

Validation of a β -agonist long-term asthma control scale derived from computerized pharmacy data

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Background: Asthma control has been defined clinically by using validated tools, but an asthma control scale using administrative data has not been reported.

Objective: We sought to validate a β -agonist asthma control scale derived from administrative data.

Methods: Surveys that included validated asthma symptom and control tools were completed by a random sample of 2250 health maintenance organization members aged 18 to 56 years with persistent asthma. Linked computerized pharmacy data provided β -agonist canister and oral corticosteroid dispensings. The proposed 4-level asthma control scale was based on the number of short-acting β -agonist canisters dispensed in 12 months. Construct validity and predictive validity were assessed.

Results: For construct validity, factor analysis showed significant loading of the β -agonist scale on the symptom control factor, and the β -agonist scale was significantly related to the validated asthma control and symptom scales ($r = 0.31$, $P < .0001$). For predictive validity, each progressive level of the proposed β -agonist control scale was associated with an increased risk of subsequent asthma hospitalizations or emergency department visits and oral corticosteroid use, independent of prior use.

Conclusion: A scale based on the number of β -agonists dispensed in a 1-year period and derived from administrative data reflects asthma symptom control over that period of time. This scale can help identify patients who are at risk for future acute asthma health care use.

Clinical implications: This information can be used in population management and by clinicians to assess long-term asthma control and identify patients who need intervention to prevent future morbidity. (J Allergy Clin Immunol 2006;117:1053-1060.)

Key words: Asthma, asthma control, β -agonists, administrative data, asthma population management

In 1991, the National Asthma Education and Prevention Program Expert Panel Report introduced an asthma severity classification based on symptoms and pulmonary function for use in guiding the therapy of patients not receiving prophylactic therapy.¹ Since then, it has become clear that asthma severity and asthma control are 2 related but separable concepts that can become particularly confused in treated patients.² Asthma severity is the inherent biologic intensity of the disease. Asthma control can be defined as the degree to which the clinical manifestations of asthma have been mitigated and the goals of asthma therapy have been achieved. Asthma control is being increasingly considered of more clinical importance than asthma severity, and several validated questionnaire tools have been developed to measure short-term asthma control.³⁻⁵

Administrative data are being increasingly used for risk stratification,⁶ identification of patients for targeted intervention,⁷ and assessment of the quality of care in populations of asthmatic patients.^{8,9} No validated administrative measure of asthma control has been reported.

We administered surveys to a random sample of adult asthmatic patients enrolled in the Kaiser Permanente Health Care Program.¹⁰ These surveys included validated asthma symptom, control, and quality-of-life tools and a history of acute exacerbations requiring emergency hospital care or oral corticosteroids. This study identified 4 asthma-related factors that reflected patients' asthma experiences: symptom control, symptom bother, activity limitation, and acute episodes. The purpose of this study is to use these surveys, linked to administrative pharmacy data for these patients, to develop and validate a long-term asthma control scale based on β -agonist canister dispensings in a 12-month period, and to assess the predictive

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Abbreviations used

AOMS: Asthma Outcomes Monitoring System
 AQLQ: Mini Asthma Quality of Life Questionnaire
 ATAQ: Asthma Therapy Assessment Questionnaire
 ED: Emergency department
 HEDIS: Health Plan Employer Data and Information Set

validity of this scale for subsequent exacerbations in a separate and larger database.

METHODS

There are 2 broad types of validity that can be empirically tested: construct validity and criterion validity (divided into concurrent and predictive validity).¹¹ *Concurrent criterion validity* requires the existence of another measure of the same attribute. Because no validated measure of long-term control exists, concurrent criterion validity cannot be tested for the β -agonist scale. This study did test the other 2 types of validity: construct validity and predictive validity. *Construct validity* is the relationship of the measure to information (constructs) that it does not measure directly but to which it should be related. The construct validity sample was chosen because information was available for this sample regarding important hypothetically related and validated patient-reported constructs, such as short-term control, quality of life, and symptom severity, as well as a history of unscheduled visits and oral steroid use. The second type of validity tested was *predictive validity*, the ability of a tool to predict subsequent events to which it should be related. In this case it is the ability of the β -agonist scale to predict subsequent acute episodes requiring an emergency department (ED) visit, hospitalization, or oral steroids. A larger general population of asthmatic patients was chosen to be the predictive validity sample to increase the power of the analyses and the generalizability of the results.

Patients

Construct validity sample. Surveys were sent in August 2000 to a random sample of Kaiser-Permanente Medical Care Program adult members aged 18 to 56 years from the Northern California ($n = 3072$), Northwest ($n = 543$), and Southern California ($n = 3251$) regions who were given diagnoses of persistent asthma during 1999 based on the presence of one or more of the following National Committee for Quality Assurance Health Plan Employer Data and Information Set (HEDIS)⁸ administrative database criteria: (1) 4 or more asthma medication dispensings, (2) 1 or more ED visits or hospitalizations with a principal diagnosis of asthma, or (3) 4 or more asthma outpatient visits with 2 or more asthma medication dispensings. The upper age of 56 years was chosen to reduce the inclusion of patients with primarily chronic obstructive pulmonary disease, as is done in the HEDIS population.⁸ Completed surveys were returned between August and October 2000 from 4175 (61%) members, of whom 3765 (90%) answered yes to the question, "Have you ever been told by a doctor that you have asthma?" Of these patients, computerized pharmacy information was available for the 2269 subjects of this report who met the above criteria for active asthma in 2000 and who were continuously enrolled in 2000 and 2001. The study was approved by the Northern California, Northwest, and Southern California Regional Kaiser-Permanente Institutional Review Boards.

Predictive validity sample. The patients for the predictive validity testing were obtained from the membership of the Southern

California Kaiser Permanente asthma database.⁹ This database makes use of administrative data to define patients as having asthma if they meet one or more of the following criteria in the prior 12-month period: (1) a hospital discharge diagnosis (principal or other diagnosis) of asthma (ICD-9 code: 493.xx); (2) 2 or more dispensings of any combination of inhaled β -agonists, inhaled steroids, other inhaled anti-inflammatory drugs, theophylline, and oral leukotriene modifiers; or (3) an ED or regular clinic visit for asthma.

This algorithm is based on the evidence that identifying physician-diagnosed asthma is a valid way to identify asthmatic patients in epidemiologic studies.¹² Physician-diagnosed asthma is captured explicitly with criteria 1 and 3 and implicitly with criterion 2.

Subjects in the testing set were patients aged 18 to 56 years (to conform to the National Committee for Quality Assurance HEDIS adult population) who were included in the asthma database on the basis of the aforementioned criteria during both 2002 and 2003. This cohort would include patients with either intermittent or persistent asthma.

Survey information

The survey for the construct validity cohort included information regarding age, sex, race-ethnicity, education (expressed as a 6-point scale from eighth grade or less to a postgraduate or professional degree), annual household income (expressed as a 7-point scale from less than \$10,000 to more than \$50,000), and smoking.

The survey for the construct validity cohort included 3 validated asthma tools. The first tool was the Asthma Therapy Assessment Questionnaire (ATAQ),³ a validated asthma control tool that has 5 levels corresponding to 0 to 4 asthma control problems, as assessed over the prior 4 weeks. Higher values indicate poorer asthma control. This questionnaire does ask about maximum daily β -agonist use over the prior month.

The second tool was the Mini Asthma Quality of Life Questionnaire (AQLQ),¹³ a disease-specific quality-of-life questionnaire with a 2-week window in which higher scores indicate better quality of life. This tool does not include questions regarding β -agonist use.

The final tool was the Asthma Outcomes Monitoring System (AOMS),¹⁴ a symptom intensity scale that is assessed relative to the prior 4 weeks. This scale has 4 levels that are meant to be analogous to the National Asthma Education and Prevention Program symptom-derived severity levels of intermittent, mild persistent, moderate persistent, and severe persistent. This scale does not ask about β -agonist use.

The survey for the construct validity sample also included questions regarding asthma hospitalizations in the past year, unscheduled ED or clinic visits for asthma in the past year, and a history of oral corticosteroid use for asthma in the past year.

Health care utilization information

Construct validity sample. Survey records were matched by using a unique medical record number to year 2000 computerized pharmacy records. These data included canisters of short-acting β -agonists and dispensings of oral corticosteroids. Nineteen subjects were excluded because no dispensings of short-acting β -agonists, inhaled corticosteroids, or oral corticosteroids during 2000 suggested they might not have obtained their prescriptions from a Kaiser pharmacy. This produced a final sample of 2250.

Predictive validity sample. The database included year 2002 and year 2003 canisters of β -agonists dispensed and dispensings of oral corticosteroids. This database also included the number of ED visits and hospitalizations for asthma during 2002 and 2003. Asthma ED visits and hospitalizations were combined into the single outcome of emergency hospital care for asthma, defined as at least one hospitalization or ED visit for asthma (ICD-9 code 493.xx), expressed as a yes-no variable.

TABLE I. Definition and distribution of the β -agonist asthma control scale in the 2 samples

Level	β -Agonist canisters per year	Implied number of puffs of albuterol per day*	Percent in sample	
			Construct validity sample (n = 2250)	Predictive validity sample (n = 62,369)
1	0-2	≤ 1	19.6	71.7
2	3-6	2-3	26.1	17.1
3	7-12	4-7	26.3	7.1
4	>12	≥ 8	28.0	4.1

*Calculations assume 200 puffs per canister and that all medication is used.

Proposed asthma control scale

The 4-level control scale was based on the number of canisters of short-acting β -agonists dispensed in 1 year. We reasoned that this would be a good surrogate for control because β -agonist use is a component of the National Asthma Education and Prevention Program asthma severity classification in untreated patients¹ and of all 3 validated short-term asthma control tools.³⁻⁵ Based on 200 puffs per canister of albuterol, the specific category cutoff points were chosen to approximate 1 or fewer puffs daily (0-2 canisters per year), 2 to 3 puffs daily (3-6 canisters per year), 4 to 7 puffs daily (7-12 canisters per year), and 8 or more puffs daily (>12 canisters per year; Table I). This face validity approach to scale cutoff points was believed to be more generalizable than data-derived cutoff points, and a 4-level scale was chosen (vs fewer or more levels) as a balance between good precision and simplicity.

Factor analysis (construct validity sample)

Factor analysis was performed by means of principal component analysis followed by varimax rotation using 53 items from the survey, as previously described,¹⁰ with the addition of the β -agonist scale derived from year 2000 administrative data and the dispensings of oral corticosteroids from year 2000 administrative data (55 total items). Factor analysis was performed on 1721 participants because of missing data on one or more of the 55 variables for 529 patients. Four factors were chosen for the rotation based on our prior analysis of asthma factors.¹⁰ We hypothesized that the β -agonist scale would load on the symptom control factor and oral corticosteroid use would load on the acute exacerbation factor.

Construct validity

It was hypothesized that the β -agonist scale, as a long-term control measure, would be significantly related to short-term asthma control, as measured by the ATAQ questionnaire and other validated scales or subscales that loaded on the symptom control factor. This hypothesis was tested by assessing the relationship of the β -agonist measure to these scales. Although not directly a measure of symptom bother, activity limitation, or acute exacerbation history, it was hypothesized that lower β -agonist use would be related to less symptom bother, less activity limitation, and a history of fewer exacerbations. These hypotheses were tested by assessing the correlations of the β -agonist measure with these factors.

Predictive validity

Predictive validity was assessed by determining the independent relationships between the β -agonist scale measured in 2002 and subsequent (year 2003) acute exacerbations, defined as emergency hospital care or any oral corticosteroid dispensing, adjusting for baseline use.

TABLE II. Characteristics of construct validity and predictive validity samples*

Characteristic	Construct validity	Predictive validity
Source	Random sample from Northwest, Northern California, and Southern California HEDIS population	Southern California Asthma Database
No.	2250	62,369
Severity characteristics	Persistent	Intermittent and persistent
Years followed	2000-2001	2002-2003
Age		
Range	18-56	18-56
Median	44.0	42.0
Mean $\pm$ SD	42.2 $\pm$ 9.8	40.0 $\pm$ 11.4
Female sex (%)	65.2	64.4
Current smoking (%)	10.1	
Race (%)		
White	59.1	
Black	10.9	
Hispanic	13.6	
Other	10.6	
Unknown	5.8	
Education (%)		
Eighth grade or less	0.9	
Some high school or technical school	4.4	
High school or technical school graduate	17.2	
Some college	31.5	
College graduate	21.0	
Postgraduate	15.3	
Unknown	9.7	
Annual household income (%)		
<\$10,000	2.9	
\$10,000-14,999	2.1	
\$15,000-19,999	2.7	
\$20,000-24,999	3.7	
\$25,000-34,999	7.4	
\$35,000-49,999	15.6	
>\$50,000	46.4	
Unknown	19.2	

*Demographic information was not available for the predictive validity sample because only administrative data were available for these patients.

Data analysis

Spearman correlation coefficients were used to assess relationships between the β -agonist scale and construct measures as continuous variables. Kruskal-Wallis tests were used to compare mean values of the short-term asthma control measures at each level of the β -agonist scale, and hypothesis testing comparing values of asthma control measures at 2 adjacent β -agonist scale levels to each other was done by means of Wilcoxon testing. The χ^2 test was used to assess the univariate relationships between year 2002 β -agonist scale categories and year 2003 emergency hospital care and oral corticosteroid dispensings. Multiple logistic regression was used to determine the independent relationships between the year 2002 β -agonist scale categories and year 2003 emergency hospital care and oral corticosteroid

TABLE III. Loading* of the β -agonist scale on factors reflecting domains of the subjective asthma experience in the construct validity sample (n = 2250)

Scales	Observed asthma factors			
	Symptom control	Symptom bother	Physical activity	Acute exacerbations
β -Agonist scale†	0.45	−0.06	0.04	0.13
ATAQ	0.76	−0.19	−0.25	0.20
AOMS	0.79	−0.14	−0.19	0.01
AQLQ—symptoms	− 0.73	0.47	0.31	−0.08
AQLQ—emotion	− 0.48	0.72	0.17	−0.06
AQLQ—environment	−0.14	0.83	0.30	−0.13
AQLQ—activity	−0.33	0.36	0.74	−0.09
Any hospitalization in past year	0.10	−0.06	−0.11	0.43
No. of unscheduled visits past year	0.22	−0.13	−0.22	0.52
Any oral steroids used in past year: questionnaire	0.04	−0.05	−0.05	0.87
Any oral steroids dispensed in past year: electronic data	0.14	−0.03	−0.12	0.48

*Significant loading is considered to be greater than 0.40 and is shown in bold.

†See Table I.

TABLE IV. Relationships of the β -agonist scale to short-term measures of asthma symptom control in the construct validity sample (n = 2250)

Scale	β-Agonist scale level				r Correlation†
	1 (n = 441)	2 (n = 587)	3 (n = 591)	4 (n = 631)	
	Mean (SD) of each scale at each level*				
ATAQ‡	0.69 (0.96)	1.03 (1.06)	1.33 (1.18)	1.70 (1.23)	0.31
AQLQ—symptoms§	5.32 (1.30)	4.80 (1.37)	4.54 (1.33)	4.16 (1.37)	−0.29
AQLQ—emotions§	5.21 (1.57)	4.60 (1.69)	4.24 (1.74)	3.75 (1.72)	−0.29
AOMS‡	2.33 (1.10)	2.68 (1.11)	3.00 (1.01)	3.29 (0.94)	0.31

*All $P < .0001$ (Kruskal-Wallis); all adjacent pairwise comparisons, $P < .001$ (Wilcoxon).

† $P < .0001$ (Spearman).

‡Higher scores indicate more impairment.

§Higher scores indicate less impairment.

dispensings (both outcomes as yes or no variables) adjusted for year 2002 use. Nominal statistical significance was set at a P value of less than .05. All analyses were performed with SAS statistical software (SAS Version 8.2 for Windows; SAS Institute Inc, Cary, NC).

RESULTS

Available characteristics of the 2 samples are shown in Table II. The majority of the patients in the construct validity sample were white, female, well educated (at least some college), nonpoor (annual income >\$35,000), and nonsmokers (Table II). Such information was not available for the predictive validity sample because only administrative data were available for these patients.

The numbers of patients in each β -agonist category in each of the cohorts are shown in Table I. Consistent with the persistent asthma of the construct validity sample, a much higher proportion of patients were in levels 2 to 4 compared with the more general population of asthmatic patients in the predictive validity sample.

Construct validity

As we found in our previous factor analysis,¹⁰ the current factor analysis resulted in 4 primary asthma factors

that appeared to reflect symptom control, symptom bother, physical activity, and acute exacerbations. The β -agonist measure loaded significantly on the symptom control factor, as predicted (Table III). Also as predicted, the use of oral corticosteroids from administrative data loaded on the acute exacerbation factor, on which a history of hospitalizations, unscheduled visits, and oral corticosteroid use from the survey data loaded as well.

The β -agonist scale was significantly ($P < .0001$) but modestly ($r = 0.31$) related to the ATAQ short-term asthma control scale (Table IV). The β -agonist scale was also significantly ($P < .0001$) related to other scales (AOMS) or subscales (AQLQ—symptoms and AQLQ—emotions) that loaded on the symptom control factor, with significant differences ($P < .001$) between asthma control scale values at each adjacent β -agonist scale level (Table IV). The relationships to measures of other asthma factors were less strong but significant ($P < .0001$) and in the predicted directions (symptom bother [AQLQ—environment], $r = -0.09$; physical activity [AQLQ—activity], $r = -0.18$; acute exacerbations as defined by number of oral corticosteroid dispensings from electronic data, $r = 0.14$; and acute exacerbations as defined by number of unscheduled visits from the survey, $r = 0.11$).

Predictive validity

The β -agonist scale derived from year 2002 data in the predictive validity sample was linearly related ($P < .0001$, χ^2 test for trend) to asthma hospitalizations or ED visits and to oral corticosteroid dispensings in the year 2003 (Table V). Differences in this sample were significant between all levels of the β -agonist scale but were most pronounced between levels 1 and 2 and between levels 3 and 4. These relationships remained significant after adjusting for year 2002 hospital or corticosteroid use (Table V).

DISCUSSION

Asthma severity and asthma control are 2 related but separate constructs.² A severity assessment scale based on symptoms and pulmonary function can be important in initiating therapy,¹ but the same scale without considering therapy cannot be used to assess severity in treated patients.² Moreover, recent studies emphasize that assessing asthma control is the most important parameter in treated patients because the goal of therapy is asthma control, and asthma control can be achieved in the majority of patients.¹⁵ Asthma control can be defined clinically based on the accomplishment of guideline goals of asthma therapy¹⁵ or by using validated questionnaires.³⁻⁵ However, managing large populations and assessing quality of care often involve use of administrative data. Thus we believed it was important to validate a simple measure of asthma control derived from administrative data. This study supports the hypothesis that β -agonist dispensings over a 1-year period of time reflects long-term asthma control.

Construct validity of the β -agonist control scale was demonstrated by the relationship between the β -agonist measure and previously defined factors that reflect the asthma experience.¹⁰ Factor analysis confirmed that the β -agonist measure reflected the symptom control domain, with minimal loading on the other asthma factors (Table III). The strongest relationships to the β -agonist long-term control scale were with the validated measure of short-term asthma control (ATAQ) and with those tools that reflect the same symptom control factor (AQLQ symptom and emotion subscales and AOMS). The modest significant correlations observed ($r = -0.29$ or 0.31) and the ability of the β -agonist measure to discriminate between levels of the previously validated scales (Table IV) support the use of this administrative β -agonist measure to reflect long-term clinical symptom control. As predicted, better controlled asthma was inversely associated with symptom bother and activity limitation, and more poorly controlled asthma was directly associated with acute exacerbations. However, consistent with the observation that these represent different domains than asthma symptom control,¹⁰ these correlations were smaller in magnitude (absolute values 0.09-0.18) than the correlations with the symptom control measures (-0.29 or 0.31 , Table IV).

The correlation between the β -agonist scale and the short-term asthma control measures was probably not stronger primarily because of the different time frames

TABLE V. Relationship of the year 2002 β -agonist scale to year 2003 hospitalization or ED visits or requirement for oral corticosteroids, univariate and adjusted for year 2002 use, in the predictive validity cohort ($n = 62,369$)

β -Agonist scale level	Hospitalization/ED visit		Any oral corticosteroid dispensing	
	Percent*	OR (95% CI)†	%*	OR (95% CI)‡
1	2.4	Reference	19.2	Reference
2	5.0	2.1 (1.9-2.2)	32.8	2.3 (2.2-2.4)
3	7.0	2.9 (2.6-3.2)	37.3	2.9 (2.7-3.0)
4	13.1	4.6 (4.1-5.2)	48.1	4.1 (3.8-4.4)

OR, Odds ratio.

*Univariate results; χ^2 test for trend = $P < .0001$; χ^2 between each adjacent level = $P < .0001$.

†Adjusted for any year 2002 hospitalization or ED visit.

‡Adjusted for any year 2002 oral corticosteroid dispensing.

being assessed. The validated tools reflected a 2- to 4-week window, whereas the β -agonist use was over a 1-year time period. Thus we believe it is appropriate to label the β -agonist scale a measure of long-term control as opposed to the short-term control measured by the validated symptom control tools. However, additional reasons for discordance between the β -agonist scale and symptom measures include patients who choose not to treat their symptoms or patients who do not perceive them well.¹⁶ The current data do not allow us to know how much of the discordance is due to the latter factors, but our clinical experience suggests that such patients are uncommon. The β -agonist control measure itself also does not differentiate mild disease requiring little medication for control from more severe but well controlled disease, although measures of controller use from administrative data would help make that differentiation if it was necessary to do so. This would be analogous to the Global Initiative for Asthma classification¹⁷ that incorporates both clinical measures of control (symptoms and pulmonary function) and treatment intensity to define severity in treated patients.

Another validation technique used was predictive validity. A valid control scale would be expected to relate to subsequent acute exacerbations, as measured on the basis of emergency hospital or oral corticosteroid use, and such relationships were demonstrated in this study independent of prior use (Table IV). This is consistent with prior studies showing that the ATAQ asthma control scale predicts subsequent emergency hospital care¹⁸ and requirement for oral corticosteroids¹⁹ above and beyond the effects of prior use. This is also consistent with several prior studies using administrative data that have associated the number of β -agonist canisters dispensed with subsequent health care use²⁰⁻²² and our own prior study of potential asthma quality measures,⁹ in which one cutoff level of β -agonist canister dispensings (≥ 6) was associated with increased subsequent emergency hospital care. The current study extends these findings by defining a 4-level β -agonist variable derived from administrative data that is incrementally related at each level to poorer asthma control, as assessed

by validated patient-centered tools, and to increased subsequent health care utilization. The differences between the risks at each scale level were significant, but the biggest incremental differences in risks were observed between levels 1 and 2 and between levels 3 and 4.

Based on the guideline-defined goals of asthma therapy,¹ comprehensive asthma control involves prevention of symptoms, activity limitation, and exacerbations and maintenance of optimal pulmonary function. Prior data^{23,24} and the current factor analysis suggest that these elements of asthma control might function as separate domains that might not correlate well with each other. The current study shows that administrative data can be used to assess 2 of these domains of asthma control: symptoms, as reflected by β -agonist canister dispensings, and exacerbations, as reflected by hospitalizations, ED visits, and/or oral steroid dispensings. The exact level on the β -agonist scale to target would depend on the exact purposes and resources of the surveillance and intervention program. Some prior studies have suggested that patients dispensed more than 5 β -agonist canisters in a 1-year period are at increased risk for subsequent acute exacerbations,^{9,20} whereas other studies have identified 12 or more canisters per year as indicating high risk.^{21,22} One of the important and unique findings in the current study is that patients who received 3 to 6 canisters per year were shown to be at significantly greater risk of subsequent exacerbations and poorer symptom control than patients who receive fewer canisters and that the risk increased progressively for 7 to 12 and more than 12 canisters per year. This finding allows the use of administrative data for more complete and prioritized targeting of asthmatic patients at higher risk for poorer chronic control or subsequent health care use. The β -agonist scale could also be helpful as a reflection of long-term control in the management of individual patients for whom real-time pharmacy data are available at the time of a clinic visit.

An important issue is the generalizability of the results of this study. Validity information was assessed in 2 separate populations that differ some in geography (although all were West Coast) and in asthma severity (all persistent in the construct validity sample and both intermittent and persistent in the predictive validity sample). However, the patients in the construct validity sample were documented to be mostly white, well educated, and nonpoor, and patients in both validation samples were members of the same integrated health care system. It remains to be determined whether the results will generalize to other populations that differ with respect to geography, demographics, or health care system.

This study does have 2 potential additional limitations. First, not all potential participants completed the survey, although a 60% response rate is considered satisfactory for a survey of this type. Second, this study did not include potential physiologic measures of asthma control, such as pulmonary function tests, because these are not captured by present administrative databases.

In summary, this study has validated an administrative measure of long-term asthma control. It should be useful for population management and quality assessments that

use administrative data. Further studies will be necessary to confirm the utility of this measure in diverse populations and what proportion of patients are inaccurately assessed by this measure because of not treating or not perceiving symptoms.

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