

EMERGENCY MEDICINE AND CARE

The Pediatric Asthma Control and Communication Instrument for the Emergency Department (PACCI-ED) improves physician assessment of asthma morbidity in pediatric emergency department patients

Elizabeth M. Goldberg, MD¹, Ursula Laskowski-Kos, MD², Dominic Wu, BS³, Julia Gutierrez, BS³, Andrew Bilderback, MS⁴, Sande O. Okelo, MD, PhD⁵, and Aris Garro, MD, MPH³

¹Department of Emergency Medicine, the Alpert Medical School of Brown University, Providence, RI, USA, ²Department of Emergency Medicine, Pediatric Division, Newark Beth Israel Medical Center, Newark, NJ, USA, ³Department of Emergency Medicine, Pediatric Division, the Alpert Medical School of Brown University, Providence, RI, USA, ⁴Department of Medicine, Pulmonary and Critical Care Division, Johns Hopkins University, Baltimore, MD, USA, and ⁵Department of Pediatrics, Pediatric Pulmonology Division, the David Geffen School of Medicine at UCLA, Baltimore, Maryland, USA

Abstract

Objectives: To determine whether the Pediatric Asthma Control and Communication Instrument for the Emergency Department (PACCI-ED), a 12-item questionnaire, can help ED attendings accurately assess a patient's asthma control and morbidity. **Methods:** This was a randomized-controlled trial performed at an urban pediatric ED of children aged 1–17 years presenting with an asthma exacerbation. Parents answered PACCI-ED questions about their children's asthma. Attendings were randomized to view responses to the PACCI-ED (intervention group) or to be blinded to the completed PACCI-ED (control group). The two groups were compared on their empirical clinical assessment of: (1) chronic asthma control categories, (2) asthma trajectory (stable, worsening or improving), (3) patient adherence to controller medications, and (4) burden of disease for the patient's family. The validated PACCI algorithm was used as the criterion standard for these four outcomes. Accuracy of clinical assessment was compared between intervention and control groups using chi-squared tests and an intention-to-treat approach. **Results:** Seventeen ED attendings were enrolled in the study and 77 children visits were included in the analysis. There were no significant differences between the intervention and the control groups for child's gender, age, race, and asthma characteristics. Intervention group attendings were more accurate than control group attendings in assessing the category of chronic asthma control (43% versus 19%; $p=0.03$), disease trajectory (72% versus 45%; $p=0.02$), and the disease burden for families (74% versus 35%; $p=0.001$) over the past 12 months. There was a trend towards more accuracy of intervention versus control attendings for estimating patient adherence to controller medications (72% versus 48%; $p=0.06$). **Conclusions:** The PACCI-ED improves the assessment of asthma control, trajectory, and burden by ED attendings, and may help assessment of asthma medication adherence and prior asthma exacerbations. The PACCI-ED can be used to improve provider assessment of asthma morbidity during pediatric ED visits for asthma exacerbations, and to identify children who may benefit from interventions to reduce asthma morbidity.

Keywords

Control, intervention, medication adherence, prevention, severity

History

Received 6 August 2013
Revised 19 September 2013
Accepted 20 October 2013
Published online 4 December 2013

Introduction**Background**

Asthma is the most common chronic disease among children, affecting 9.5% of children nationally [1] and resulting in 593 000 annual Emergency Department (ED) visits by children 18 and under [2]. The rate of ED visits for asthma complaints has not dropped appreciably despite many initiatives to improve asthma care [1]. Thirty percent of the

patients preferentially seek asthma care in EDs, rather than visiting a primary care provider, despite adequate insurance coverage [3,4]. Many children with asthma who use the ED are not on inhaled corticosteroids or other appropriate long-term controller medication [5,6]. Many of these patients do not follow-up appropriately with their primary care providers (PCPs) [7–10]. Therefore, ED providers are in a position to play an important role in the chronic disease management of this patient population.

Importance

ED visits for asthma are opportunities to educate patients and improve long-term disease management. Increasingly ED

Correspondence: Elizabeth M Goldberg, 55 Claverick Street, Providence, RI 02903, USA. Tel: 401-444-7975. Fax: 401-444-6662. E-mail: Elizabeth_goldberg@brown.edu

providers are recognizing the many roles they play in asthma care: communicating with primary care physicians, referring patients to asthma specialists, and prescribing asthma controller medications for children with uncontrolled asthma [11–15]. The 2007 National Asthma Education and Prevention Program guidelines published by the National Heart, Lung, and Blood Institute (NHLBI) define the clinical criteria for persistent asthma and recommend that children with persistent asthma be treated daily with long-term controller medications (e.g. inhaled corticosteroids) [16]. These guidelines, as well as the Global Initiative for Asthma (GINA) 2011 guidelines [17], recommend preventing relapse of the exacerbation or recurrence of another exacerbation by providing: (1) referral to follow-up asthma care within 1–4 weeks; (2) an ED asthma action plan provided at discharge with appropriate teaching; (3) review of inhaler techniques whenever possible; and (4) consideration of initiation of inhaled corticosteroids in the ED.

ED attendings report a belief in the efficacy and safety of long-term controller medications for children with persistent asthma [18], yet ED attendings only prescribe these medicines at 4% of ED visits for children with asthma [19]. One barrier faced by ED attendings is that they may not be facile with the guidelines used to identify children with persistent-level asthma. There is evidence that <16% of generalist physicians can correctly identify a patient's asthma severity and are unclear on how to implement treatment plans [20], and it is plausible that ED attendings may fare even worse at this task. Validated asthma assessment tools may improve provider identification of persistent asthma and facilitate more appropriate asthma care (e.g., prescribing controller medications) [21]. An asthma assessment tool that rapidly informs the provider of a patient's asthma disease status could improve providers' ability to assess asthma morbidity and thereby facilitate prescribing of long-term controller medications or other interventions to reduce asthma-related morbidity.

Goals of this investigation

The purpose of this study is to determine whether a parent-completed asthma questionnaire, the PACCI-ED, can improve the accuracy of attendings' classification of asthma disease status in the ED.

Methods

Study recruitment and setting

We performed a randomized-controlled trial by randomizing individual ED attendings to be in the intervention group (view a parent-completed PACCI-ED) or control group (no access to the PACCI-ED). A block randomization scheme with block sizes of 4 was used to randomize attendings prior to beginning the study. The study took place at Hasbro Children's Hospital, an urban, academic, tertiary care pediatric ED. The annual census for the ED is approximately 52 000 patients per year. There are approximately 1700 annual pediatric asthma visits. All attendings involved in the study were board-certified in pediatrics and pediatric emergency medicine and were not aware of the study hypotheses. Attendings provided written consent to participate in the study. The study was approved by

the Lifespan Institutional Review Board (Providence, RI). The study was registered at www.clinicaltrials.gov.

Research staff enrolled a convenience sample of patients presenting to the ED for care between April 2011 and May 2012. Research staff was available 7 d a week, 7 a.m. to midnight on weekdays and 11 a.m. to 8 p.m. on weekends. Patients were selected by screening the electronic medical record, MEDHOST, for chief complaints of wheeze, trouble breathing, cough, and related complaints. The patients and their families were then approached by the research staff for additional questioning once they were triaged to a patient care room.

A patient visit for a given attending was included in the study if the following criteria were met: (1) a child aged 1–17 years presenting with a chief complaint consistent with an asthma exacerbation, such as wheeze or trouble breathing, (2) the child had a history of asthma by parent report, and (3) the visit was believed to be consistent with an asthma exacerbation by the treating attending. Participants were excluded if the treating attending was not part of the study, the child had a major pulmonary or cardiac comorbid illness, the child's parent was non-English speaking, or if the child was triaged to the med-trauma bay for severe respiratory distress. After identification, the parent of each child provided written informed consent to participate in the study.

Instrument development and content

The PACCI has been previously validated for use in an outpatient asthma clinic and primary care offices [22,23], but has not been used in an ED setting. The PACCI is a 12-item questionnaire completed by parents of children with asthma, and requires no more than two minutes to fill out. It measures five domains of asthma health:

- (1) Current Control (referred to in this manuscript as “sub-acute control”): categories mirror NHLBI guideline categories [16] which are based on frequency of daytime symptoms, short-acting β_2 agonist use, asthma attacks, activity limitation and nocturnal symptoms
- (2) Trajectory: perceived stability, improvement or worsening of child's asthma
- (3) Risk: reports of asthma-related emergency department visits, hospitalizations, and oral steroid use
- (4) Medication adherence: frequency with which parents administer daily controller medications
- (5) Burden: how much bother or worry the child's asthma causes caregivers

Capturing these domains of asthma health in an ED setting would aid attendings in identifying children most in need for further intervention (e.g. prescription for controller medications). The PACCI-ED is adapted from the PACCI. The PACCI-ED shares the same content and conceptual domains as the PACCI. Like the PACCI, the PACCI-ED is written at a 5th grade reading level, was designed for use across diverse patient populations, and is intended to help attendings better utilize patient/parent reported information to assess asthma morbidity and to guide asthma treatment. To make the PACCI-ED appropriate for use in the ED setting, two formatting changes were made: (1) a one-year time frame is used for parents to report on trajectory, risk, and burden

items; (2) a count of risk events (0–1, 2, 3, 4, 5 or more) rather than “yes” or “no” response options is used (see Appendix). For the purpose of the current project, the risk events were combined to inform a chronic asthma control designation (controlled = 0–1 event; partly controlled = 2 events; mildly uncontrolled = 3 events; moderately uncontrolled = 4 events; severely uncontrolled = 5 or more events).

Data collection and processing

Parents of enrolled children provided demographic and clinical data about the child’s asthma. They then completed the PACCI-ED. Children who were old enough and cognitively able were allowed to assist their parents in completing the PACCI-ED. If parents had questions about the PACCI-ED, research staff was available to answer these questions, but the staff did not directly assist in completing the form. After completing the questionnaires, research staff used the guidelines on the PACCI-ED to categorize the sub-acute and chronic control category for that participant. Scoring the instrument requires no more than a minute. To score the device, one marks the box in the scoring field that corresponds to the parents’ marking that is most to the right of the page. Due to the color scaling (with more red denoting poorer control) and geographic location (the further right, the worse control) of the answer choices, it is easy to translate them into clinically relevant parameters without using calculation. This should allow busy providers to score the device without prior training and without adding much additional time to their patient assessment.

Index test

After the patient was visited and evaluated by the attending, this attending was asked to complete a standardized form (see Figure 1) to determine their empiric clinical assessment of:

- (1) the child’s chronic asthma control category,
- (2) trajectory of asthma control (stable, worsening or improving),
- (3) controller medication adherence, and
- (4) burden of disease for the patient’s family.

1. CONTROL: Which of the following best describes this patient’s asthma control over the past 12 months?

RESPONSES: Controlled, partly controlled, mildly uncontrolled, moderately uncontrolled, severely uncontrolled

2. TRAJECTORY: Which of the following best describes the changes in this patient’s asthma status over the past 12 months?

RESPONSES: No change, getting worse, getting better

3. MEDICATION ADHERENCE: In your clinical judgment, during the past week, how often does this patient use his/her daily controller asthma medicine?

RESPONSES: Not at all (0 days/week), sometimes (1–3 days/week), most of the time (4–6 days/week), all of the time (7 days/week)

4. BURDEN: Which of the following best describes how burdensome to the caregiver this patient’s asthma has been over the past 12 months?

RESPONSES: Not at all burdensome, somewhat burdensome, very burdensome

Figure 1. Questions on the Standardized Assessment Form.

The attending could use any information available to make this assessment including history of present illness, past medical history (by report or electronic medical record), physical exam, and the PACCI-ED responses. Attendings randomized to the *intervention group* could view the patient’s PACCI-ED before completing the assessment form. Attendings randomized to the *control group* could not view the PACCI-ED while completing the assessment form.

Of note, attendings in the intervention arm were told at the time of the child’s ED visit that the PACCI-ED is used to assess a child’s asthma control and medication adherence, and that they could use it to complete the outcomes assessment form. They did not receive a formal training session on PACCI-ED use and were not prompted by the research staff on specific use of the PACCI-ED to complete the questions on the clinician assessment form. Attendings in the control group had no known exposure to the PACCI-ED before or during the study.

Criterion standard

Responses on the PACCI-ED were used to put children in categories for the four major outcomes using a validated scoring system [22].

Analysis

Descriptive statistics were used to compare demographic characteristics of patients in each study arm. Chi-squared analysis was used to compare the proportions of correct classification for the four outcomes between the intervention and control groups of attendings. The index test was the empiric clinical assessment of the treating attending based on all available information (gestalt). The criterion standard was the PACCI categorization of that outcome based on the responses the parent provided. *p* Values <0.05 were considered statistically significant. Analysis followed an intention-to-treat approach, where all attendings were analyzed in the group to which they were originally assigned. This was a feasibility study and therefore power to detect clinically significant differences were reported based on the final sample size. Analyses were performed using STATA 11 (College Station, TX).

Results

Seventeen ED attendings were enrolled during the study period. There were 108 visits for asthma that were screened for inclusion in this analysis. Of these visits, 29 were excluded; 28 because the treating attending was not part of the study, and one due to inability to speak English. Prior to analysis, two more participants were excluded because of missing/incomplete demographic data. Seventy-seven children were enrolled, 40 with intervention group attendings, and 37 with control group attendings. Patients treated by intervention and control attendings did not differ statistically by sociodemographic or clinical characteristics (see Tables 1 and 2). Participants were 52% female, 60% non-white ethnicity, and had a mean age of 8 years old. In terms of asthma morbidity, a slight majority had moderate persistent (33%) or severe persistent (22%) asthma. In the prior 12 months, two-thirds of children reported at least one

other ED visit, 30% reported a hospitalization and 75% reported at least one other course of systemic steroids. Over that same period, a majority of parents reported some degree of disease burden as being either somewhat bothered (41%) or very bothered (32%) about their child's asthma, and that their child's asthma was not getting better (75%). There was a broad distribution across chronic asthma control categories, including controlled (20%), partly controlled (23%), mildly uncontrolled (20%), moderately uncontrolled (8%) and severely uncontrolled (30%).

As seen in Table 3, ED attendings in the intervention group more accurately assessed children's asthma morbidity over the prior 12 months, including chronic asthma control, disease trajectory, and disease burden ($p < 0.05$ for all comparisons).

Table 1. Demographics of child participants by treatment group.

Demographic	Control	Intervention	<i>p</i> Value
Age (SD)	8.8 (4.4)	7.4 (5)	0.2
Gender			0.9
Male	49%	48%	
Female	51%	53%	
Race/Ethnicity			0.6
White	43%	38%	
Black	16%	15%	
Hispanic	27%	18%	
Mixed or Other	14%	29%	
Parents' Education			0.4
<HS	8%	18%	
HS	49%	38%	
Some college	24%	18%	
College	19%	28%	

Table 2. Clinical characteristics of child participants by treatment group.

Clinical characteristic	Control	Intervention	<i>p</i> Value
Subacute Asthma Control (past 1–2 weeks)			0.8
Intermittent	14%	8%	
Persistent	86%	93%	
Chronic Asthma Control (past 12 months)			0.8
Controlled	5%	3%	
Partly controlled	22%	28%	
Mildly uncontrolled	14%	8%	
Moderately uncontrolled	3%	3%	
Severely uncontrolled	57%	60%	
“Risk” Events (past 12 months)			
ED Visits	68%	65%	0.8
Hospitalizations	27%	32%	0.6
Use of Systemic Steroids	68%	75%	0.5
Asthma controller medication adherence			0.9
0 days/week	22%	20%	
1–3 days/week	19%	15%	
4–6 days/week	27%	30%	
7 days/week	11%	13%	
Not prescribed	22%	23%	

Percentages may add up to more than 100% due to rounding.

There was a trend towards better assessment of medication adherence in the intervention group ($p = 0.06$). Power to detect a statistically significant result with our sample size ranged from 0.55 to 0.94, with one outlier (0.06 for correctly identifying intermittent versus persistent asthma).

Discussion

ED attendings who used the PACCI-ED, were more accurate at identifying children with uncontrolled asthma, children whose asthma was getting worse, and families that felt burdened by the child's asthma. There was also a trend towards better identification of asthma medication adherence. These findings suggest that the PACCI-ED can be a useful tool for ED attendings to identify children that may benefit from ED-based interventions, for example prescribing of asthma controller medicines, or referral to an asthma specialist. The PACCI-ED is the first instrument to be validated in the ED setting to improve the quality of asthma assessments by attendings.

Primary care offices are the most appropriate venue for chronic asthma disease management. Despite this, the reality of the current healthcare system is that many children with asthma use the ED as a substitute for primary care, or do not follow-up appropriately with primary care providers [24–27]. These children are especially vulnerable as they are less likely to have access to primary care, have worse asthma control, and are less likely to use asthma controller medications appropriately [10,26].

ED visits are an opportunity to intervene to improve asthma control and reduce disease burden in this vulnerable pediatric population. Interventions include educating families about disease management techniques, facilitating and encouraging primary care follow-up, and prescribing asthma controller medications when indicated. Primary care providers are welcoming more involvement of ED attendings in asthma prevention strategies, and ED providers recognize the need to use asthma visits as teachable moments and opportunities to intervene to reduce asthma burden for children and families [18,28].

In this study we provide a means to overcome one of the most commonly cited reasons that ED providers do not intervene: a lack of familiarity with guidelines for assessing asthma control. The PACCI-ED uses patient/caregiver-provided data and requires only a few minutes to complete, and therefore does not increase the burden on busy ED providers. Furthermore, the PACCI-ED provides an algorithm that can be used to guide appropriate interventions for a child based on the child's control category.

Our naturalistic study design allowed providers to decide to what extent they would employ the PACCI-ED in their clinical assessment of the child's asthma. Anecdotally, our

Table 3. Comparison of Attending Assessments of Children's Asthma (Intervention versus Control Group).

	Control	Intervention	<i>p</i> Value
Correctly identified level of chronic asthma control	19%	43%	0.03
Correctly identified child's asthma trajectory	45%	72%	0.02
Correctly identified level of medication adherence	48%	72%	0.06
Correctly identified degree of disease burden to the family	35%	74%	0.001

research staff noted that some providers paid close attention to the PACCI-ED answers when considering the child's disease process, while others relied on their own intuitive approach to assessing asthma. Despite these different approaches, there was a noticeable improvement in the intervention arm that can be attributed to PACCI-ED use.

Despite the improvement demonstrated by attendings using the PACCI-ED, this study highlights some important areas that need to be improved upon. For example, even with the aid of the PACCI-ED, more than half of the attendings still could not accurately assess the patient's asthma control category. It is also concerning that more than 25% of the providers who used the PACCI-ED, inaccurately assessed both controller medication adherence and whether the child's asthma was worsening. This may result in a missed teaching opportunity during the ED visit, especially because parents may be more receptive to asthma teaching when manifestations of the child's asthma are more salient. By improving awareness of poor controller medication adherence, attendings could potentially educate patients about the importance of using controller medications and identify barriers to adherence that need to be addressed. Attendings who recognize that a child's asthma is worsening may be prompted to step-up treatment, or communicate with primary care providers or asthma specialists to coordinate this effort.

Limitations

There are several limitations to our study. Because this was a feasibility study, we were limited to a small convenience sample. Sampling bias thus cannot be excluded. In addition, power to detect statistically significant differences was limited. This could have resulted in a type I error (not detecting a statistically significant difference), but this is less relevant considering we did find differences for several outcomes. The study was limited to English-speaking participants for practical reasons, and therefore the results may not apply to non-English speaking populations.

As this was a prospective study requiring participant (attending) completion of paperwork for each enrollment, it was impossible to entirely eliminate the Hawthorne effect or observation bias. However, we attempted to limit it by using a research design that required both intervention and control group attendings to be approached by research assistants to complete paperwork for the enrolled patients.

Finally, we randomized by attendings (not patients), therefore the outcomes for individual children treated by a given attending were not independent of each other. An alternative option would have been to randomize individual study patients into the intervention or control group, but this would have resulted in contamination, allowing ED attendings in the control group to become familiar with the PACCI-ED during the study. While a cluster analysis may have been more appropriate to guard against contamination within groups, the sample size for such an analysis would have been prohibitive.

Despite the limitations of a small convenience sample, the demographic characteristics of our population were similar to other populations of children visiting urban EDs for asthma (Table 1). The improved accuracy of ED attendings is

consistent over four different outcomes and provides evidence that the PACCI-ED is a useful tool for assessing asthma. We expect over time that attendings will incorporate the PACCI-ED questions into their practice and become more facile with scoring, minimizing the impact the tool will have on workflow in the busy ED setting. Further research will incorporate the PACCI-ED to guide interventions including controller medication prescriptions and improving follow-up with primary care providers or asthma specialists after ED visits.

Conclusions

In summary, the use of the PACCI-ED in the ED setting is feasible and improved physician assessment of asthma morbidity. Using the PACCI-ED has the potential to standardize assessment of asthma control and medication adherence, and improve ED-based interventions for children at high risk for asthma-related morbidity.

Declaration of interest

The authors have nothing to disclose.

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Appendix

Contains PACCL-ED form, ED Clinician Asthma Assessment and Treatment Plan, ED Sociodemographics & Clinical History Form, Asthma Inhaler Identification Tool for Parents.

Pediatric Asthma Control & Communication Instrument for Emergency Department

Asthma also includes reactive airway disease, regular coughing, wheezing, or difficulty breathing with or without colds.

Your child's name: _____

Today's Date: _____

When was your child's last asthma visit? _____ If your child has never had an asthma visit, check here: ☐

Please check ☒ one answer for each of the following questions. Your answers will help your doctor give you the best asthma care.

Questions 1–5 ask about how your child's asthma has been over the past 12 months, not just today. If your child has had asthma for less than 12 months, then think about how things have been since he/she started having breathing problems.

Over the past 12 months

1. How has your child's asthma been? Getting Staying Getting



Getting Better



Staying The Same



Getting Worse

Over the past 12 months

2. How much have you been bothered by your child's asthma?



Not Bothered



Somewhat Bothered



Very Bothered

Over the past 12 months

Before today

3. How many times has your child been to the **emergency room** for asthma?



0–1



2



3



4



≥5

4. How many times has your child been **hospitalized** for asthma?



0–1



2



3



4



≥5

5. How many times has your child used **an oral steroid** (Orapred, steroid pill, steroid liquid or steroid syrup) for asthma? Don't include today.



0–1



2



3



4



≥5

FOR CLINICIAN USE ONLY:

Control Assignment: Assign patient's chronic level of asthma control by looking at the box checked *farthest to the right* on questions 3–5 and match the box color to the level of asthma control in this section.

Chronic Asthma Control Classification

Controlled

Partly Controlled

Mildly Uncontrolled

Moderately Uncontrolled

Severely Uncontrolled



PLEASE TURN OVER

Take Medicine

6. How often do you give your child's <u>daily</u> asthma medicine when he/she feels fine?	My child is not supposed to take a daily asthma	All of the time 5-7 days/week	Most of the time 3-4 days/week	Some of the time 1-2 days/week	None of the time
Daily asthma medicines include: Aerobid, Advair, Asmanex, Azmacort, Budesonide, Flovent, QVAR, Pulmicort, Singulair, Symbicort					

FOR CLINICIAN USE: If any of the answers farthest To the right or in red  are selected, this may be consistent with poorly controlled and/or undertreated asthma. Further assessment and follow-up in 2-6 weeks is recommended.

Sub-Acute Asthma symptoms.

These questions are about your child's recent asthma

Asthma Symptoms

7. Over the past week, how many days has your child had asthma symptoms?
For example:

*Cough *Chest tightness, *Shortness of breath, *Sputum (spit, mucous, phlegm when coughing), *Difficulty taking a deep breath, *Wheezy or whistling sound in the chest

Days					
0	1-2	3-6	Every day (not all day long)	Every day (all day long)	
					

Reliever Use

8. Over the past week, how many days have you had to give your child medicine to quickly relieve asthma symptoms? For example: *Albuterol/Proventil/Proair/Ventolin/Xopenex via Inhaler/Spray/Pump or Machine/Nebulizer

Days					
0	1-2	3-6	Every day (not all day long)	Every day (all day long)	
					

Attacks

9. Over the past week, how many days did your child have an asthma attack?
For example: *When it is harder for your child to breathe*When you give your child more quick-relief asthma medicine (e.g., Albuterol)

*When the asthma medicine does not work

Days					
0	1	2-3	4-7		
					

Activity Limitation

10. Over the past week, how much has asthma limited your child's activities?

Not at all	Slightly	Moderately	Very much	Completely
				

Nighttime Symptoms

11. Over the past TWO weeks, how many nights did your child's asthma keep your child from sleeping or wake him/her up?
12. Please write down any concerns or anything else you would like your doctor to know about your child's asthma.

8–14

3–7

2

1

0

PLEASE GIVE THIS TO YOUR PROVIDER. THANK YOU!

FOR CLINICIAN USE ONLY:

Control/Severity Assignment: Assign patient's current level of asthma control by looking at the box checked farthest to the right on questions 7–11 and match the box color to the level of asthma control in this section

Sub-Acute Asthma Severity/Control Classification

Controlled/
Intermittent

Partly Controlled/
Mild Persistent

Uncontrolled/
Moderate

Poorly
Controlled/Severe

*Percentages may add up to more than 100% due to rounding.