal of the Association of American Medical Colleges* 2013, **88**(6):788-794.
93. Beaulieu MD, Hudon E, Roberge D, Pineault R, Forte D, Legare J: **Practice guidelines for clinical prevention: do patients, physicians and experts share common ground?** *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne* 1999, **161**(5):519-523.
94. Langley C, Faulkner A, Watkins C, Gray S, Harvey I: **Use of guidelines in primary care--practitioners' perspectives.** *Family practice* 1998, **15**(2):105-111.
95. Schiff GD, Leape LL: **Commentary: how can we make diagnosis safer?** *Academic medicine : journal of the Association of American Medical Colleges* 2012, **87**(2):135-138.
96. Zwaan L, Thijs A, Wagner C, van der Wal G, Timmermans DR: **Relating faults in diagnostic reasoning with diagnostic errors and patient harm.** *Academic medicine : journal of the Association of American Medical Colleges* 2012, **87**(2):149-156.
97. Campbell A: **Inter-professional collaboration and children with asthma.** *Paediatric nursing* 2002, **14**(10):32-34.
98. Garvis S, Kirkby J, McMahon K, Meyer C: **Collaboration is key: The actual experience of disciplines working together in child care.** *Nursing & health sciences* 2015.
99. Anell A, Glenngard AH, Merkur S: **Sweden health system review.** *Health systems in transition* 2012, **14**(5):1-159.
100. Gilbert JH, Yan J, Hoffman SJ: **A WHO report: framework for action on interprofessional education and collaborative practice.** *Journal of allied health* 2010, **39 Suppl 1**:196-197.

101. Davidsen JR, Sondergaard J, Hallas J, Siersted HC, Knudsen TB, Lykkegaard J, Andersen M: **Impact of socioeconomic status on the use of inhaled corticosteroids in young adult asthmatics.** *Respiratory medicine* 2011, **105**(5):683-690.
102. Heibert Arnlind M, Wettermark B, Sjoborg B, Dahlen E, Loikas D, Wikstrom Jonsson E: **Socioeconomic status and the quality of prescribing asthma drugs in Sweden.** *The Journal of asthma : official journal of the Association for the Care of Asthma* 2013, **50**(8):842-849.
103. Salama AA, Mohammed AA, El Okda el SE, Said RM: **Quality of care of Egyptian asthmatic children: clinicians adherence to asthma guidelines.** *Italian journal of pediatrics* 2010, **36**:33.
104. Rothman KJ: **Biases in Study Design.** In: *Epidemiology An Introduction.* edn. New York: Oxford University Press; 2002: 96.
105. Sorensen HT, Sabroe S, Olsen J: **A framework for evaluation of secondary data sources for epidemiological research.** *International journal of epidemiology* 1996, **25**(2):435-442.
106. Krueger RA, Casey MA: **Participants in a Focus Group.** In: *Focus groups: a practical guide for applied research.* edn. Thousand Oaks, Calif.: Sage Publications; 2009: 63-81.
107. Mays N, Pope C: **Qualitative research: Observational methods in health care settings.** *Bmj* 1995, **311**(6998):182-184.
108. Mays N, Pope C: **Qualitative research in health care. Assessing quality in qualitative research.** *Bmj* 2000, **320**(7226):50-52.
109. Krueger RA, Casey MA: **Moderating Skills.** In: *Focus groups: a practical guide for applied research.* edn. Thousand Oaks, Calif.: Sage Publications; 2009: 85-106.
110. Elo S, Kyngas H: **The qualitative content analysis process.** *Journal of advanced nursing* 2008, **62**(1):107-115.
111. Patton MQ: **Qualitative Analysis and Interpretation.** In: *Qualitative research & evaluation methods.* edn. Edited by Patton MQ. London: SAGE; 2002: 431-525.
112. Lincoln YS, Guba EG: **Establishing Trustworthiness.** In: *Naturalistic Inquiry.* edn. Beverly Hills, Calif.: Sage; 1985: 298-299.
113. Patton MQ: **Strategic Themes in Qualitative Inquiry.** In: *Qualitative research & evaluation methods.* edn. Edited by Patton MQ. London: SAGE; 2002: 40.

Appendix 1

The following case exemplifies how the decision making process could be discussed during a seminar.

Dr Lena Karlsson is a general practitioner at Valbo Primary Health Care Centre. Dr Karlsson has as usual a fully booked day and the last patient before lunch is Erik, a 15-year old boy who comes with his mother who is worried about her son's long-time coughing. Erik and his mother meet Dr Karlsson for the first time and just before the appointment the nurse Katarina Pettersson, who has performed a spirometry, mentions that Erik smells like he has been smoking.

Background: Valbo Primary Health Care Centre is located in a district with many small children as well as many elderly people requiring a high need of care. Seven general practitioners work at the centre but one position has been vacant since several months. Also based at the centre are six highly competent nurses and a small laboratory. One half-day a month is scheduled for continuing medical education activities together with surrounding primary health care centres. Up-dated regional guidelines are available at a local website. Cooperation with the local paediatric outpatient clinic is rare, apart from phone-calls. Because of a vacancy at the paediatric outpatient clinic there is a couple of months waiting time for an appointment when a patient is referred.

Dr Lena Karlsson has been working six years at Valbo Primary Health care Centre. She has a special interest in patients with asthma and has recently established team-based care with Katarina Pettersson, the nurse responsible for asthma care. They are responsible for the asthma team at Valbo and Dr Karlsson has the main responsibility to see that Valbo fulfils the criteria to offer a good asthma care. As a result of the vacancy and various reorganisations Dr Karlsson has not had any time for education, reading or reflection during the past months.

Erik has chronic asthma and allergy towards cat and birch pollen. He has regular treatment with inhaled steroids and inhaled beta2- agonist when needed since many years. The treatment was initiated at the local paediatric outpatient clinic. Three years ago Erik was referred to primary care. At the last visit 5 months ago he was feeling well and his asthma was considered stable.

Erik's parents are divorced and have divided custody. His mother works part-time as a secretary. She smokes but only outdoors. Erik's father runs a painting company and works a lot. He has asthma since childhood.

Erik is an average student. He spends most of his time playing with his band or being with his girlfriend who has a cat.

The spirometry shows a low FEV1.0 of 82 % and a significant reversibility of 15 %. When inhaling his beta-2 stimulator nurse Katarina Pettersson notices insufficient technique. When she corrects Erik his mother gets upset since no one has shown the inhalation technique before. Erik remembered that he should have been shown the technique a couple of years ago but that his father found that unnecessary since he was taken the same type of medicine himself..

Specific problem: What decision would you make if you stood in the position of Dr Karlsson?

Examples of factors and aspects in the decision making process to discuss during a seminar

What: Can the participants identify the problem in the case? What are the possibilities/difficulties in following the guidelines in a case like this?

Context: Social setting of Valbo Primary Health Care Centre and the surrounding health care organisation. Dr Karlsson's workload. Erik's current lifestyle, medical history and family situation.

Content: Dr Karlsson's, Erik's and his parents knowledge, attitudes, motivation and ability to communicate.

Cost: Dr Lena Karlsson's and nurse Katarina Petterson's increased time commitment required to motivate and explain to Erik and his parents. Financial commitment for the parents.

Ethics: The priority of this patient compared to other patients at Valbo Primary Health Care Centre.

Who: Does Dr Karlsson have the responsibility to make a decision? Are the guidelines applicable to Erik?

Sense of coherence: Dr Lena Karlsson's and nurse Katarina Petterson's sense of professional coherence. Erik's sense of coherence as a patient. His mother's and father's coherence as parents to a teenager with a chronic disease.

How: Can Dr Lena Karlsson and nurse Katarina Petterson interact and benefit from the specific knowledge in their professions in the motivational work with Erik and his parents?

When: Urgency, importance and timing in the life of Erik and his parents and in the schedule of Dr Lena Karlsson and nurse Katarina Petterson.

Dr Karlsson's task: To schedule a treatment and motivational plan together with nurse Katarina Petterson for Erik and his parents or to refer him to the local paediatric outpatient clinic. To preserve or continue to develop the asthma team at Valbo Primary Health Care Centre.

Appendix 2

Interview guide (translated from Swedish)

Opening question

1. Please tell us your name and if you are a general practitioner or a resident.
The purpose with this question is to give everyone a possibility to speak

Core questions

1. **How do you act when you decide how to take care of your patient? How do you use guidelines in your decision-making?**
 - Guidelines as a dictionary or as confirmation of own knowledge (*probe question*)
 - When you have a patient, do you use one kind of guidelines only or do you compare several different kinds? (*probe question*)
 - Do you use the guidelines before, after or during the patient-visit? (*probe question*)
2. **Please give example of factors that influence your decision to approach a specific type of guideline?**
 - How does the design and lay-out affect your choice of guideline? (*probe question*)
 - How does the amount of time you have affect your choice of guideline (*probe question*)
3. **What is your opinion of the fact that there are guidelines for most diseases that you handle and that you are expected to follow them in your daily practice?**
 - Do you see the guidelines mostly as a support or as an obstacle in your daily practice? (*probe question*)
 - In what way may the guidelines support your decision-making? (*probe question*)
 - In what way may the guidelines hinder you in your decision-making? (*probe question*)

Closing questions

1. If you were asked to advice the authors of the guidelines, what advice(s) would you give?
2. If you were asked to advice your junior colleagues in the use of guidelines in daily practice, what advice(s) would you give?

Appendix 3

Checklist for primary health care centre (translated from Swedish)

Primary health care centre (name): _____

Aspect ¹	Yes	No	Comments
Organisation			
Is there scheduled time for asthma care?			Hours/week:
Is there an asthma nurse?			
Is there a nurse with further education in asthma and allergy?			If yes, how many?
Is there a GP with responsibility for asthma?			
Is there a GP with further education in asthma and allergy?			If yes, how many?
Equipment			
Is there a spirometer?			
Is it used in children with asthma?			If yes, how often? Always <input type="checkbox"/> Often <input type="checkbox"/> Rarely <input type="checkbox"/>
If yes, from which age?			Age:
Is there a PEF-meter?			
Is it used in children?			If yes, how often? Always <input type="checkbox"/> Often <input type="checkbox"/> Rarely <input type="checkbox"/>
Demonstration and patient education			
Are there inhaler devices for demonstration?			
Is there patient education material?			
If yes, is it distributed?			Always <input type="checkbox"/> Often <input type="checkbox"/> Rarely <input type="checkbox"/>
Is there material regarding smoking cessation?			
If yes, is it distributed?			Always <input type="checkbox"/> Often <input type="checkbox"/> Rarely <input type="checkbox"/>
Is there a checklist or other structured information used when educating children with asthma?			

¹Aspects from the original checklist relevant for this study

Comments: