

Severity assessment in asthma: An evolving concept

Mary K. Miller, MS,^a Charles Johnson, MBChB,^a Dave P. Miller, MS,^b Yamo Deniz, MD,^a Eugene R. Bleeker, MD,^c and Sally E. Wenzel, MD,^d for the TENOR Study Group*

South San Francisco and San Francisco, Calif, Winston-Salem, NC, and Denver, Colo

Background: Guidelines for the clinical management of asthma base specific treatment recommendations on the assessment of disease severity. Thus, the accuracy of such assessments is essential for proper clinical management. The consistency of asthma severity assessment in patients with difficult-to-treat disease is unknown.

Objective: The objectives of this analysis were to compare the asthma severity assessment according to 3 methodologies in patients from The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens study.

Methods: Asthma severity on the basis of the National Asthma Education and Prevention Program and the Global Initiative for Asthma guidelines was compared with physician assessment and benchmarked against asthma-related health care use. Guideline-based asthma severity symptom components were derived from patient-reported questionnaires. Lung function levels were determined by prebronchodilator FEV₁ measurements; asthma-related medication and recent health care use were reported by patients.

Results: There was a clear lack of agreement among the asthma severity assessment modalities. Asthma severity was associated with asthma-related health care use, and patients considered to have severe asthma according to both sets of guidelines and physicians' assessment had the highest health care and medication use.

Conclusion: Classification of asthma severity on the basis of current asthma symptoms and lung function may be useful but not completely reflective of a patient's true asthma condition. Clinical assessment of asthma severity should consider a patient's medication use and consumption of health care

resources for asthma exacerbations. Additional studies that apply criteria for asthma severity longitudinally are needed to support recommendations for optimal assessment of asthma severity. (*J Allergy Clin Immunol* 2005;116:990-5.)

Key words: Epidemiology, practice guidelines, questionnaires, respiratory function tests, health care use

Patients with asthma consume more than 12.7 billion health care-related dollars annually.¹ However, the relationship between the amount of health care dollars consumed by patients and definitions of severity defined by guidelines from the National Asthma Education and Prevention Program (NAEPP), a United States organization affiliated with the National Heart, Lung, and Blood Institute,^{2,3} and the Global Initiative for Asthma (GINA), undertaken jointly by the National Heart, Lung, and Blood Institute and the World Health Organization, is not known.⁴

According to the NAEPP guidelines, the assessment of severity depends on the subjective report of current daytime and nighttime symptoms as well as on objective evaluation of lung function by spirometry or peak expiratory flow rate (FEV₁ or PEF_R) before the initiation of treatment. GINA guidelines consider the current clinical features of asthma (symptoms and pulmonary function) as well as medications in determining asthma severity. The NAEPP guidelines evaluate the current degree of asthma control without adjusting for medications. GINA guidelines focus on assessing the severity of underlying disease by evaluating clinical features of asthma before treatment and then adjusting the assessment of asthma severity on the basis of the patient's response to therapy.⁴ Neither set of current guidelines incorporates recent asthma-related health care use (HCU) into asthma severity definitions. In addition to these guidelines, physicians often form opinions about a patient's severity that may or may not incorporate guideline definitions.⁵⁻⁷

This study evaluates asthma severity on the basis of criteria from the NAEPP and GINA guidelines applied to The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) cohort of severe or difficult-to-treat patients in whom physicians also independently assessed asthma severity. TENOR was a longitudinal observational study in the United States of patients ≥ 6 years of age who received care from a specialist in pulmonary and/or allergy medicine and were identified as having severe or difficult-to-treat asthma.⁸ The concordance between the 3 measures of asthma

From ^aGenentech, Inc, South San Francisco; ^bOvation Research Group, San Francisco; ^cWake Forest University, Winston-Salem; and ^dNational Jewish Medical and Research Center, Denver.

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Reprint requests: Mary K. Miller, MS, Genentech, Inc, 1 DNA Way, Mail Stop 84, South San Francisco, CA 94080. E-mail: mkmiller@gene.com. 0091-6749/\$30.00

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Abbreviations used

GINA: Global Initiative for Asthma
HCU: Health care use
ICS: Inhaled corticosteroids
LTC: Long-term asthma control medication
NAEPP: National Asthma Education and Prevention Program
TENOR: The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens

severity in TENOR patients with diverse FEV₁ measurements, symptoms, and medication use was estimated. In addition, the relationship between recent asthma-related HCU among all 3 severity assessments was evaluated.

METHODS

The 283 study sites that made up TENOR were located in diverse geographical areas and managed by >400 pulmonologists and allergists. Represented sites were part of managed care organizations, community physician groups, and academic centers. The TENOR study population was recruited between January and October 2001 and included patients ≥ 6 years with severe or difficult-to-treat asthma. Patients with mild or moderate asthma were eligible for enrollment if their physician considered their asthma difficult to treat and they met the additional inclusion and exclusion criteria.⁸ Difficult-to-treat asthma was defined as any of the following: a need for multiple asthma drugs, occurrence of frequent or severe exacerbations, an inability to avoid asthma triggers, and/or a requirement for a complex treatment regimen. Physicians were not instructed to use specific clinical parameters or guidelines when completing the patients' asthma severity and difficult-to-treat assessments. More than half the patients classified as mild by physician assessment ($n = 45$ of 88; 51%) met ≥ 2 difficult-to-treat criteria, and all met at least 1 criterion, of which requiring multiple drugs was the most common ($n = 76$; 86.4%). During the previous year, patients had at least 1 of the following: ≥ 2 unscheduled asthma care office visits, ≥ 2 corticosteroid bursts, use of ≥ 3 control medications, use of high-dose inhaled corticosteroids, and/or chronic use of ≥ 5 mg oral prednisone daily. Only patients who were ≤ 55 years of age at study entry were included in this analysis. Patients older than 55 and current smokers were excluded to minimize potential confounding with chronic obstructive lung disease.

Prebronchodilator FEV₁ measurements (recorded as percent predicted) were taken at baseline by using standard spirometry techniques.⁹ FEV₁ was categorized according to NAEPP and GINA guideline parameters to denote mild intermittent or persistent ($\geq 80\%$ of predicted), moderate persistent ($>60\%$ to $<80\%$ of predicted), or severe persistent ($\leq 60\%$ of predicted) asthma. Diurnal variation in expiratory flow was not captured.

For this study, items numbered 2, 5, 7, 9, and 11 from the patient-reported questionnaires Mini Asthma Quality of Life Questionnaire and Pediatric Asthma Quality of Life Questionnaire^{10,11} to determine the symptom components of the NAEPP and GINA severity scales were selected. Patients ranked responses to questions such as, "In general how much of the time during the last 2 weeks did you feel short of breath as a result of your asthma?" on a 7-point ordinal scale, with 1 corresponding to "all of the time" and 7 corresponding to "none of the time." Before data analysis, the responses were assigned to 1 of 4 asthma severity categories. For consistency, the same assignment was used for both NAEPP and GINA systems, despite minor

differences in symptom descriptions between the 2 guidelines. A score of 1 or 2 ("all or most of the time") was used to approximate the severe persistent category; 3 ("a good bit of the time") the moderate persistent category; 4 or 5 ("some or a little of the time") the mild persistent category, and 6 or 7 ("hardly or none of the time") the intermittent category.

Current asthma medication and recent HCU were determined by patient interview. Actual medication use was collected by study coordinator interview and reflected current use. To collect medications data as accurately and consistently as possible, patients were asked to bring their asthma medications to their study visit. Patient-reported medication doses, frequency, and routes of administration were summarized as the number of long-term control medications and use of high-dose inhaled corticosteroids.¹² Based on medications alone, patients were classified as having mild asthma if they reported using inhaled corticosteroids (ICS) or, but not both, a long-term asthma control medication (LTC), including long-acting β -agonist, cromone, theophylline, or leukotriene modifier. Moderate asthma, based solely on medication use, was defined as use of high dose ICS without LTC use or lower-dose ICS use with at least 1 LTC. Patients considered to have severe asthma reported taking high-dose ICS and at least 1 LTC.

TENOR physicians evaluated each participant's asthma severity and then categorized each patient with mild, moderate, or severe asthma on the basis of their clinical opinions. With only 3 categories to compare with physician assessment, the mild intermittent and mild persistent categories from the NAEPP and GINA classifications were combined into a single mild category. Meeting any 1 of the criteria for a given category of severity was sufficient to place a patient in that category.

Asthma-related hospitalizations, number of short courses of corticosteroid therapy (bursts), emergency department visits, and unscheduled office visits during the 3 months immediately before the interview were reported along with lifetime intubations and/or mechanical ventilation as a result of asthma.

Agreement between asthma severity assessment by physician and NAEPP and GINA guideline-based assessments was measured by using the Cohen κ .¹³ κ Measures the degree to which 2 judges agree in rating the same items, using identical categories. κ Values range from -1.0 (perfect disagreement) to 0 (random association) to $+1.0$ (perfect agreement); values of 0.4 to 0.7 reflect fair to good agreement.¹³ Categorical data are presented as counts and percentages. Percentages were computed as a proportion of nonmissing data, and pairwise comparisons were made on the basis of the Pearson χ^2 test. Continuous variables are presented as means, with P values of $<.05$ considered statistically significant.

RESULTS

Patient demographics

A total of 2927 patients 6 to 55 years of age had sufficient data to calculate asthma severity according to NAEPP, GINA, and physician classifications (Table I). The mean age for all patients was 31 years, and the majority were female (60.6%) and white according to race/ethnicity (72.5%). According to all 3 classifications, patients with severe asthma were more likely to be non-white and previous smokers compared with patients with mild or moderate asthma. A higher proportion of patients classified as having mild asthma according to the NAEPP and GINA were educated beyond high school compared with patients classified as having either moderate or severe asthma.

TABLE I. Demographic characteristics TENOR patients according to severity classification (N = 2927)

	NAEPP			GINA			Physician assessment			All N = 2927
	Mild N = 850	Moderate N = 835	Severe N = 1242	Mild N = 109	Moderate N = 1105	Severe N = 1713	Mild N = 88	Moderate N = 1453	Severe N = 1386	
Female, n (%)	502 (59.1)	487 (58.3)	785 (63.2)	62 (56.9)	698 (63.2)	1014 (59.2)	49 (55.7)	862 (59.3)	863 (62.3)	1774 (60.6)
Age, mean (y)	27.8	31.7	32.7	27.1	32.0	30.6	26.9	29.2	33.2	31.0
Nonwhite, n (%)	150 (17.7)	208 (24.9)	447 (36.0)	19 (17.4)	194 (17.6)	592 (34.6)	11 (12.5)	353 (24.3)	441 (31.8)	805 (27.5)
Children, n (%)	187 (22.0)	141 (16.9)	193 (15.5)	26 (23.9)	139 (12.6)	356 (20.8)	27 (30.7)	316 (21.7)	178 (12.8)	521 (17.8)
Adolescents, n (%)	181 (21.3)	138 (16.5)	203 (16.3)	21 (19.3)	211 (19.1)	290 (16.9)	16 (18.2)	265 (18.2)	241 (17.4)	522 (17.8)
Adults, n (%)	482 (56.7)	556 (66.6)	846 (68.1)	62 (56.9)	755 (68.3)	1067 (62.3)	45 (51.1)	872 (60.0)	967 (69.8)	1884 (64.4)
Education > high school, n (%)	408 (48.6)	445 (53.3)	561 (45.2)	59 (54.1)	614 (55.6)	741 (43.3)	33 (37.5)	689 (47.4)	692 (50.0)	1414 (48.3)
Never smoked, n (%)	716 (84.3)	683 (81.9)	975 (78.6)	97 (89.8)	904 (81.9)	1373 (80.2)	74 (84.1)	1215 (83.7)	1085 (78.3)	2374 (81.2)

TABLE II. Classification of TENOR patients according to asthma severity category: children 6-11 years (N = 521)

	Asthma severity criteria		
	Mild	Moderate	Severe
Symptoms alone, n (%)	257 (49.3)	91 (17.5)	173 (33.2)
Lung function alone, n (%)	351 (67.4)	132 (25.3)	38 (7.3)
NAEPP, n (%)	187 (35.9)	141 (27.1)	193 (37.0)
Medications alone, n (%)	50 (9.6)	194 (37.2)	277 (53.2)
GINA, n (%)	26 (5.0)	139 (26.7)	356 (68.3)
Physician assessment, n (%)	27 (5.2)	316 (60.7)	178 (34.2)

TABLE III. Classification of TENOR patients according to asthma severity category: adolescents 12-18 years (N = 522)

	Asthma severity criteria		
	Mild	Moderate	Severe
Symptoms alone, n (%)	283 (54.2)	80 (15.3)	159 (30.5)
Lung function alone, n (%)	306 (58.6)	136 (26.1)	80 (15.3)
NAEPP, n (%)	181 (34.7)	138 (26.4)	203 (38.9)
Medications alone, n (%)	54 (10.3)	304 (58.2)	164 (31.4)
GINA, n (%)	21 (4.0)	211 (40.4)	290 (55.6)
Physician assessment, n (%)	16 (3.1)	265 (50.8)	241 (46.2)

Severity assessment in a group of patients with difficult-to-treat asthma

Tables II, III, and IV present the classification of severe or difficult-to-treat asthma patients by age (6-11 years, 12-18 years, and 19-55 years). Classification by symptoms alone showed all 3 age groups to be similarly distributed. On the basis of lung function alone, the youngest patient group was least likely to be categorized as severe. In contrast, children were more likely to be categorized as severe when medications were considered alone. Across all age groups, more patients were classified as severe according to GINA compared with NAEPP. This was especially true for children, who were nearly twice as likely to be classified as severe according to GINA compared with NAEPP.

Agreement between guidelines-based severity assessments and physicians' assessments in TENOR

Agreement between the guidelines-based assessments and physicians' assessments for all patients (N = 2927) in Table V is shown along the shaded diagonal: mild/mild, moderate/moderate, and severe/severe. The NAEPP classification agreed with the TENOR physicians' assessments 45.1% of the time. Of all patients, 1.7% had mild asthma, 16.2% moderate, and 27.2% severe according to both the physicians and NAEPP. Thirty-nine percent of patients were given a more severe asthma classification

by physicians than NAEPP, and nearly 16% of patients were rated more severe by NAEPP than by physicians.

TENOR physicians had the same assessment as the GINA guidelines 58.8% of the time (n = 1722 of 2927). Nearly 16% were given a more severe asthma classification by the physicians than by GINA, whereas 25.8% of patients were rated more severe by GINA than by physicians. The TENOR physicians were less likely than GINA to rate a patient as severe; NAEPP was slightly less likely than the physicians to rate a patient as severe and much more likely to rate patients as mild (29%) compared with either the TENOR physicians (3%) or the GINA classification (3.7%). Overall, agreement between the classification of asthma severity by TENOR physicians and NAEPP (weighted κ = 0.20; 95% CI, 0.177-0.224) or GINA (weighted κ = 0.25; 95% CI, 0.219-0.281) was low.

The low correlation persisted across age categories (data not shown), with weighted κ statistics lowest in children according to physician assessment compared with NAEPP (κ = 0.15; 95% CI, 0.098-0.210) and for physician assessment compared with GINA (κ = 0.22; 95% CI, 0.164-0.282). Age stratification showed that by NAEPP and GINA, 37% and 68.3%, respectively, of children had severe asthma, but that by physician assessment, most children had moderate asthma (60.7%). This trend was similar for adolescents (NAEPP = 38.9% severe; GINA = 55.6% severe; physician = 50.8% moderate);

TABLE IV. Classification of TENOR patients according to asthma severity category: adults 19-55 years (N = 1884)

	Asthma severity criteria		
	Mild	Moderate	Severe
Symptoms alone, n (%)	931 (49.4)	347 (18.4)	606 (32.2)
Lung function alone, n (%)	879 (46.7)	576 (30.6)	429 (22.8)
NAEPP, n (%)	482 (25.6)	556 (29.5)	846 (44.9)
Medications alone, n (%)	201 (10.7)	1155 (61.3)	528 (28.0)
GINA, n (%)	62 (3.3)	755 (40.1)	1067 (56.6)
Physician assessment, n (%)	45 (2.4)	872 (46.3)	967 (51.3)

however, by all 3 classifications, the greatest percentage of adult patients had severe asthma (NAEPP = 44.9% severe; GINA = 56.6% severe; physician = 51.3% severe).

Among patients classified as severe by physicians but mild or moderate according to NAEPP, a greater proportion reported current use of ≥ 3 long-term control medications and high-dose ICS compared with patients classified as severe by NAEPP but mild or moderate according to physicians (66.6% vs 58% and 36.8% vs 30.8%; $P < .05$; Fig 1). Of patients rated severe according to GINA but mild or moderate according to physicians, 56.2% were using high-dose ICS (Fig 2). In contrast, only 1.1% of patients rated severe by physician assessment but mild or moderate according to GINA reported taking high-dose ICS. This latter proportion was similar to the 2.1% of patients taking high-dose ICS considered mild or moderate by both physicians and GINA.

Evaluation of severity assessment methods using health care utilization data

Overall, for all age groups combined, HCU was highest in the group of patients designated as moderate or severe and lowest among mild patients classified by NAEPP, GINA, or the TENOR physicians. However, many of the 799 patients classified as mild according to NAEPP criteria but moderate or severe by the TENOR physicians reported substantial recent asthma-related HCU. In the previous 3 months, 27 (3.4%) were hospitalized, 77 (9.7%) had an emergency department visit, 297 (37.2%) had unscheduled office visits, 283 (35.5%) received steroid bursts, and 66 (8.3%) had a history of intubation and/or mechanical ventilation. In contrast, patients classified as mild according to physician assessment (N = 88) had few HCU encounters (data not shown).

Few patients were classified as mild according to either GINA or physician assessment (3.7% and 3.0%, respectively); therefore, HCU was analyzed and displayed for the severe and not severe (that is, mild or moderate) categories for each classification scheme. HCU was highest among patients for whom both sets of guidelines and the TENOR physicians classified as severe and lowest among patients for whom both sets of guidelines and the TENOR physicians classified as mild or moderate. HCU was comparable among the patients with discordant classification (severe by one classification but not the other; Figs 1 and 2).

TABLE V. Concordance between asthma severity assessments in TENOR (N = 2927)

	Physician assessment			Total, n (%)
	Mild, n (%)	Moderate, n (%)	Severe, n (%)	
NAEPP*				
Mild, n (%)	51 (1.7)	551 (18.8)	248 (8.5)	850 (29.0)
Moderate, n (%)	19 (0.7)	475 (16.2)	341 (11.7)	835 (28.5)
Severe, n (%)	18 (0.6)	427 (14.6)	797 (27.2)	1242 (42.4)
Total, n (%)	88 (3.0)	1453 (49.6)	1386 (47.4)	2927 (100.0)
GINA†				
Mild, n (%)	13 (0.4)	76 (2.6)	20 (0.7)	109 (3.7)
Moderate, n (%)	50 (1.7)	699 (23.9)	356 (12.2)	1105 (37.8)
Severe, n (%)	25 (0.9)	678 (23.2)	1010 (34.5)	1713 (58.5)
Total, n (%)	88 (3.0)	1453 (49.6)	1386 (47.4)	2927 (100.0)

*Weighted κ for physician assessment versus NAEPP = 0.20 (95% CI, 0.177-0.224).

†Weighted κ for physician assessment versus GINA = 0.25 (95% CI, 0.219-0.281).

DISCUSSION

This is the first study to compare asthma severity levels assessed by 2 different instruments (NAEPP and GINA), as well as by overall physician assessment, in a very large cohort of patients with severe or difficult-to-treat asthma. Striking differences in asthma severity classification were observed by the 3 approaches. The most notable observation: NAEPP criteria produced a surprisingly large number of patients with mild asthma (n = 850; 29%). Ultimately, there was very poor concordance among the classifications. There was slightly better agreement between physician assessment and GINA versus physician assessment and NAEPP. This observation may be a result of the high medication use component of the TENOR inclusion criteria. Other research, however, has found that classification of patients according to severity of asthma is inconsistent.¹⁴⁻²⁰ Baker et al¹⁴ asked pediatric allergists and pulmonologists to use NAEPP guidelines to classify asthma severity and found poor agreement ($\kappa = 0.29$; 95% CI, 0.25-0.33). Agreement was even lower when physicians were asked the main factors used in their asthma severity assessment ($\kappa = 0.19$; 95% CI, 0.14-0.23). Inconsistency in the driving factors used by physicians to assess asthma severity has implications for this analysis as well, because the precise methods by which TENOR physicians classified patients are not known.

The effect of asthma on patients, often equated to asthma severity, cannot simply be assessed by using physiologic measures. There is also increasing recognition that measures of the physiologic and symptom deficits and amount of asthma therapy required to achieve control may be more appropriate measures of severity. To provide some validity to the comparison of severity classification, each was assessed against recent asthma-related HCU.

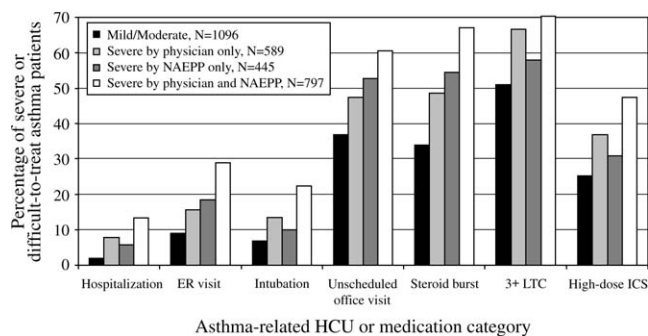


FIG 1. Percentage of TENOR patients age 6 to 55 years with severe asthma: NAEPP versus physician assessment by health care utilization and medication use (N = 2927). Mild/moderate versus severe by physician only: all $P < .001$. Mild/moderate versus severe by NAEPP only: all $P < .05$. Mild/moderate versus severe by both physician and NAEPP: all $P < .001$. Severe by physician only versus severe by NAEPP only: P value for 3+ long-term controllers and high-dose ICS $< .05$. Severe by physician only versus severe by both physician and NAEPP: all $P < .01$, except for 3+ long-term controllers. Severe by NAEPP only versus severe by both physician and NAEPP: all $P < .01$. ER, Asthma-related emergency room visit.

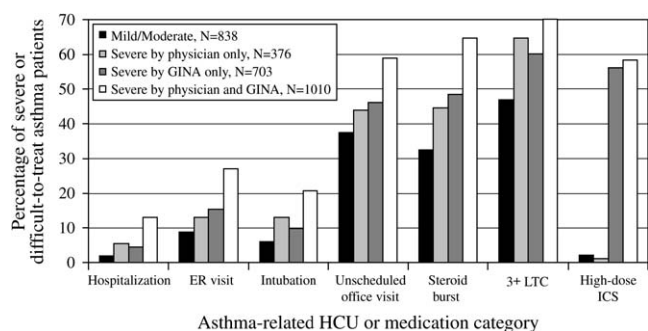


FIG 2. Percentage of TENOR patients age 6 to 55 years with severe asthma: GINA versus physician assessment by health care utilization and medication use (N = 2927). Mild/moderate versus severe by physician only: all $P < .05$, except high-dose ICS. Mild/moderate versus severe by GINA only: all $P < .01$. Mild/moderate versus severe by both physician and GINA: all $P < .001$. Severe by physician only versus severe by GINA only: P value for high-dose ICS $< .001$. Severe by physician only versus severe by both physician and GINA: all $P < .05$. Severe by GINA only versus severe by both physician and GINA: all $P < .001$, except for high-dose ICS. ER, Asthma-related emergency room visit.

This analysis found a positive relationship between HCU and asthma severity. A recent study by Diette et al²¹ also showed physician-assessed asthma severity to be significantly associated with emergency department visits and hospitalizations in patients with mild, moderate, or severe asthma enrolled in managed care organizations. Interestingly, a large percentage of patients classified as mild in this analysis, most according to NAEPP criteria, used more health care resources than would be expected in patients with truly mild disease. This observation is likely a result of the NAEPP guideline's inclusion of only current symptoms and FEV₁ status to identify severity. Therefore, the use of NAEPP criteria alone in asthma severity assessment of patients with severe or difficult-to-treat asthma may be insufficient.

The results of this analysis of patients with severe or difficult-to-treat asthma may not be applicable to other populations. Specifically, the asthma-related HCU in TENOR may not represent use outside the United States because of differences in access to medical care, outcome definition, and ascertainment. However, Antonicelli et al²²

conducted a multicenter cross-sectional study in specialized asthma clinics in Italy and also found associations between asthma severity and medical resource utilization.

The lack of agreement between GINA and TENOR physicians' assessments may be related to confusion that arises between measures of asthma control versus measures of asthma severity. According to GINA criteria, severity increases with increasing medication use. In contrast, physicians may rate patients as less severe if their asthma is well controlled while on an intensive medication regimen. Physicians may also classify patients as severe, but for various reasons may undertreat them, which then may lead to high utilization of health care resources. The analysis found age-related differences in asthma severity classification; for example, the majority of children and adolescents had moderate asthma according to physicians but severe asthma according to NAEPP and GINA. This finding raises the concern about how physicians incorporate medication use into asthma severity classification. Likewise, the very small percentage of patients classified as severe according to TENOR

physicians (mild or moderate by GINA) used high-dose ICS therapy (1.4%), despite studies to suggest improvement in hospitalizations and emergency department visits with increasing steroid doses. In contrast, only 40% of patients classified as severe by GINA (mild or moderate by physicians) were receiving high-dose inhaled corticosteroid therapy. These results may be artifacts of the high asthma medication component of the study's inclusion criteria or alternatively may highlight potential undertreatment of severe or difficult-to-treat asthma.

Patient-reported symptoms, medication use, and HCU data, as collected in TENOR, may be subject to poor, inaccurate, and/or associative recall biases, especially for less frequent and less significant events. However, as mentioned, subjects were asked to bring their medications to their visits to ensure accurate collection of use. In addition, a shorter window for HCU recall, such as the 3 months used in TENOR, has been found to be more precise than recall windows of longer duration.^{23,24} Patient-reported outcome instruments, such as the Mini Asthma Quality of Life Questionnaire and Pediatric Asthma Quality of Life Questionnaire, designed to assess asthma-related quality of life, may not be ideal measures of asthma severity. Recent research from 2 large studies of adult asthma patients, however, found results of asthma-related psychometric tools significantly associated with subsequent HCU.^{25,26} Future TENOR analyses, such as the prospective evaluation of predictiveness of symptoms, lung function, medication use, and previous HCU on future asthma-related health care outcomes, will help clarify the relationships between these measures.

There is currently no gold standard for assessment of asthma severity. Considering that current asthma treatment recommendations are based primarily on asthma severity, it follows that accurate severity assessment is essential for proper clinical patient management. The results of this study suggest that improvement in the classification of asthma severity is warranted. Global asthma severity assessments should consider not only patients' physiologic and symptom measures but also recent medication and health care utilization. The data presented here suggest that none of the 3 classifications alone (NAEPP, GINA, or physician assessment) is capable of identifying the severe asthma population with the highest recent HCU. As a result, asthma severity classification systems that consistently identify patients at risk may be necessary so that limited health care resources can be utilized appropriately.

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