

Guidelines for Asthma Management: A Review and Comparison of 5 Current Guidelines

Timothy R Myers RRT-NPS

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The first clinical practice guidelines for the assessment and management of asthma were published over 20 years ago in New Zealand and Australia. During the same period, British and Scottish groups were collaborating on a United Kingdom version of asthma guidelines. Shortly after the introduction of the New Zealand and Canadian guidelines, the National Heart, Lung, and Blood Institute of the United States National Institutes of Health participated in 2 additional asthma guideline endeavors, which were published in the early 1990s. The National Heart, Lung, and Blood Institute formed the National Asthma Education and Prevention Program to develop asthma guidelines for the United States, and participated with an international task force to develop guidelines for the treatment of asthma in all countries, which resulted in the formation of the Global Initiative for Asthma in the mid-1990s. The asthma guidelines issued by professional societies and other groups prior to the late 1990s were primarily based on consensus or expert opinion in each guideline committee, though those opinions were based on the available studies. The early guidelines played a vital role in bridging the gap between various treatment options and recent discoveries in basic science, and served as the vehicle to implementation into daily clinical practice. Asthma guidelines have been published and revised in dozens of countries around the world and have become reputable directives or “road maps” in asthma diagnosis, treatment, and management for patients of all ages. The guidelines have similar formats. The dissemination and implementation of the early guidelines was inconsistent, and they were criticized for not being evidence-based. As the knowledge of asthma pathophysiology continues to expand, along with basic science research on asthma diagnosis, treatment, and management, as well as education of the asthma patient, it is essential that

the asthma guidelines be frequently updated and based on evidence-based-medicine processes. *Key words: asthma, practice guidelines, spirometry, severity, control, management, bronchodilators, corticosteroids, education.* [Respir Care 2008;53(6):751–767. © 2008 Daedalus Enterprises]

Introduction

Asthma is a chronic inflammatory disease, with episodic occurrences of airflow obstruction and hypersensitivity and responsiveness to various stimuli. Asthma is one of the most common chronic conditions today. The global burden of asthma occurs in approximately 300 million people of all ages and ethnic backgrounds worldwide,¹ and has a prevalence of approximately 21 million citizens of the United States, according to the Centers for Disease Control and Prevention.²

Clinical practice guidelines are systematically developed statements designed to help practitioners and patients make appropriate health care decisions in specific circumstances.³ The first opinion-based asthma guidelines were published in the mid-1980s in Australia and New Zealand. The overall goal of these guidelines and others that followed was to reduce asthma deaths and morbidity as disease prevalence, morbidity and mortality were increasing in all age groups. Expert-opinion-based asthma guidelines were produced over the next 2 decades in many different countries.

With the change from opinion-based to evidence-based practice, the principles of evidence-based medicine became essential in the preparation of guidelines. Evidence-based medicine attempts to present a rational and suitable structure of problem-solving from which the quality and importance of clinical studies can be analyzed in an unbiased manner. And when there is uncertainty in the research, systematic reviews may offer a resolution. Evidence-based clinical practice guidelines offer both evidence and instructional components, and represent the present ideal for bringing current scientific knowledge to the clinic and bedside.⁴

Timothy R Myers RRT-NPS is affiliated with Pediatric Diagnostics and Respiratory Care, Rainbow Babies and Children's Hospital, and Department of Pediatrics, Case Western Reserve University School of Medicine, Cleveland, Ohio.

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Correspondence: Timothy R Myers RRT-NPS, Pediatric Diagnostics and Respiratory Care, Rainbow Babies and Children's Hospital, 11100 Euclid Avenue, Room 684, Cleveland OH 44106. E-mail: timothy.myers@uhhospitals.org.

In this paper I will review the history of clinical practice guidelines for managing asthma. I will compare the current guidelines from the Global Initiative for Asthma (GINA), the (United States) National Asthma Education and Prevention Program (NAEPP), Canada, Australia, and the United Kingdom on selected topics in asthma diagnosis and management, and discuss the degree to which these guidelines are evidence-based, accessible to potential users, and applicable in different practice contexts. All 5 of these guidelines address exacerbation management, including mechanical ventilation and other aspects of critical care, but as those issues are covered in other articles in this Journal Conference, I will focus primarily on assessment and management of clinically stable patients.

History of Asthma Guidelines

A standardized template for asthma guideline development would theoretically consist of 4 basic components. First, practical asthma guidelines should be constructed on a strong foundation from scientific or evidenced-based therapies or discoveries. Second, they should be widely disseminated and implemented throughout the health care community. Third, they should ultimately benefit patient outcomes. Fourth, to ensure that they remain current and based on knowledge and evidence, they should have a mechanism for regular scheduled update.

Asthma guidelines are approaching their third decade of existence, and each set of guidelines has attempted to build on the earlier guidelines and consensus documents. The first (opinion-based) asthma guidelines were published in the late 1980s by groups in Australia and New Zealand⁵ and Canada,⁶ with the primary goal to reduce asthma deaths and morbidity, which was increasing in all age groups. Upon investigation, many of these deaths were believed to have been preventable, because there had been suboptimal long-term care and patient delays in seeking medical assistance during asthma attacks. Since those initial guidelines, an assortment of other asthma guidelines have been produced for specific countries,⁵⁻⁷ a global initiative,⁸ specific patient populations,⁹ and specific clinicians.¹⁰ All the current versions of the guidelines reviewed below are evidence-based.

Asthma is generally managed in general-practice settings, throughout most nations, and the organization of directives or guidelines for asthma care affects how this care can be delivered. Differential diagnosis and management practices differ according to location, traditions, and availability of resources and medications. To facilitate gen-

Table 1. The 6-Step Australian Asthma Management Plan

Frequent regular assessment of asthma severity
Optimal use of asthma medications
Help patient to avoid asthma triggers
Develop and instruct patient about individualized asthma action plan
Educate patient about his or her asthma
Regular review and assessment of asthma status by a physician

eral practitioners' understanding of asthma management, guidelines for asthma assessment and treatment have been compiled in the United States,^{11,12} United Kingdom,¹³ Canada,¹⁴ Australia,⁵ and many other countries. These guidelines have similar goals: reduce asthma morbidity and mortality; minimize airflow obstruction; and increase proper asthma diagnosis. Common methods for achieving these goals include encouraging greater long-term use of preventive medications (inhaled anti-inflammatories), objective monitoring by clinicians and self-monitoring by patients, and increased self-management of asthma.

All of the original guidelines produced in the late 1980s and early 1990s were based on expert opinion, with references from the scientific literature to support the "standards of care" established by the published guidelines. The majority of those early guidelines had commonalities in 4 main categories: epidemiology, pathophysiology, and diagnosis of asthma; pharmacologic therapies for acute and chronic asthma management; nonpharmacologic interventions; and asthma education and self-management practices. I will make a brief historical review of the 5 most frequently cited early guidelines.

New Zealand and Australian Guidelines

During the 1980s, asthma mortality data from Australia and New Zealand indicated that those countries were experiencing more asthma deaths than any other countries. After investigating fatal and near-fatal asthma attacks, some investigators concluded that inadequate asthma management and treatment, poor medical care, poor patient adherence to therapy, and delays in seeking and receiving care were all preventable factors involved in the fatalities.

Though the Australian guidelines were only 4 pages long, the first breakthrough in Australia for improving asthma management was the development of the 6-Step Asthma Management Plan by the Thoracic Society of Australia and New Zealand in 1989.⁵ The plan used a systematic approach to asthma management; it recommended that physicians assess asthma severity on a regular basis in an effort to attain and maintain the best possible lung function status. The guidelines listed objectives to achieve in every person with asthma (Table 1).

After publication of the Asthma Management Plan, studies on the application of asthma management plans dem-

onstrated improved health outcomes for people with asthma.¹⁵⁻¹⁷ A study by Adams et al, in South Australia, found that the percentage of adults who had a written asthma action plan almost doubled between 1992 and 1995.¹⁸ However, not all the news in asthma management was positive; there was increasing evidence that asthma management was not ideal.¹⁹⁻²¹ A study by Robertson et al¹⁹ indicated that almost 45% of those who suffered an asthma-related death in the Australian state of Victoria had been assessed as having mild-to-moderate asthma. A separate study by Rubinfeld et al,²⁰ in Victoria, assessed asthma patients' knowledge, and the median score was less than 50%. This led to 2 separate studies by Bauman and colleagues, which both seriously questioned practitioners' ability to implement effective asthma management plans in Australia²¹ and indicated that the overall treatment and management of asthma in Australia and New Zealand was suboptimal.²²

There was increasing evidence of and mounting concern about various problems in the 2 countries' asthma treatment and management, as well as an increasing acknowledgment of inadequate general awareness of new treatment recommendations and inadequate dissemination and implementation of asthma guidelines. These discoveries led to the establishment of the National Asthma Campaign,²³ a collaboration of the Thoracic Society of Australia and New Zealand, the Royal Australian College of General Practitioners, the Pharmaceutical Society of Australia, and the Asthma Foundations of Australia.

The National Asthma Campaign goal was to implement better asthma management according to the published guidelines and to promote community awareness of the asthma problem. This is believed to be the first national public education campaign through radio and television media to promote and enhance the general population's asthma knowledge. Within Australia the Asthma Management Plan was widely disseminated to doctors and allied health professionals by the National Asthma Campaign, in the *Asthma Management Handbook*, which has undergone multiple revisions, the latest in 2002. Any major public health initiative should be rigorously evaluated before its recommendations become established practice, and the National Asthma Campaign has been monitoring asthma management practices and outcomes since 1990.²⁴

Canadian Guidelines

In 1998 the Canadian Thoracic Society's Asthma Committee and other Canadian asthma specialists reviewed recommendations for optimal asthma management, and published their consensus guidelines in 1999.¹⁴ The recommendations to be published in the 1999 guidelines were debated at regional meetings throughout Canada and compared and contrasted to the recommendations of similar guidelines from other countries. The goal was to provide the health care com-

munity with current guidelines for the diagnosis and optimal management of asthma in all patient populations and in various ambulatory and in-patient settings.

The guideline development committee established core values and key points for consideration in asthma prevention, achieving and maintaining optimal asthma control and avoiding environmental triggers, thorough patient education with necessary measures of self-maintenance and pharmacologic asthma management and control at the lowest dose that effectively controls symptoms and minimizes morbidity and the risk of exacerbation. The consensus group also considered the roles of a diversified pharmacotherapy regimen and the importance of appropriate use of asthma-medication delivery devices and an evidence-based approach to emergency and in-hospital asthma management.

The 1999 Canadian guidelines also gave the world a look at some essential staples for future asthma guidelines: an evidence-based system for asthma guideline development and production, and guideline-based outcomes to evaluate effectiveness. Guideline adherence should significantly reduce symptoms, morbidity, mortality, emergency and hospital admissions, and adverse effects from medications, improve patient quality of life, and reduce the overall cost of care. The key diagnostic and therapeutic recommendations were based on the 1995 Canadian guidelines²⁵ and received a thorough and critical literature review by small groups prior to going to the full group at the consensus meeting. All the recommendations were graded according to 5 levels of evidence. When evidence was lacking or scientifically weak, recommendations were based on consensus opinion following discussion. Effectiveness of outcomes was based on the stipulation of optimal asthma management by confirmation of diagnosis, using objective measures, rapid attainment, and continual maintenance of asthma control with interventions, treatment, and regular follow-up.

The 1999 Canadian guidelines included recommendations in each section of the report. A summary of these recommendations would suggest that after the diagnosis of asthma is made based on clinical evaluation, including demonstration of variable airflow obstruction, and contributing factors are identified, a treatment plan should be established to obtain and maintain optimal asthma control. The main components of the guidelines are patient education, environmental control, individualized pharmacotherapy, and regular follow-up at recommended intervals. The Canadian consensus group also recognized that dissemination and implementation would be key to the overall success and effectiveness of the guidelines, and an implementation committee was established to develop a strategy for disseminating the guidelines to various health professionals and patients, and to create tools and resources to integrate the recommendations into current asthma care practice.

British Guidelines

In 1989 a group of physicians and researchers from the British Thoracic Society, Asthma United Kingdom, and the Royal College of Physicians in London began drafting the first British asthma management guidelines, which were published in the *British Medical Journal* in 2 papers: one directed at chronic asthma management²⁶ and one at exacerbation management.²⁷ The British guidelines were produced about the same time as asthma guidelines were being developed in Australia and Canada. The first British guidelines²⁶ endorsed a stepwise approach to asthma management and recommended inhaled anti-inflammatories if a bronchodilator was required more than occasionally. If symptoms were not relieved, then inhaled corticosteroids would be increased. These guidelines also promoted monitoring asthma with a peak flow meter, the avoidance of asthma triggers, and stressed the importance of patient self-management.

The British guidelines also stressed the need to increase inhaled corticosteroids and add bronchodilators at step 4. The guidelines briefly touched on ipratropium bromide, oral β agonists, xanthines, and high-dose bronchodilators. As well as introducing a plan for incremental increases in medication for lack of asthma control, these guidelines discussed the need for periodic review and the potential to decrease medication when asthma control was achieved. Other treatment options that had not proven beneficial were briefly mentioned but not encouraged.

The second publication²⁷ of the 2-part British guidelines focused on asthma exacerbation management and emphasized the importance of objective measurements. This part of the guidelines provided recommendations for treating acute asthma in the home, the emergency department, and the hospital setting, and stressed the importance of recognizing objective symptoms and signs of asthma exacerbation, and identifying features that were classified as imminently life-threatening. Arterial blood gas values and peak flow readings were identified as objective measurements that could be useful in exacerbation management.

Similar to other guidelines at that time (and even to their current editions), the British guidelines' recommendations for immediate asthma exacerbation management included oxygen as necessary, high doses of both inhaled bronchodilators and systemic corticosteroids, and possibly intravenous bronchodilators if necessary. They recommended frequent patient reassessment and provided guidelines for continuing or stopping asthma treatment. The British guidelines even included a generic treatment algorithm to illustrate the flow of assessment and treatment. The document concluded with brief sections on criteria for admission to the intensive care setting, monitoring of treatment, additional tests that might be necessary, discharge planning, and the need for physician follow-up.

Global Initiative for Asthma Guidelines

A different perspective and approach to asthma guidelines was also formulated in the late 1980s that did not take a local, regional, or national approach. In 1989 the GINA program was started to raise international awareness among public health and government officials, health care workers, and the general public that the prevalence of asthma was on the increase. The GINA program's mission was to develop recommendations on asthma care and management that would be based on the best available scientific evidence so that it could be customized or adapted to meet the needs and resources of local health care systems.

The GINA program was launched as a collaboration of the World Health Organization and the National Heart, Lung, and Blood Institute of the United States National Institutes of Health. The initial phase of the GINA program was to produce a report that reflected the most up-to-date clinical practice²⁸ and provided an overview of asthma epidemiology, pathogenesis, and prevention, and the more traditional components on treatment and education.

Because the GINA guidelines focused on international asthma, the different financial statuses of various countries led the GINA panel to produce a comprehensive document that highlighted preferred treatment categories for acute and chronic asthma but did not focus on specific medications. However, the report documented acceptable therapies and included a well-referenced review of complementary therapies. The document concluded with sections on health economics, guideline implementation, and organization of care. The second phase of the GINA project was to produce a variety of reference materials to assist with the delivery of asthma care.

National Asthma Education and Prevention Program Guidelines

In 1989 the National Heart, Lung, and Blood Institute established the NAEPP Expert Panel to begin the process of developing consensus, science-based guidelines for the diagnosis and management of asthma. The panel's original objectives were simple, yet comprehensive (Table 2). The panel consisted of a coordinating committee with representatives from 36 major medical associations, voluntary health organizations, and federal agencies with an interest in asthma.

In 1991 the NAEPP published a set of practical, comprehensive asthma guidelines, "Guidelines for the Diagnosis and Management of Asthma," to assist clinicians in bridging the gap between advances in basic science and treatment options and clinical practice.⁷ These consensus-based guidelines were developed from the panel's comprehensive review and interpretation of the available literature at that time.

The 1991 NAEPP guidelines stated that effective asthma management consisted of objective measurements of lung

Table 2. Guiding Principles of the NAEPP Asthma Guidelines

To raise awareness among patients, health professionals, and the public that asthma is a serious chronic disease.
To ensure that asthma symptoms are recognized by patients, families, and the public, and that appropriate diagnosis is made by health professionals.
To ensure effective asthma control by encouraging a partnership among patients, physicians, and other health professionals, using modern treatment and education programs.

NAEPP = National Asthma Education and Prevention Program⁷

function, environmental control, pharmacotherapy directed at airway inflammation, and patient education. They recommended that patients self-monitor peak expiratory flow daily, and that clinicians assist patients to identify, eliminate, remediate, and/or avoid asthma triggers. Inhaled steroids were the recommended drugs for controlling airway inflammation, and there was a stepwise protocol for adjusting pharmacotherapy, based on 3 asthma severity categories: mild, moderate, and severe. Finally, the 1991 NAEPP guidelines suggested that clinicians devote time to asthma education partnership with patients and their families.

This landmark document established the foundation for nationwide improvements in clinical asthma management. The guidelines reversed the clinical practice from focus on treating asthma exacerbations to long-term disease management that emphasized the role of airways inflammation, the importance of objective measurement of lung function, and the need to establish education partnerships between patients and providers. Over 300,000 copies of the 1991 NAEPP guidelines were printed and distributed to physicians, health professionals, and medical schools. To further support extensive use of the guidelines, the NAEPP developed supplemental documents for nurses, emergency department personnel, pharmacists, and school personnel.

One of the major benefits of the original NAEPP guidelines was that they stimulated additional and new research to bridge the gaps in the evidence. This academic research drastically increased knowledge and evidence about asthma and asthma care.

The second Expert Panel was convened in 1995, to revise and update the 1991 NAEPP guidelines. The second Expert Panel (1) reviewed the asthma literature published since the previous guidelines, (2) prepared practical management and treatment recommendations for use by clinicians, and (3) developed specific aids to assist in implementing the recommendations. The second edition of the NAEPP guidelines (Expert Panel Report 2) was published in July 1997.²⁹ One major change in the dissemination of the 1997 guidelines was that they were initially released over the Internet, in early 1997, but these revised guidelines shared the program's initial goals (Table 3).

Table 3. Main Goals of the 1997 NAEPP Asthma Guidelines

Prevent asthma symptoms
Maintain (near) "normal" pulmonary function and activity level
Prevent exacerbations
Minimize emergency department visits and hospitalizations
Provide optimal pharmacologic therapy, with minimal or no adverse effects

NAEPP = National Asthma Education and Prevention Program²⁹

The 1995 Expert Panel used new methods in their literature review and guideline development process. They initiated an evidence-based approach, though they chose not to use a specific evidence-ranking system, opting instead to simply cite and reference relevant studies. On recommendations that had robust evidence (eg, peak flow measurement), comprehensive reviews were reported. When evidence was nonexistent, controversial, or vague the panel acknowledged their recommendations as "based on the opinion of" or "recommended by the Expert Panel."

The 1997 NAEPP guidelines classified asthma severity on 2 variables: symptom frequency and objective measurement of airflow obstruction, assessed via peak expiratory flow or spirometry. The 1997 NAEPP guidelines classified patients into 4 levels of asthma severity: mild intermittent, and mild, moderate, or severe persistent asthma. These guidelines also adopted a new scheme for a modified home-management strategy ("asthma action plan"), and new peak-flow value "cutoffs" to direct care. They classified asthma medications as either "long-term controllers" or "quick-relief medications," and added newly approved controller medications for long-term therapy (eg, leukotriene modifiers), and new approaches in acute asthma care (eg, anticholinergics, aggressive use of inhaled β agonists, and prompt emergency-medical-services intervention in the acute setting). New patient education materials were also included.

Overall, the 1997 NAEPP guidelines could be summarized as follows:

1. A new appreciation for the major role of airway inflammation in the pathogenesis of asthma
2. A focused effort to emphasize anti-inflammatory maintenance therapy
3. A center of attention to establish important risk factors for the development of asthma and identifying suitable programs for control and prevention

To facilitate these new goals, the NAEPP outlined several key management components. First, self-management skills and patient education (disease knowledge, correct medication use, proper metered-dose-inhaler technique, and written action plans for managing exacerbations) are vital to overall success. Second, patients with moderate or severe disease should use a home peak-flow meter to monitor disease severity, but only once a day, in the morning,

Table 4. Key Evidence-Based Points in the 2002 Update of the NAEPP Asthma Guidelines

Strong emphasis on inhaled corticosteroids as the recommended long-term controller medications for children with mild to moderate persistent asthma
Recommend adding long-acting β agonists (for patients > 5 y old) with moderate persistent asthma that is poorly or inadequately controlled by inhaled corticosteroids
Do not add antibiotics during asthma exacerbation
De-emphasize written action plans, because they have not shown benefit over medical management alone

NAEPP = National Asthma Education and Prevention Program³⁰

before inhaling bronchodilator. Third, such patients should minimize or avoid exposure to known asthma triggers, both in the home and outdoors. Fourth, such patients should use pharmacotherapy, with a special emphasis on "step-down" therapy after a period of good control. The 1997 NAEPP guidelines were disseminated nationwide, and were modified into a practical guide, a best-practices pediatric guide, and a pocket guideline.

An update to the 1997 NAEPP guidelines was published in 2002,³⁰ and it serves as a companion to the 1997 NAEPP guidelines. The "Quick Reference" section provided a concise review of timely information on 10 selected priority asthma topics essential for ensuring the prevention aspect of asthma care and addresses the components of care recommended in the guidelines. The action steps listed for each key clinical activity suggest specific ways to accomplish each activity. The 2002 update added several evidenced-based points (Table 4). The 1997 NAEPP guidelines and their 2002 update represented the established science-based consensus concerning accurate information for health-care providers regarding asthma diagnosis and management.

However, although those asthma care principles have been widely endorsed, numerous studies have highlighted that publication of guidelines does not guarantee appropriate dissemination or guideline adoption throughout the medical community. For instance, Hartert et al³¹ found that under-assessment and under-treatment remained a common problem. Legorreta et al³² found that adherence to national guideline management principles was low in California health-maintenance organizations, which had poor practices in prescribing preventive medication and routine measurement of peak flow. Meng et al³³ documented that adherence to the national guidelines was consistently low in various regions in the United States, and they called for targeted interventions to increase guideline adherence among both providers and patients.

The NAEPP guidelines have provided an excellent vehicle for translating research findings into clinical recommendations. As with guidelines from other countries and

COMPARISON OF ASTHMA GUIDELINES

Table 5. Comparison of the Major Content Sections of the Asthma Guidelines From Canada, Britain, Australia, GINA, and NAEPP

Section	Canada ⁴³	Britain ¹³	Australia ⁴⁴	GINA ¹²	2007 NAEPP ¹¹
Diagnosis and evaluation	Yes	Yes	Yes	Yes	Yes
Provocative factors	Yes	No	No	No	No
Asthma education and patient monitoring	Yes	Yes	Yes	Yes	Yes
Avoidance of environmental allergens	Yes	Yes	Yes	Yes	Yes
Immunotherapy	Yes	No	Yes	No	Yes
Pharmacology	Yes	Yes	Yes	Yes	Yes
Inhalation devices	Yes	Yes	Yes	No	Yes
Special considerations	Yes	Yes	Yes	Yes	Yes
Exacerbation management	Yes	Yes	Yes	Yes	Yes
Implementation	Yes	Yes	Yes	Yes	No
Organization and delivery	No	Yes	No	No	No
Outcomes	No	Yes	Yes	No	No

GINA = Global Initiative for Asthma
 NAEPP = National Asthma Education and Prevention Program

organizations, a body of scientific evidence suggests that when the guidelines are followed there is a significant reduction in the severity and frequency of exacerbations, and patients are better able to maintain normal, active lives.³⁴⁻⁴⁰ Education programs that focus on community outreach and self-management and target high-risk populations are an indispensable part of the effort to ensure full guideline utilization. Creative interventions that assist access to medical care, and suitable financial support for asthma-management components (medication, monitoring aids, and environmental control measures) reduce the burden of asthma.

Currently Available Guidelines

Since the initial development of asthma guidelines in the late 1980s and early 1990s, dozens of different versions of asthma management guidelines have been developed and produced worldwide. Regardless of the content of these guidelines or when they were produced, advances in their content have been made, and most of them are now evidence-based.

The systematic development of guidelines through an evidence-based process is currently regarded as the most rigorous and accurate means to develop clinical practice guidelines.⁴¹ Developing evidence-based consensus guidelines is an enormous undertaking in a field such as asthma; it involves a major literature search, consideration of thousands of papers, and a large time commitment by numerous individuals in the respiratory medical community.⁴²

Since the initial guidelines were published in the late 1980s, asthma guidelines have taken on both more specific approaches (local, regional, national, specific patient populations, and specific clinicians) and a generalized ap-

proach (the global initiative). I will compare the current asthma guidelines from the NAEPP,¹¹ GINA,¹² United Kingdom (British and Scottish),¹³ Canada,⁴³ and Australia.⁴⁴ These guidelines have a similar structure and format, but each offers unique perspectives and sections, and some cover certain components in much more detail. Table 5 identifies the major content sections of each of these 5 guidelines.

Comparison of Selected Topics in the NAEPP, GINA, Canadian, Australian, and British Guidelines

Evidence-Based Grading System

The 5 guidelines take slightly different approaches in grading the evidence, but they share the common hierarchical component that randomized controlled trials (RCTs) are always graded as the highest level of evidence, and expert-opinion is graded the lowest. The GINA guidelines and 2007 NAEPP guidelines follow a similar approach⁴⁵ and grade the levels of evidence in an A (highest) through D (lowest) hierarchy. The general format of evidence-grading systems is a descending-order alphabetical or numerical hierarchy (eg, A-B-C, 1-2-3, or I-II-III). Table 6 compares the evidence grading scales in the 5 guidelines.

There are some limitations to evidence-based guidelines. RCTs are typically designed to maximize internal validity and to minimize confounding variables in a controlled population and setting. RCTs are not primarily concerned with the external validity or generalizability of the findings to whole populations, and differences between the homogeneity of the trial population and the heterogeneity of the general population may limit the generalizability of RCT findings.⁴⁶ So, though the evidence from RCTs is strong, many question

COMPARISON OF ASTHMA GUIDELINES

Table 6. Evidence Levels and Grades Used in the Asthma Guidelines From Canada, Britain, Australia, GINA, and NAEPP

	Canada ⁴³	Britain ¹³	Australia ⁴⁴	GINA ¹²	2007 NAEPP ¹¹
Evidence Levels	Level I	1++ 2+	1++ 2+	A	A
	Level II	1+ 2-	1+ 2-	B	B
	Level III	1- 3	1- 3	C	C
	Level IV	2++ 4	2++ 4	D	D
	Level V	NA	NA	NA	NA
Evidence Grades	Level I	A	A	A	A
	Level II	B	B	B	B
	Level III	C	C	C	C
	Level IV	D	D	D	D
	Level V	NA	NA	NA	NA

GINA = Global Initiative for Asthma

NAEPP = National Asthma Education and Prevention Program

NA = not applicable because this guideline has only 4 evidences levels/grades.

the “real-world” practicality of certain recommendations that are based on RCTs, in certain situations.

Two recent peer-reviewed papers compared the results of RCTs and observational studies and determined that when you review similar studies that are RCTs or lower level evidence trials, the results are the same.^{47,48} Knowledge acquired from realistic trials and observational studies can be a valuable adjunct to that gained from RCTs. Realistic trials, which may be blinded or open-label, are designed to more closely replicate conditions in clinical practice, including differences in patient characteristics and the use of a management protocol rather than a predetermined assigned treatment.⁴⁹

Another criticism of evidence-based guidelines arises from the amount of time and effort required for their development, resulting in delayed implementation of best practice. The process of reviewing the literature, arriving at a consensus, and writing and publishing the guidelines can take several years and therefore might inadvertently exclude recent publications, and always excludes potentially important research published soon after the guidelines. The Australian guidelines include a brief section that recognizes the potential gaps between the evidence and current practice.⁴⁴

Introduction, Diagnosis, and Natural History

All 5 asthma guidelines open with an introduction and then discuss the epidemiology, pathophysiology, and diagnosis of asthma. Most include an explanation of the evidence-grading system. All 5 guidelines also include a summary of the current version and describe the differences between the current version and its predecessor.

Both the 2007 NAEPP guidelines¹¹ and the GINA guidelines¹² provide much more detail on the pathophysiology and pathogenesis of asthma than do the recent versions of the British, Canadian, and Australian guidelines. The 2007

NAEPP and GINA guidelines also look at the genetic and environmental factors that may play a vital role in the development of asthma and that hinder disease control. The 2007 NAEPP guidelines extensively review the definition of asthma, the inflammation aspects of asthma, and both acute and chronic asthma’s impact on the airways.

All 5 guidelines spend a sizeable amount of space discussing the diagnosis of asthma. Unlike the original severity-based asthma guidelines, asthma assessment now depends on 2 concepts: control and severity. Signs and symptoms are systematically identified and quantified to assist the clinician in determining disease severity (during diagnosis) and assessing asthma control (during follow-up care and management). The control and severity assessments are both based on symptoms, exacerbations, impact on daily life, use of rescue medications, lung function, and variations in lung function.⁵⁰ All the guidelines provide an overview of the main components of assessment and monitoring, and they cover physical examination, medical-history-taking, and objective measurements as the primary components in making a diagnosis.

Also covered in great detail in each of these guidelines are the relevant (eg, spirometry, skin testing) and optional (eg, radiology and laboratory testing) diagnostic tests, and some new tests and factors to consider (eg, exhaled nitric oxide, quality of life). The topic that receives the greatest attention is the hallmark measurement for diagnosing asthma: pulmonary function testing, specifically spirometry. Some of the guidelines provide very detailed explanations of the role of spirometry,¹¹⁻¹³ whereas the others provide only a summary and citations for relevant articles or resources for more specific information.

In all the guidelines the sections on asthma severity, asthma control, and pulmonary function are similar in that they all establish the basis for the treatment recommendations. In a stepwise pharmacologic approach

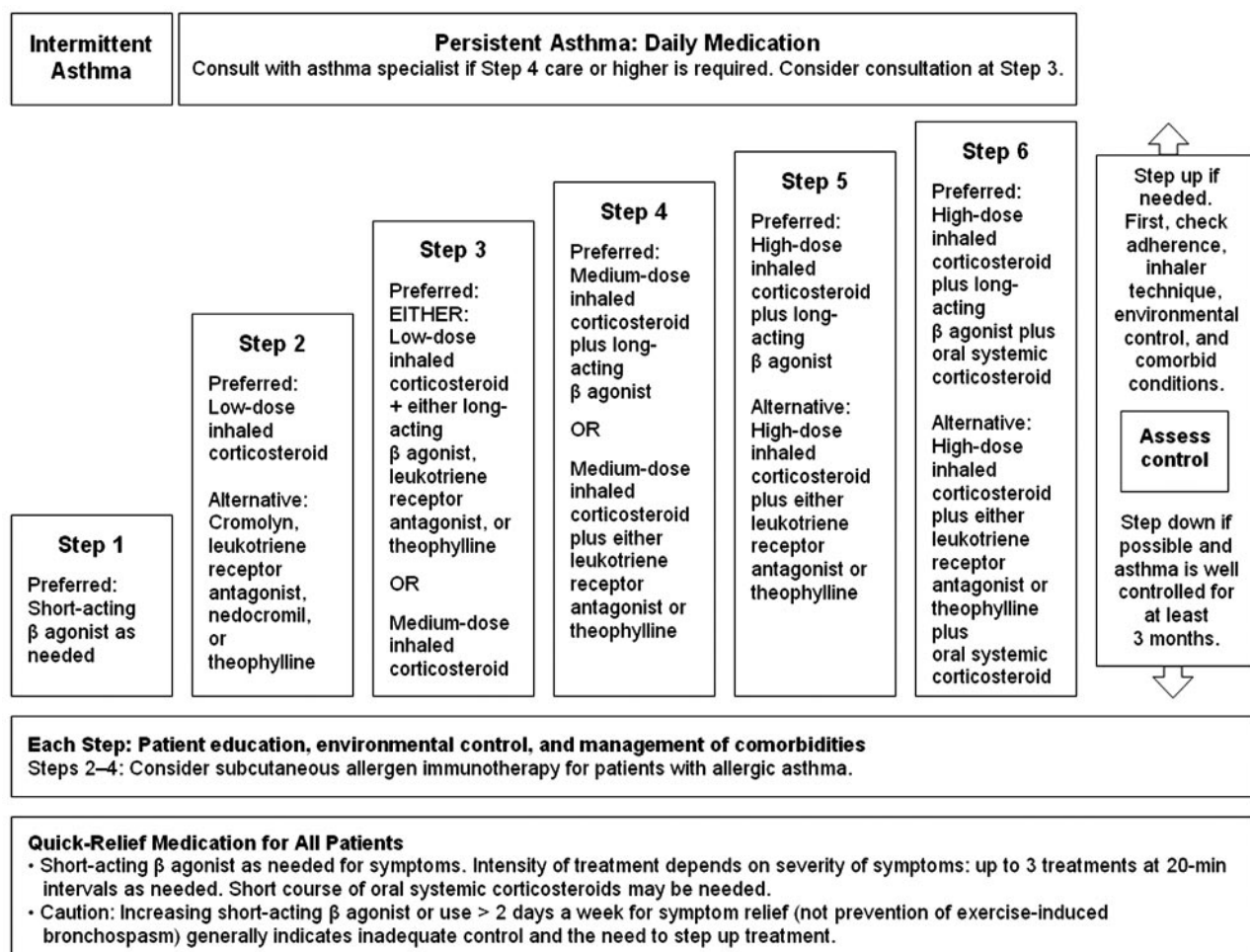


Fig. 1. Stepwise approach to asthma management in children 5–11 years old. (Based on a figure in Reference 11.)

Table 7. Comparison of the Sections on Asthma Severity, Control, and Pharmacology in the Asthma Guidelines From Canada, Britain, Australia, GINA, and NAEPP

	Canada ⁴³	Britain ¹³	Australia ⁴⁴	GINA ¹²	2007 NAEPP ¹¹
Pharmacology steps	5	5	6	5	6
Severity levels	5	Follows treatment steps	3	4	4
Asthma control	Present, with specific definitions	Present, with recommendations on step-treatment	Present, with measurement tools	Present, with measurement tools	Present, with measurement tools

GINA = Global Initiative for Asthma

NAEPP = National Asthma Education and Prevention Program

to asthma management, medications and regimen are adjusted based on information obtained from the severity and control assessment variables and pulmonary function measurements (Fig. 1). Table 7 compares the similarities and differences.

Environmental Control

Allergies and asthma go hand in hand in many patients. As many as 85% of individuals diagnosed with asthma also have a positive skin test to one or more of the common aeroaller-

Table 8. Example of How the 2007 NAEPP Asthma Guidelines Classify Asthma Severity After the Asthma Becomes Well Controlled, by Lowest Level of Treatment Required to Maintain Control

Classification of Asthma Severity			
Intermittent	Persistent		
	Mild	Moderate	Severe
Step 1	Step 2	Step 3 or 4	Step 5 or 6

NAEPP = National Asthma Education and Prevention Program
(Adapted from Reference 11.)

gens. For good long-term asthma control it is necessary to identify and reduce exposure to allergens, irritants, and other factors that increase asthma symptoms or precipitate asthma exacerbations. These environment factors can be classified into 5 categories: inhaled allergens, irritants, occupational exposures, comorbid conditions, and other factors.

All 5 guidelines comprehensively overview and analyze the importance of environmental aspects of asthma management. There is a strong correlation between sensitization to aeroallergens and the subsequent development of asthma, and a strong association between early exposure and sensitization to aeroallergens. Some of the guidelines divide environmental control into 2 parts: primary, preventive measures, and secondary measures to reduce or avoid exposures. Though there are certainly different strategies between the primary and secondary measures, there is also some overlap.

The primary prophylaxis strategies focus on intervening on risk factors and exposures prior to the onset of asthma. Most of the data in this category come from research on young children, and it is a subject that is growing in interest and evidence. The primary topics being investigated are inhaled allergens, genetics, natural and immunotherapy strategies, outdoor and indoor environments, irritants, comorbid conditions, and occupational exposures.

Secondary prophylaxis strategies focus on environmental interventions after the onset and development of asthma. The cause/effect relationship is much stronger in this area and the data receive much higher evidence scores in all 5 guidelines. Some of the strongest evidence of cause/effect and intervention studies exists on aeroallergens in the indoor environment. These environmental factors fall into 4 categories: pests (eg, roaches, mice), pets (eg, cats, dogs), irritants (eg, tobacco smoke, chemicals), and airborne particulate matter (eg, from dust mites, molds, mildew).

Though the GINA (4 pages), British (4 pages), and Canadian (7 pages) guidelines^{12,13,43} cover environmental aspects of asthma adequately, the most thorough examination of environmental factors is in the 2007 NAEPP guidelines¹¹ (47 pages, including references), where the focus is

much the same, but the level of detail is much greater and includes discussion of comorbid conditions, infections, medications, and diet. Though all the guidelines discuss the cause/effect relationship in an evidence-based fashion, the 2007 NAEPP guidelines have a large section that details evidence-based interventions for reducing exposures and remediating environmental conditions.

Pharmacologic Management

As one might expect, the most extensively covered topic in all 5 guidelines is pharmacologic management of asthma. The primary goal of asthma management is to achieve and maintain control of symptoms. The efficacy of pharmacologic management has been well established for many decades, and pharmacologic management remains the foundation of both chronic and acute asthma management. All 5 guidelines address pharmacologic asthma management in the chronic and acute domains, specifically, as controller and reliever medications.

Chronic Asthma Management: Controller Medications.

All 5 guidelines stress the importance of daily preventive (controller) medications for patients with persistent symptoms or inadequate asthma control. All 5 guidelines also provide a stepwise approach or rationale for recommending controller medications, and the dose can be escalated or reduced based on how well the asthma is controlled (see Fig. 1). Each set of guidelines takes a slightly different approach to how they document and explain the stepwise approach to pharmacologic asthma management. There are differences in terminology and number of steps in the treatment hierarchies (Table 8), but each of the guidelines clearly points out that robust clinical trial evidence supports the use of inhaled corticosteroids for asthma control in patients with persistent asthma, who are above the bottom tier (step 1). All 5 guidelines devote considerable space to the nuances of dosing difference between corticosteroid types and patient populations (eg, adults vs children), in a very similar fashion. All 5 guidelines discuss the potential adverse effects of inhaled corticosteroids. The 2007 NAEPP guidelines¹¹ and Canadian guidelines⁴³ provide the most thorough explanations of the local and systemic adverse effects. The most distinct difference between the guidelines is the medications mentioned. As one might expect, medication availability differs markedly country-to-country, which causes less of a consensus on medications from guideline-to-guideline.

For patients who fail to achieve adequate asthma control in the lower steps/tiers of asthma treatment with inhaled corticosteroids, all 5 guidelines promote escalating the pharmacologic treatment with an increase in inhaled corticosteroid dose or addition of another class of controller medication. The guidelines take slightly different approaches

to escalation of inhaled corticosteroid dose versus adding other medications. Because asthma is a nonhomogenous disease that has great variability from person to person, and possibly in the same person over time, one might expect these differences among the guidelines.

Though there are slightly different approaches to medications and pharmacology with lack of asthma control and a need to escalate asthma medications, all 5 guidelines provide a detailed explanation of the various classes of medications (leukotriene modifiers, nonsteroidal anti-inflammatories, anticholinergics, long-acting β agonists, oral corticosteroids, methylxanthines, and anti-immunoglobulin E human monoclonal antibodies).

Acute Asthma Management: Reliever Medications. All 5 guidelines highlight the importance of as-needed reliever medication for patients at all asthma severity levels, to manage acute symptoms and exacerbations. There is general consensus among the 5 guidelines that the preferred reliever medications are the short-acting β agonists (forms of albuterol). Though the primary purpose of the short-acting β agonists is rapid relief of acute bronchoconstriction, all 5 guidelines provide evidence of their benefits as a maintenance or preventive medication in patients with documented exercise-induced asthma.

The sections on reliever medications are relatively brief (compared to the sections on controller medications) in all 5 guidelines, which is understandable, based on the step-wise approach to the pharmacologic asthma management and the role assigned to the reliever medications. As with the sections on the controller medications, the sections on reliever medications all discuss other classes of medication (anticholinergics, long-acting β agonists, oral corticosteroids, and methylxanthines) that might be considered optional reliever medications, based on regional or national opinions, in the absence of solid evidence.

Other Materials in the Pharmacology Sections

Though the 5 guidelines are all consistent in their approach to providing adequate materials and resources on controller and reliever medications, the pharmacology sections also contain other materials and resources. I will briefly summarize the pharmacology sections and provide examples of the types of materials therein.

Australian. The Australian guidelines⁴⁴ provide an algorithm-based approach for managing asthma exacerbations, at the beginning of the pharmacology section. This algorithm branches into various management approaches based on exacerbation severity. This section also provides criteria for hospital admission, general recommendations for hospital management of prolonged asthma treatment, and a brief review of the various medication-delivery devices

used in both chronic and acute asthma. A different section provides materials on nonpharmaceutical and complementary asthma-management therapies, in an evidence-based format, and therapies and approaches that do not have sufficient or any evidence are grouped together without any evidence-based analysis.

Canadian. The Canadian guidelines⁴³ provide an evidence-based review of other drugs for severe asthma, and unconventional therapies. Most of these other drugs fall into the level 3 (of 5) category of evidence. They include drugs such as methotrexate, cyclosporin A, gold salts, and intravenous immunoglobulins. The Canadian guidelines state that there is no objective evidence of any benefit, apart from placebo effect, from the more frequently used unconventional therapies such as acupuncture, chiropractic, homeopathy, naturopathy, osteopathy, and herbal remedies (level 1 or 3, depending on the therapy). The Canadian guidelines complete their coverage of pharmacology with a 10-page section on medication-delivery devices, for both adults and children, and provide 10 evidence-based recommendations and some suggestions for future research.

British. The British guidelines¹³ pharmacology section addresses specific management problems, including asthma exacerbations, exercise-induced asthma, rhinitis, allergic bronchopulmonary aspergillosis, aspirin-intolerant asthma, and anti-immunoglobulin E monoclonal antibodies. The section that addresses aerosol-delivery devices starts with the comment that, though “studies of inhaler devices are more suitable for an evidence-based approach than many other aspects of asthma management, a number of methodological issues complicate evidence review in this area.” This section also provides some information on spacers and valved holding chambers. Section 6 of the British guidelines comprehensively reviews (14 pages, or 14% of the document) strategies, approaches, and recommendations on asthma exacerbations, including specific criteria to determine exacerbation severity, assessment recommendations, hospital admission criteria, recommendations for intensive care admission, and adjunctive therapies (eg, heliox and noninvasive ventilation).

GINA. The GINA guidelines¹² pharmacology section sticks to controller and reliever medications, but also devotes a portion of this section to specific needs in and recommendations on asthma pharmacology in children. The section after the pharmacology section deals with asthma management and prevention. The asthma-management portion of this section comprehensively reviews assessment, exacerbation severity, and treatment recommendations. One highlight of this section is an intricate chart with which to determine asthma exacerbation severity,

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Table 9. Classifying Asthma Severity in Patients ≥ 12 Years Old and Who Are Not Currently Taking Long-Term Asthma-Control Medications*

Components of Severity		Asthma Severity Classification (children ≥ 12 y old and adults)			
		Intermittent	Persistent		
Symptoms			Mild	Moderate	Severe
Impairment	Nighttime awakenings	≤ 2 d/wk	> 2 d/wk but not daily	Daily	Throughout the day
		≤ twice a month	3–4 times a month	> once a week but not nightly	Often 7 times a week
	Short-acting β ₂ agonists for symptom control (not prevention of exercise-induced bronchospasm)	≤ 2 d/wk	> 2 d/wk but not > once a day	Daily	Several times a day
	Interference with normal activity	None	Minor limitation	Some limitation	Extreme limitation
	Lung function	Normal FEV ₁ between exacerbations FEV ₁ > 80% of predicted FEV ₁ /FVC normal	FEV ₁ > 80% of predicted FEV ₁ /FVC normal	FEV ₁ > 60% but < 80% of predicted FEV ₁ /FVC reduced 5%	FEV ₁ < 60% of predicted FEV ₁ /FVC reduced > 5%
Risk	Exacerbation that requires oral systemic corticosteroids	0–1 time a year [†] Consider severity and interval since last exacerbation. Frequency and severity may fluctuate for patients in any severity category. Relative annual risk of exacerbation may be related to FEV ₁ .	> twice a year [†]	> twice a year [†]	> twice a year [†]

FEV₁/FVC:

8–19 yr 85%

20–39 yr 80%

40–59 yr 75%

60–80 yr 70%

* Severity level is determined by assessment of both impairment and risk. Assess impairment domain by patient's/caregiver's recall of previous 2–4 weeks and spirometry. Assign severity to the most severe category in which any feature occurs.

† There are inadequate data to correspond frequency of exacerbation to asthma severity level. In general, more frequent and intense exacerbations (eg, that require urgent, unscheduled care, hospitalization, or admission to the intensive care unit) indicate greater underlying asthma severity. For treatment purposes, patients who had ≥ 2 exacerbations that required oral systemic corticosteroids in the past year may be considered the same as patients who have persistent asthma, even in the absence of impairment consistent with the diagnosis of persistent asthma.

FEV₁/FVC = ratio of forced expiratory volume in the first second to forced vital capacity

(Adapted from Reference 11.)

based on both subjective and objective measures. The exacerbation-treatment algorithm later in the section is based on the exacerbation-severity assessment. The section wraps up with discharge criteria for both the emergency department and hospital setting.

2007 NAEPP Guidelines. The 2007 NAEPP guidelines¹¹ are similar in many aspects to the GINA guidelines,¹² in that the pharmacology section includes specific recommendations and components that address pharmacologic approaches to asthma in children. The section immediately after the pharmacology section deals with a more detailed approached to medications and treatment. Section 4 provides a comprehensive (95 pages) system for managing

asthma long-term, which is divided into 4 components, based on either age (0–4 y, 5–11 y, or > 12 y) or special circumstances of asthma. This section devotes a great deal of space to discussing the new (to the NAEPP guidelines) components of impairment and risk and how they relate to asthma management and control (Table 9). To oversimplify these concepts, impairment refers to functional morbidity or daily symptoms, and risk refers to exacerbations, medication adverse effects, and long-term decline in function from asthma.

Section 5 thoroughly reviews the concepts of assessing and treating asthma exacerbations. As in the GINA guidelines,¹² there is an intricate chart with which to determine

asthma-exacerbation severity, based on both subjective and objective measurements (Table 10), and the exacerbation-treatment algorithm is based on the exacerbation-severity assessment. This section also highlights risk factors for fatal asthma. There is an algorithm-based exacerbation-management approach for both the home and acute care (emergency department and hospital) settings (Fig. 2). There is even a section on pre-hospital (emergency medical services) management strategies.

The 2007 NAEPP guidelines also review treatments that are not recommended for exacerbations (eg, methylxanthines, hydration, chest physiotherapy) and discuss adjunctive therapies (eg, magnesium sulfate, heliox, noninvasive ventilation) that need more investigation in order to provide evidence-based recommendations. This section finishes with some criteria for discharge from acute settings and recommendations for specific documentation for the patient.

Patient Education

The primary objective of asthma care and patient self-management is to decrease asthma morbidity and asthma's effects on activities of daily living and overall quality of life. There is now sufficient evidence that asthma self-management education improves long-term asthma outcomes. Behavioral modification through specific training in various self-management skills is essential to produce positive outcomes in chronic conditions such as asthma. Equally important is clinician education, to facilitate educating patients on self-management skills and to support guideline implementation.

All 5 asthma guidelines extensively cover and stress the importance of asthma education for patients, caregivers, clinicians, and the general public. Each of the 5 guidelines address this important topic, with slightly different approaches, but all share some common viewpoints. They all stress the importance of a partnership between patients and clinicians to achieve optimal asthma outcomes. This partnership and formalized education should be initiated on the confirmation of the asthma diagnosis, and reviewed and reinforced at each subsequent visit.

All the guidelines stress the importance of self-management skill training and review. This can include a multitude of behavior-based skills, but also includes items such as written asthma education and action plans, peak flow and medication-delivery-device education and technique reviews, and the ability to recognize signs and symptoms of worsening asthma control. Most of the guidelines also stress the importance of assessing the patient for adherence to the written treatment plan and medication regimen. The 2007 NAEPP guidelines¹¹ and the Canadian guidelines⁴³ include detailed information on providing asthma education in various settings (eg, clinician's office, patient's home, acute care setting,

school), which provides some insight into the necessity of a multi-dimensional approach to education.

Education of the nonasthmatic is equally important to the success of asthma education. The GINA guidelines¹² truly take a global approach to education and address the role of asthma guidelines in providing information to the general public. The Canadian guidelines⁴³ focus on the importance of appropriate training of asthma educators. This is not surprising, because education programs for asthma educators have been developed in various regions in Canada, and national certification for asthma educators has been available for over a decade. The 2007 NAEPP guidelines¹¹ provide specific information on methods for improving clinician behavior, starting with recommended practices for implementing the vast amount of information in the guidelines, then they discuss how to improve communication techniques. This section concludes with a review of methods for improving system supports and details on asthma clinical pathways and clinical decision-support systems.

Special Circumstances

Patients with asthma frequently encounter situations that require adjustments to their management regimen to keep their asthma under control. All of the guidelines provide some review of some common and uncommon occurrences or comorbid conditions that can necessitate a change in asthma management or that call for additional patient education. Special situations described in the 2007 NAEPP guidelines¹¹ include exercise-induced bronchospasm, pregnancy, and surgery. The NAEPP guidelines also review the problems that racial and ethnic differences can pose in asthma management.

The Canadian guidelines⁴³ review 2 specific subjects in great detail: asthma in the elderly, and asthma during pregnancy. In both these conditions, specific treatment and management recommendations are provided in an evidence-based format. The British guidelines similarly address asthma and pregnancy, and offer a unique approach in their review of occupational asthma, which does not exist in the NAEPP guidelines¹¹ or Canadian guidelines⁴³ as a separate entity. The GINA guidelines¹² provide the most diverse outlook on special circumstances in asthma, including pregnancy, surgery, occupational exposure, respiratory infection, gastroesophageal reflux, aspirin-induced asthma, rhinitis, sinusitis, nasal polyps, and anaphylaxis.

Target Audience

All 5 guidelines contain materials and resources for health professionals of all disciplines, patients, and the general public, and are easily accessible via the Internet. The documents and resources for health care professionals differ somewhat in structure and comprehensiveness, but are presented in a manner appropriate for all care providers, regardless of spe-

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Table 10. Classification System for Asthma Exacerbation Severity in the Urgent or Emergency Department Setting

	Mild	Moderate	Severe	Subset of Severe: Respiratory Arrest Imminent
Symptoms*				
Breathlessness	While walking Can lie down	While at rest (infant: softer, shorter cry, difficulty feeding) Prefers sitting	While at rest (infant stops feeding) Sits upright	NA
Talks in	Sentences	Phrases	Words	NA
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Signs				
Respiratory rate Guide to respiratory rate in awake children: <u>Age Rate (breaths/min)</u> < 2 mo < 60 2–12 mo < 50 1–5 y < 40 6–8 y < 30	Increased	Increased	Often > 30 breaths/min	NA
Use of accessory muscles: suprasternal retractions	Usually not	Commonly	Usually	Paradoxical thoracoabdominal movement
Wheeze	Moderate, often only end-expiratory	Loud: throughout exhalation	Usually loud: throughout inhalation and exhalation	Absence of wheeze
Heart rate (beats/min) Guide to normal heart rate in children: <u>Age Rate (beats/min)</u> 2–12 mo < 160 1–2 y < 120 2–8 y < 110	< 100	100–200	> 120	Bradycardia
Pulsus paradoxus (mm Hg)	Absent < 10	May be present 10–25	Often present Adult: > 25 Child: 20–40	Absence suggests respiratory muscle fatigue
Functional Assessment				
PEF (% of predicted or % of personal best)	≥ 70	Approximately 40–69 or response lasts < 2 h	< 40	< 25 PEF test may not be needed during a very severe attack.
P _{aO₂} (mm Hg) on air	Normal Test not usually necessary	≥ 60 Test not usually necessary	< 60 Possible cyanosis	NA
and/or P _{CO₂} (mm Hg)	< 42 Test not usually necessary	< 42 Test not usually necessary	≥ 42 Possible respiratory failure	NA
S _{aO₂} (%) on air, at sea level	> 95 Test not usually necessary [†]	90–95 Test not usually necessary [†]	< 90 [†]	NA

* The presence of several (but not necessarily all) signs/symptoms indicates the general classification of the exacerbation. Many of these variables have not been systematically studied, especially as they correlate to each other, so they serve only as general guides. The emotional impact of asthma symptoms on the patient and family is variable but must be recognized and addressed, and can affect approaches to treatment and follow-up.

[†] Hypercapnia (hypoventilation) develops more readily in young children than in adolescents or adults.

NA = not applicable or data not available

PEF = peak expiratory flow

S_{aO₂} = arterial oxygen saturation

(Adapted from Reference 11.)

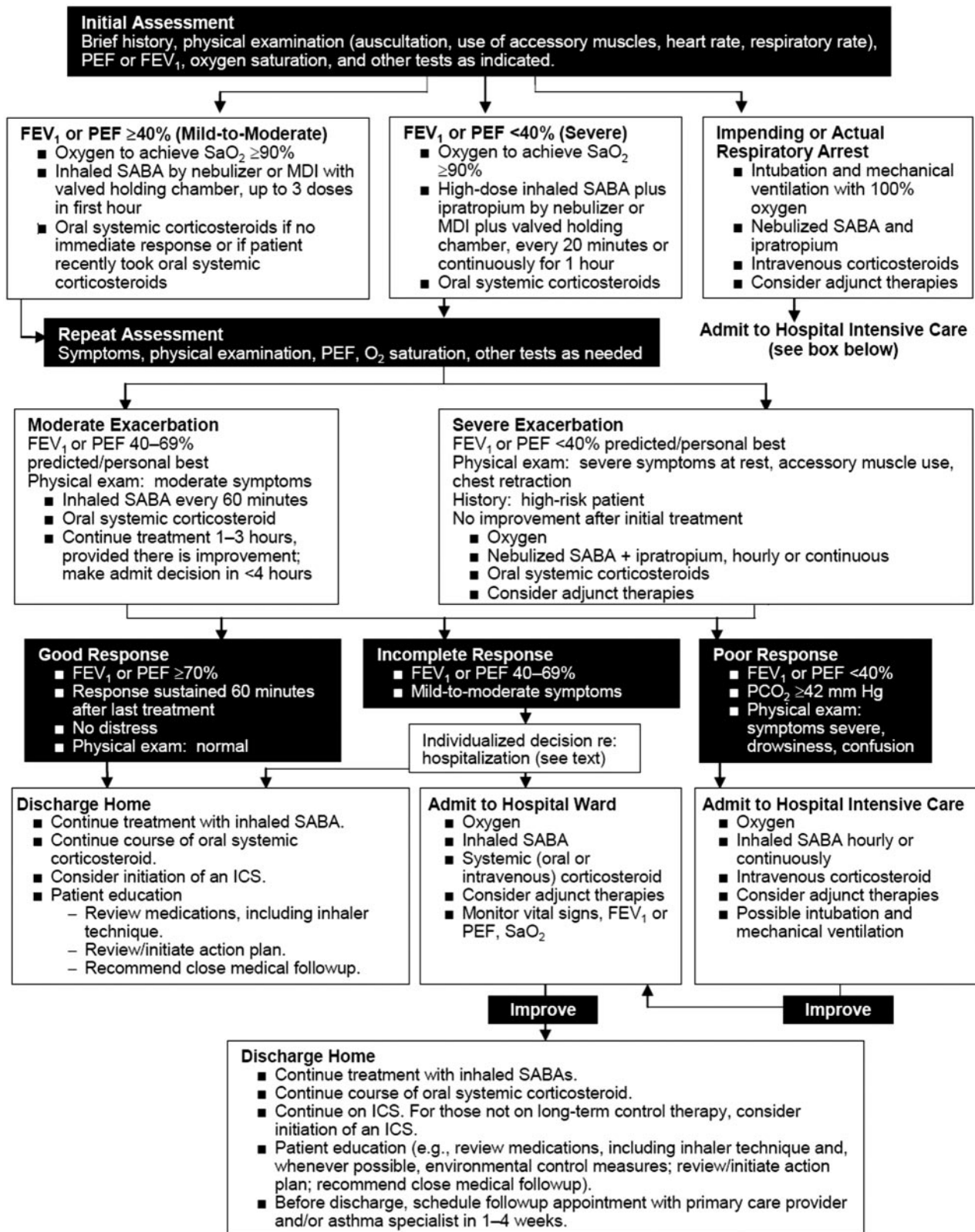


Fig. 2. Asthma exacerbation-management algorithm for the emergency department and hospital settings. (Adapted from Reference 11.)

cialty or area of care within the continuum of asthma management. The summary documents of the NAEPP guidelines¹¹ and Canadian guidelines⁴³ are the most useful and accessible resource from the point of view of the respiratory therapist. The British¹³ and Australian⁴⁴ guidelines are directed more at primary care physicians in those countries, but also provide valuable information not necessarily found in the other guidelines. The GINA guidelines¹² offer a true global perspective in their recommendations and can be generalized to many different countries and care providers.

Provision for Frequent Updating

The previous generations of asthma guidelines were prepared by their respective professional groups for publication on a particular date, with no specific plan or format for updating. Many of the updates came only when the respective group thought that a sufficient amount of information or treatment changes had developed to merit publishing a revision. The NAEPP group had empirically selected a revision frequency of 5–6 years. The latest change was that all the groups developed evidence-based guidelines, which take much longer to update. Some of the guideline groups now publish annual or biannual updates on the Web, in an abbreviated format from the original documents. This Web-based strategy may assure the timely posting of updated information and resources for all groups.

Summary

Asthma guidelines are approaching their 25th anniversary in the literature and have positively influenced the quality and outcomes of asthma care worldwide. The NAEPP guidelines¹¹ and the GINA guidelines¹² are the most frequently cited and solicited by American clinicians, and are now evidence-based and have similar frameworks, because both originated from the National Institutes of Health. Though the 5 guidelines are formatted in vastly different frameworks, they take a relatively consistent approach to diagnosis, environmental control, pharmacologic management, exacerbation management, and patient education, compared to the expert-opinion-based guidelines of the 1990s. The convenience of access to these guidelines via the Internet, and their inclusion of potentially helpful information for patients, should promote wider awareness and implementation across the continuum of asthma care.

With the emergence of the electronic age and the Internet, guideline availability and retrieval is nearly instantaneous, and access to information is nearly unlimited. Guidelines and guideline updates continue to be needed, because many patients still have uncontrolled asthma and new studies frequently produce either a new treatment or a better understanding of the current treatments.

Though asthma guidelines may not be perfect, they are the best vehicle to assist primary care physicians to provide the best possible asthma care.

REFERENCES

- Masoli M, Fabian D, Holt S, Beasley R. The global burden of asthma: executive summary of the GINA Dissemination Committee Report. *Allergy* 2004;59(5):469-478.
- Moorman JE, Rudd RA, Johnson CA, King M, Minor P, Bailey C, et al. National surveillance for asthma—United States, 1980-2004. *MMWR Surveill Summ* 2007;56(8):1-54.
- Jackson R, Feder G. Guidelines for clinical guidelines (editorial). *BMJ* 1998;317(7156):427-428.
- Hess DR. What is evidence-based medicine and why should I care? *Respir Care* 2004;49(7):730-741.
- Woolcock AJ, Rubinfeld A, Seale P. The Australian asthma management plan. *Med J Aust* 1989;151:650-653.
- Hargreave FE, Dolovich J, Newhouse MT. The assessment and treatment of asthma: a conference report. *J Allergy Clin Immunol* 1990;85(6):1098-1111.
- Expert panel report 1: guidelines for the diagnosis and management of asthma. Bethesda, Maryland: National Institutes of Health, National Asthma Education and Prevention Program; 1991. Publication No. 91-3642.
- GINA workshop report 2002: Global strategy for asthma management and prevention. NIH Publication No. 02-3659.
- Pediatric asthma: promoting best practice guidelines for managing asthma in children 1999, American Academy of Allergy Asthma & Immunology (AAAAI).
- Making a difference in the management of asthma: a guide for respiratory therapists. National Institutes of Health pub no 02-1964. Bethesda, MD, 2003.
- Expert panel report 3: guidelines for the diagnosis and management of asthma. Bethesda, Maryland: National Institutes of Health, National Asthma Education and Prevention Program; 2007. NIH Publication No. 08-4051. <http://www.nhlbi.nih.gov/guidelines/asthma/asthdn.pdf>. Accessed April 1, 2008.
- Global strategy for asthma management and prevention (updated 2006): Global Initiative for Asthma (GINA). <http://www.ginasthma.org>. Accessed March 27, 2008.
- British Guideline on the Management of Asthma: a national clinical guideline. British Thoracic Society and Scottish Intercollegiate Guidelines Network, 2007.
- Boulet LP, Becker A, Berube D, Beveridge R, Ernst P. Canadian Asthma Consensus Report, 1999. Canadian Asthma Consensus Group. *CMAJ* 1999;161(11 Suppl):S1-S61.
- Beasley R, Cushley M, Holgate ST. A self-management plan in the treatment of adult asthma. *Thorax* 1989;44:200-204.
- Yoon R, McKenzie DK, Bauman A, Miles DA. Controlled trial evaluation of an asthma program for adults. *Thorax* 1993;48(11):1110-1116.
- Comino EJ, Mitchell CA, Bauman A, Henry RL, Robertson CF, Abramson MJ, et al. Asthma management in eastern Australia. *Med J Aust* 1996;164(7):403-406.
- Adams R, Ruffin R, Wakefield M, Campbell D, Smith B. Asthma prevalence, morbidity and management practices in South Australia, 1992-1995. *Aust N Z J Med* 1997;27(6):672-679.
- Robertson C, Rubinfeld AR, Bowes G. Deaths from asthma in Victoria: a twelve-month survey. *Med J Aust* 1990;152(10):511-517.
- Rubinfeld AR, Dunt DR, McLure BG. Do patients understand asthma? A community survey of asthma knowledge. *Med J Aust* 1988;149(10):526-530.

21. Bauman A, Young L, Peat JK, Hunt J, Larkin P. Asthma under-recognition and under-treatment in an Australian community. *Aust N Z J Med* 1992;22(1):36-40.
22. Bauman A, Mitchell CA, Henry RL, Robertson CF, Abramson MJ, Comino EJ, et al. Asthma morbidity in Australia: an epidemiological study. *Med J Aust* 1992;156(12):827-831.
23. Pierce R, Irving L. The National Asthma Campaign—A measurable public health exercise. *Aust N Z J Med* 1991;2(11):4-5.
24. Comino EJ, Mitchell CA, Bauman A, Henry RL, Robertson CF, Abramson MJ, et al. Asthma management in eastern Australia, 1990 and 1993. *Med J Aust* 1996;164(7):403-406.
25. Ernst P, Fitzgerald JM, Spier S. Canadian Asthma Consensus Conference: summary of recommendations. *Can Respir J* 1996;3:101-114.
26. Guidelines for management of asthma in adults: I—chronic persistent asthma. Statement by the British Thoracic Society, Research Unit of the Royal College of Physicians of London, King's Fund Centre, National Asthma Campaign. *BMJ* 1990;301:651-653.
27. Guidelines for management of asthma in adults: II—acute severe asthma. Statement by the British Thoracic Society, Research Unit of the Royal College of Physicians of London, King's Fund Centre, National Asthma Campaign. *Br Med J* 1990;301:797-800.
28. Global strategy for asthma management and prevention. WHO/NHLBI workshop report. Lung and Blood Institute: National Institutes of Health, National Heart, Publication Number 95-3659 1995.
29. Expert panel report 2: guidelines for the diagnosis and management of asthma. Bethesda, Maryland: National Institutes of Health, National Asthma Education and Prevention Program; 1997. http://www.nhlbi.nih.gov/guidelines/archives/ep-2/asthgdln_archive.pdf. Accessed April 1, 2008.
30. Expert panel report 2: guidelines for the diagnosis and management of asthma—Update on selected topics 2002. Bethesda MD: National Institutes of Health, National Asthma Education and Prevention Program; 2003 June. NIH Publication No. 02-5074. http://www.nhlbi.nih.gov/guidelines/archives/ep-2_upd/asthmafullrpt_archive.pdf. Accessed April 1, 2008.
31. Hartert TV, Windom HH, Peebles RS Jr, Freidhoff LR, Togias A. Inadequate outpatient medical therapy for patients with asthma admitted to two urban hospitals. *Am J of Med* 1996;100(4):386-394.
32. Legorreta AP, Christian-Herman J, O'Connor RD, Hasan MM, Evans R, Leung KM. Compliance with national asthma management guidelines and specialty care: a health maintenance organization experience. *Arch Int Med* 1998;158(5):457-464.
33. Meng YY, Leung KM, Berkbigler D, Halbert RJ, Legorreta AP. Compliance with US asthma management guidelines and specialty care: a regional variation or national concern? *J Eval Clin Pract* 1999;5(2):213-221.
34. Webb LZ, Kuykendall DH, Zeiger RS, Berquist SL, Lischio D, Wilson T, Freedman C. The impact of status asthmaticus practice guidelines on patient outcome and physician behavior. *Qual Rev Bull* 1992;18(12):471-476.
35. Gibson PG, Wilson AJ. The use of continuous quality improvement methods to implement practice guidelines in asthma. *J Qual Clin Pract* 1996;16(2):87-102.
36. Crim C. Clinical practice guidelines vs actual clinical practice: the asthma paradigm. *Chest* 2000;118(2 Suppl):62S-64S.
37. Powell CV, Maskell GR, Marks MK, South M, Robertson CF. Successful implementation of spacer treatment guideline for acute asthma. *Arch Dis Child* 2001;84(2):142-146.
38. Ruoff G. Effects of flow sheet implementation on physician performance in the management of asthmatic patients. *Fam Med* 2002;34(7):514-517.
39. Lesho EP, Myers CP, Ott M, Winslow C, Brown JE. Do clinical practice guidelines improve processes or outcomes in primary care? *Mil Med* 2005;170(3):243-246.
40. Carlton BG, Lucas DO, Ellis EF, Conboy-Ellis K, Shoheiber O, Stempel DA. The status of asthma control and asthma prescribing practices in the United States: results of a large prospective asthma control survey of primary care practices. *J Asthma* 2005;42(7):529-535.
41. Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, et al. Grading quality of evidence and strength of recommendations. *BMJ* 2004;328(7454):1490.
42. Price D, Thomas M. Breaking new ground: challenging existing asthma guidelines. *BMC Pulm Med* 2006;6(Suppl 1):S6.
43. Summary of recommendations from the Canadian Asthma Consensus Guidelines, 2003 and Canadian Pediatric Asthma Consensus Guidelines, 2003 (updated to December 2004). *CMAJ* 2005;173(6 Suppl):S1-S56.
44. Best practice evidence-based guideline: the diagnosis and treatment of adult asthma. New Zealand Guidelines Group. September 2002.
45. Jadad AR, Moher M, Browman GP, Booker L, Sigouin C, Fuentes M, Stevens R. Systematic reviews and meta-analyses on treatment of asthma: critical evaluation. *BMJ* 2000;320(7234):537-540.
46. Bjermer L. Evidence-based recommendations or "Show me the patients selected and I will tell you the results". *Respir Med* 2006;100(Suppl 1):S17-S21.
47. Benson K, Hartz AJ. A comparison of observational studies and randomized, controlled trials. *Am J Ophthalmol* 2000;130(5):688.
48. Concato J, Shah N, Horwitz RI. Randomized, controlled trials, observational studies, and the hierarchy of research designs. *N Engl J Med* 2000;342(25):1887-1892.
49. Roland M, Torgerson DJ. What are pragmatic trials? *BMJ* 1998;316(7127):285.
50. Roche N, Godard P. Control and severity: complementary approaches to asthma management. *Allergy* 2007;62(2):116-119.

Discussion

Enright: Probably the weakest aspect of the guidelines for asthma and COPD [chronic obstructive pulmonary disease] is that the diagnosis recommendations are not evidence-based. The ATS/ERS [American Thoracic Society and European Respiratory Society] 2005 pulmonary function group,

which worked for 3 years, did not even attempt to assign evidence grades for their diagnosis scheme, so I resigned from the committee and asked that my name be taken off of the Italian scheme for interpreting lung function.

The NAEPP asthma guidelines and GINA guidelines do grade the evidence, and that's certainly a massive step forward, but another step needs to be taken

for both COPD and asthma guidelines, and it is well-stated in the ATS evidence-grading recommendations.¹

After grading the evidence, we should consider the cost, the inconvenience, and temporary and permanent adverse effects of the recommendations. That will take a lot of time, expertise, and dedication. For example, there is grade A evidence that prednisone

treats asthma wonderfully, but should everyone who has asthma be taking prednisone? No. Another example is bronchial thermoplasty. Maybe 5 years from now there'll be grade B evidence that it works wonderfully for a small subset of patients with asthma, but it's going to be very expensive and the adverse effects will probably be severe. This is an additional layer of considering evidence that has not yet been undertaken by the NAEPP group.

1. Schunemann HJ, Jaeschke R, Cook DJ, Briar WF, El-Solh AA, Ernst A, et al. ATS Documents Development and Implementation Committee. An official ATS statement: grading the quality of evidence and strength of recommendations in ATS guidelines and recommendations. *Am J Respir Crit Care Med* 2006;174(5):605-614.

Myers: I think the take-home message is that grading the evidence is just the first step. We shouldn't be discouraged by evidence grades of C or D; they just identify gaps in the evidence and questions on which we need randomized controlled trials. I don't look at a low evidence grade as a detriment to or a negative component of the guidelines, but as a spur to thought and research to support or refute the recommendations and perhaps take a different approach. The problem is that it's kind of a "surgeon-based" approach to evidence-based medicine, in that we are not going to do something that is detrimental or even that we don't think is beneficial to the patient just to get the level of evidence up.

Enright: You are a bit more optimistic than I am, because identifying and recognizing important gaps in the evidence doesn't mean the research is going to get funded. The professional societies are not set up to fill those evidence gaps, and the NHLBI [National Heart, Lung, and Blood Institute] is very slow to do so.

Rubin:* Tim mentioned the superb 1999 Canadian guidelines,¹ which were certainly well in advance of others. That was during the time that the Medical Research Council was being reorganized into the Canadian Institutes of Health Research (CIHR), which is similar to the NIH [National Institutes of Health]. One of the things the guidelines committee was charged with was specifically developing recommendations for further studies and further funding, to help guide the CIHR. The CIHR listened and were responsive to those guidelines, and used them to consider study proposals. So it was a nice interaction. Perhaps we should be thinking the same way, just as optimistically, if we can identify in these papers, in meetings like this, and in guidelines where data are lacking and why it's important that we develop it. I think we might be able to influence some of the funding agencies. The voice will be loud enough.

1. Becker A, Lemiere C, Berube D, Boulet LP, Ducharme FM, FitzGerald M, Kovesi T; Asthma guidelines working group of the Canadian Network for Asthma Care. Summary of recommendations from the Canadian Asthma Consensus guidelines, 2003. *CMAJ* 2005;173(6 Suppl):S3-S11.

Stoloff:† The 1997 NAEPP asthma guidelines, which we started developing in late 1994, were as evidence-based as possible. It was the first time we had used Jadad's process to evaluate and grade the evidence. We made our recommendations based on the available studies, and knowing that in the future there would be more robust data. The robust data comes out of evidence reports—Canadian, British, American, GINA—where questions are raised within the documents that researchers both in translational and

basic sciences have identified as interesting and worth studying.

Clearly, in all these guidelines what you find when you start making a new one is the amount of literature that has come forth as a result of questions raised in the guidelines, which is one of the major reasons it's done. Tim, what to you were the striking changes between the latest version of the GINA guidelines and the NAEPP guidelines?

Myers: They are very similar. The biggest difference is that the GINA guidelines are for a global audience, because their mission is to improve asthma care all over the world, whereas the NAEPP guidelines are more specific to the United States style of asthma management, though they did incorporate recommendations and evidence from the other guidelines and from other patients. But they are similar, as are the 1999 Canadian guidelines. One difference is that they grade the evidence a little differently, which sometimes makes it difficult to compare the evidence grades between the guidelines. They are all similar with regard to the layout, the way they provide recommendations, the way they drive home key points, and where they found that the evidence wasn't strong and needed more work.

Stoloff: On the NAEPP guidelines panel we wanted to do cost/benefit analyses of all the different interests, in addition to pharmacotherapy, but the NHLBI told us very clearly that we were not allowed to comment on that. That was not the panel's purview. In the future there will be ways they approach that, but the NHLBI was appropriately concerned about how that would come out, because they are a federal agency.

Kercsmar: You mentioned that 70% of asthma care is rendered in a primary care setting. With the 1997 NAEPP guidelines the implementation didn't match the dissemination. I suspect the same thing will happen with the 2007 NAEPP guidelines. It's a very

* Bruce K Rubin MD MEng MBA FAARC, Department of Pediatrics, Wake Forest University School of Medicine, Winston Salem, North Carolina.

† Stuart W Stoloff MD, Department of Family and Community Medicine, University of Nevada, Reno, Nevada, representing Monaghan/Trudell Medical.

different paradigm; there's more emphasis on monitoring and control. There is a call for doing things that are probably beyond what can be done easily in most primary care settings.

As we've seen from the ACE [Asthma Control Evaluation] trial¹ data, asthma care and management in the hands of specialists is much more effective, even in difficult populations, where we can do this kind of care. There probably aren't enough specialists to provide that care. We have the interface with RTs, who we would like to be an adjunct to providing specialty care, and they may be a group that has the knowledge and tools to do some of this asthma management. However, how are we going to resolve this tension between evidence-based guidelines that we'd like to not only disseminate but implement in settings that may be ill-equipped to do so?

1. Inner-City Asthma Consortium. Evaluation of an asthma treatment strategy based on exhaled nitric oxide measurements in adolescents: the Asthma Control and Evaluation (ACE) trial. <http://clinicaltrials.gov>. Accessed March 20, 2008.

Myers: The 2007 NAEPP asthma guidelines are very outcomes-focused. A separate committee was spun off to look at implementing the guidelines, building on past successes, and addressing past failures.

Kallstrom: Yes, the implementation committee is a multidisciplinary group. They're trying to avoid mistakes made with the previous versions of the guidelines and to put the document in the hands of people who can really use it. It's been 10 years since we updated the NAEPP guidelines, Stuart, how do you see the next version coming forth?

Stoloff: The next? You mean after what we just did? Some individuals in the present group said that they won't be in the next group; the work load of this project is very heavy. You do this because you love it, but the workload over the three and a half years was far more than any of us anticipated. We did

not want to *rewrite* the report; we wanted to do a rapid—"rapid" in federal government terms—update, similar to the 2002 update of the NAEPP guidelines, and address a few questions that are important to certain audiences, but in a much shorter period. This piece of work was enormous. Few people in the NHLBI participated in facilitating this process; it was really the clinicians on the committee who wrote the report and did the grunt work.

I am for more concerned about implementation, because there are enormous differences between the GINA guidelines and the 2007 NAEPP guidelines. The 2007 NAEPP guidelines is the most evidence-based report ever produced on asthma. *The Lancet*,¹ on September 8th, 2007, said the 2007 NAEPP guidelines are "brilliant," and described the 1997 version as average or less. To have *The Lancet*—the British group—say that these guidelines are rigorous and meet the standards of evidenced-based medicine in an editorial listed on the cover is an enormous positive for the members of the NAEPP committee, the NHLBI, and for all of you here who contributed their hard work in basic science, translational science, and clinical science, as well as for the networks that Chris [Sorkness] is part of. The networks are a crucial means of answering important questions.

So I think that GINA pales in comparison. GINA deals with countries where the major asthma medicines might be theophylline, oral steroids, and oral bronchodilators—which none of us would use any more. GINA addresses the needs of less developed countries and does it exceedingly well, but there are important differences in how we see asthma therapy, in what role we see therapy. There's no mention of immunotherapy in GINA, whereas we considered it, or of \$12,000 medications such as Xolair. So there are enormous differences. But the concern we all have is identical: dissemination to and implementation by clinicians, and facilitating asthma co-management between specialists

and their primary-care colleagues. I think developing those "bridges" is mandatory for this document to "live."

What a guideline is: you get in your car, you turn it on. Neither the car nor you is a guideline. You drive down the road; still not a guideline. A sign says Tucson, Phoenix, Peoria; *that's* the guideline; you get to choose. You choose your direction based on your situation and the best evidence. That's what our guideline is. Our hope is to facilitate this communication. Though it's 417 pages, I think this document is actually simple. It talks about a chronic disease model, about impairment and risk, and about following patients carefully, no differently than we should do in diabetes, hypertension, hyperlipidemia, and other chronic diseases. That's the education we need to disseminate, whether you're a subspecialist or a primary-care clinician with special interest in it. RTs have a role, pharmacists have a role, medical assistants, nurses—everyone needs to be engaged in this, because so far we haven't done it well enough.

1. New guidelines for better asthma control. *Lancet* 2007;370(9590):802.

Moore: I don't think any of us have the answer for guideline implementation. That's probably a conference in and of itself. My bias, coming from the ACCP [American College of Chest Physicians], where I think we do a lot of good guidelines on other subjects—maybe one thing that's changed in the environment that—good or bad—might help is in the area of patient safety and looking at pay-for-performance initiatives. Perhaps more importantly, maintenance of certification and licensure—all of those forces are a little different than they were when we first started putting out guidelines, and they're going to force us to look at some of these measures that are done. We are going to have to start saying that if you're not following the evidence-based guidelines, you're not meeting the standard of care.