ACAAI/AAAAI Joint Task Force Report

Asthma quality-of-care measures using administrative data: identifying the optimal denominator

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INTRODUCTION

The Healthcare Effectiveness Data and Information Set (HEDIS) was developed by the National Committee for Quality Assurance and has been applied to many diseases, including asthma.[1] The National Committee for Quality Assurance attempts to create and facilitate HEDIS measures that reflect "quality care" that then may be used to identify plans offering such quality care and to compare results among plans. The HEDIS asthma measure identifies patients with "persistent asthma" based on inpatient, outpatient, and pharmacy utilization data and assesses the proportion of such patients dispensed at least 1 controller medication. Problems with this measure include that this administrative definition of persistent asthma may not adequately reflect persistent asthma as defined clinically[2,3] and that patients who meet these criteria for appropriate treatment may actually be at increased risk for subsequent emergency hospital care.[4,5] Since 2005, 2 years of continuous enrollment and qualification as "persistent asthma" have been required to increase the specificity of the HEDIS denominator.[1] However, health plans may prefer a measure that can be applied to members with a single year of continuous enrollment so as to maximize the number of patients who can be evaluated.

A Joint Task Force of the American Academy of Allergy, Asthma and Immunology and the American College of Allergy, Asthma and Immunology was convened to study this subject. Working with pharmaceutical company collaborators, a study[5] was performed in 4 different commercial insurance data sets to try to identify an improved asthma quality-of-care measure using administrative data. The strategy was to test the relationship of different numerator-denominator combinations of medical and pharmacy claims in year 1 to asthma exacerbations in the subsequent year. A measure associated with reduced exacerbations would presumably be a better measure of quality care than would a measure not associated with reduced exacerbations. The main findings of this previous study[5] were as follows:

1. Based on the lowest number of patients, the highest prevalence of controller use, and the highest prevalence of exacerbations in patients not receiving controller medications, the diagnosis plus 4 medications denominator was the most specific of the 1-year denominators tested for persistent asthma.
2. Compared with other numerators tested, the ratio measure (ratio of controllers to total medications ≥ 0.5) was most consistently associated with improved outcomes in all age groups with the more specific denominators.

However, the previous Task Force report[5] did not evaluate close alternative denominators (eg, ≥ 1 encounter with an asthma diagnosis plus ≥ 3 medications or ≥ 2 encounters plus ≥ 2 medication dispensings). The purpose of the present study was to test several additional denominators to define the optimal 1-year denominator to be used with the ratio measure. The main characteristic of the denominator being sought was optimal discrimination of the ratio in predicting acute asthma episodes. Other aspects of the denominators that were evaluated included the size of the denominator and the proportion of patients with medication ratios of 0.5 or greater.

METHODS

Study Populations

The study was completed using 3 Health Insurance Portability and Accountability Act–compliant administrative claims databases and was exempt from review by the human subjects committee. The databases each contained adjudicated pharmacy and medical claims submitted by providers, health care facilities, and pharmacies. Claims included information on each physician visit, medical procedure, hospitalization, dispensed drug, and performed test. Member enrollment and benefit information and limited patient, provider, and hospital demographic information were also available. All major regions of the United States were represented in each data set.

The data sets were provided by collaborating pharmaceutical companies as follows: Ingenix i3 LabRx (Genentech Inc,

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South San Francisco, California), MarketScan (Novartis, East Hanover, New Jersey), and Pharmetrics (AstraZeneca, Wilmington, Delaware). In each data set, we identified patients with persistent asthma who were 5 to 56 years old (the current HEDIS age range chosen to maximize asthma diagnosis specificity) and who were enrolled continuously (≤1 enrollment gap of up to 45 days during the year) in commercial health plans during 2005, the measurement year. We also identified a subpopulation with 2 years' continuous enrollment in the measurement year and the follow-up year, 2006, to evaluate health care utilization outcomes.

Denominators

The following denominator groupings were constructed using 2005 data in each data set: DX3, 1 or more medical claims with asthma in any diagnosis field (*International Classification of Diseases, Ninth Revision, Clinical Modification,* code 493.xx) and 3 or more asthma medication dispensing events; DX4, 1 or more medical claims with asthma in any diagnosis field and 4 or more asthma medication dispensing events; 2DX2, 2 or more medical claims with asthma in any diagnosis field and 2 or more asthma medication dispensing events.

Asthma Medications

The following asthma medications were identified using pharmacy and medical claims: cromolyn sodium, leukotriene modifiers, nedocromil, methylxanthines, long-acting inhaled β_2-agonists (LABAs), short-acting inhaled β_2-agonists (SABAs), inhaled corticosteroids (ICSs) (including combination ICS/LABA products), and omalizumab.

Dispensing Event

We used HEDIS definitions to count medication use for inclusion. A dispensing event for an oral medication was 1 prescription of an amount lasting 30 days or less. To calculate dispensing events for prescriptions longer than 30 days, we divided the days of supply by 30 and rounded down to convert. For example, a 100-day prescription was equal to 3 dispensing events (100/30 = 3.33, rounded down to 3). Two different prescriptions dispensed on the same day were counted as 2 different dispensing events. Fills of inhalers were counted as 1 dispensing event. For example, an inhaler with a 90-day supply was considered 1 dispensing event. Multiple inhalers of the same medication filled on the same date of service were counted as 1 dispensing event. For injected medications (omalizumab), each claim was counted as a dispensing event.

Medication Ratio Measure

An unweighted medication ratio was calculated for each patient using the following formula: Units of Controllers/[Units of Controllers + Units of Relievers]. Patients were stratified into 2 groups based on medication ratio: patients with ratios of 0.5 or greater (high ratio) and patients with ratios less than 0.5 (low ratio).

Controller medications included cromolyn sodium, leukotriene modifiers, nedocromil, methylxanthines, ICSs (including combination ICS/LABA products), and omalizumab. The SABAs were considered relievers, and LABAs were excluded. Proportions of patients with high and low ratios were reported in each population. The value of the ratio measure was missing for patients with no use of a reliever or a controller medication (eg, use of LABAs only). We reported the number of these patients and excluded them from further analysis.

Medication units. To count medication units for the ratio measure, we used the definition previously proposed[6] for oral medications: 1 unit was equivalent to 1 dispensing event (see the "Dispensing Event" subsection). For inhalers, 1 unit was 1 canister. For injected medications, 1 unit was 1 claim, but if a subsequent claim had a service date within 21 days it was ignored (eg, claims on days 1 and 15 counted as 1 unit).

Number of inhaler canisters. The number of canisters dispensed in each claim was determined by a ratio of quantity to package size. For example, a claim for Azmacort Inhalation Aerosol Solution, 75 μg per actuation (20-g package size), with a quantity of 20 was interpreted as 1 canister dispensed. Any claim with a ratio of quantity to package size less than 1 was counted as 1 canister. For claims with quantity to package size ratios more than 1, we rounded the number to a whole number of canisters. For example, claims of Aerosol Solution, 75 μg per actuation (20-g package size), with quantities of 35 and 25 were counted as 2 canisters (35/20 = 1.75; rounded to 2) and 1 canister (25/20 = 1.25; rounded to 1), respectively. If a claim was for more than 12 canisters, it was truncated to 12 canisters.

Baseline Measures

Claims from the measurement year were used to determine baseline measures, including demographics (age, sex, and census region) and markers of asthma severity (emergency hospital care, >14 SABA canisters dispensed, and ≥1 oral corticosteroid [OCS] dispensing event).[7]

Outcome Measures

Outcomes were reported for the measurement and follow-up years (for patients with 2 years of continuous enrollment). Medical and pharmacy claims during each year were used to determine 2 outcomes of interest: (1) emergency hospital care, defined as either emergency department (ED) visits with asthma listed as the primary diagnosis or inpatient hospitalizations with asthma listed as the primary diagnosis; and (2) asthma exacerbation, defined as either emergency hospital care (as defined in the previous outcome) or an OCS dispensing event.

Statistical Analyses

All data transformations and statistical analyses were performed using a software program (SAS version 9.1; SAS Institute Inc, Cary, North Carolina). The percentages of patients with high medication ratios were reported for each population. Numbers and percentages with emergency hospital care and exacerbations during the measurement and follow-up years were reported by asthma ratio group. We

Table 1. Characteristics of the 3 Denominator Populations[a] in the 3 Databases

Characteristic	Ingenix			MarketScan			Pharmetrics		
	DX3	DX4	2DX2	DX3	DX4	2DX2	DX3	DX4	2DX2
Patients, No.[b]									
Measurement year	126,327	105,243	94,543	163,031	135,646	101,630	71,617	59,724	51,724
Measurement year nonmissing ratio	126,178	105,116	94,457	162,857	135,518	101,550	71,526	59,651	51,607
Follow-up year (% of measurement year)	89,638 (71)	74,891 (71)	66,829 (71)	107,607 (66)	89,805 (66)	66,486 (65)	58,473 (82)	48,806 (82)	41,940 (81)
Age, mean (SD), y	29.7 (16.9)	30.2 (17.0)	29.2 (17.1)	30.4 (17.4)	30.9 (17.4)	29.6 (17.6)	30.9 (17.1)	31.4 (17.1)	30.0 (17.3)
Female sex, %	54.6	54.5	56.5	57.3	57.3	58.6	57.0	56.9	58.7
Region, %									
Midwest	32.6	33.3	31.1	25.9	26.5	25.4	48.6	48.8	48.6
Northeast	11.8	11.8	12.7	9.9	10.0	10.3	16.1	16.1	17.4
West	16.1	15.8	15.8	26.3	25.6	25.1	6.9	6.8	6.4
South	39.5	39.2	40.4	37.9	37.9	39.1	28.4	28.3	27.5
Medication ratio ≥0.5, %	70.8	74.5	69.6	69.4	73.0	68.5	69.2	72.7	68.3

[a] See the "Denominators" subsection of the text for definitions of the 3 denominator populations.
[b] Patients aged 5 to 56 years who were continuously enrolled.

used χ^2 tests to compare rates between ratio groups and the *c* statistic area under the receiver operating characteristic curve to evaluate how well the ratio discriminated between groups with and without exacerbations across the populations. We applied a propensity score weighting method to adjust for potential bias due to patients lost by requiring an additional year of continuous enrollment. The weighted outcomes did not differ materially from the unadjusted ones, so we present only unadjusted results.

RESULTS

The numbers of patients in each denominator population in each database are given in Table 1. In all the databases, the DX3 denominator population was largest and the 2DX2 denominator population was smallest. There was minimal loss of patients due to missing ratios, but the proportion of patients with 2 years of continuous enrollment varied among databases (66%–82%). The mean age of patients in all the databases was 29 to 31 years, and the proportion of females was 55% to 59%. There was some regional variation between databases but not between the 3 denominator populations in each database. In all the databases, the highest proportion of patients with ratios of 0.5 or greater was seen in the DX4 population and the lowest in the 2DX2 population.

The relationships of ratios of 0.5 or greater vs less than 0.5 to acute asthma episodes in the measurement year in each population in each database are given in Table 2. More striking differences are seen when acute episodes are defined

Table 2. Outcomes in the Measurement Year Stratified by Asthma Medication Ratio Group in Each Denominator Population[a] in Each Database

Database/outcome[b]	DX3			DX4			2DX2		
	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]
Ingenix									
Emergency hospital care, %	5.4	12.0	<.001 (0.601)	5.5	13.4	<.001 (0.608)	7.8	16.3	<.001 (0.596)
Asthma exacerbation, %	38.7	48.4	<.001 (0.541)	39.5	50.1	<.001 (0.541)	46.2	57.4	<.001 (0.547)
MarketScan									
Emergency hospital care, %	6.4	14.8	<.001 (0.610)	6.6	16.4	<.001 (0.616)	9.9	21.7	<.001 (0.608)
Asthma exacerbation, %	42.1	52.5	<.001 (0.545)	42.9	54.8	<.001 (0.547)	51.1	64.0	<.001 (0.556)
Pharmetrics									
Emergency hospital care, %	5.0	11.9	<.001 (0.611)	5.1	13.1	<.001 (0.616)	7.5	16.7	<.001 (0.607)
Asthma exacerbation, %	39.8	49.6	<.001 (0.543)	40.5	51.2	<.001 (0.543)	47.8	59.8	<.001 (0.552)

[a] See the "Denominators" subsection of the text for definitions of the 3 denominator populations.
[b] See the "Outcome Measures" subsection of the text for definitions of the outcomes.
[c] Rate comparison between asthma ratio groups.
[d] Discrimination test between ratio group and outcome.

Table 3. Comparison of Measurement Year Characteristics of 1- and 2-y Enrollment Groups in Each Denominator Population[a] in the 3 Databases

Characteristic	DX3			DX4			2DX2		
	2-y enrollment		*P* value	2-y enrollment		*P* value	2-y enrollment		*P* value
	No	Yes		No	Yes		No	Yes	
Ingenix database									
Age, mean (SD), y	29.4 (16.5)	29.8 (17.1)	<.001	29.9 (16.5)	30.3 (17.2)	<.001	28.9 (16.6)	29.3 (17.3)	.001
Female sex, %	55.0	54.4	.07	54.9	54.3	.045	57.1	56.2	.007
Asthma ED visit or hospitalization, %	8.1	7.0	<.001	8.3	7.2	<.001	11.4	10.0	<.001
>14 SABA canisters, %	3.8	3.6	.08	4.6	4.3	.02	3.8	3.6	.13
≥1 OCS dispensing event, %	40.5	40.3	.51	41.3	40.9	.28	48.2	47.8	.21
Ratio ≥0.5, %	68.9	71.6	<.001	72.5	75.3	<.001	67.7	70.4	<.001
MarketScan database									
Age, mean (SD), y	30.0 (16.8)	30.6 (17.6)	<.001	30.5 (16.8)	31.1 (17.7)	<.001	29.2 (17.0)	29.7 (17.8)	<.001
Female sex, %	57.7	57.1	.01	57.7	57.1	.04	59.0	58.4	.054
Asthma ED visit or hospitalization, %	10.0	8.5	<.001	10.4	8.6	<.001	15.0	12.9	<.001
>14 SABA canisters, %	5.4	5.0	.005	6.4	6.0	.001	5.7	5.4	.03
≥1 OCS dispensing event, %	43.9	43.6	.39	44.6	44.7	.86	53.2	52.8	.28
Ratio ≥0.5,%	66.3	71.0	<.001	69.7	74.6	<.001	65.2	70.2	<.001
Pharmetrics database									
Age, mean (SD), y	29.5 (16.3)	31.2 (17.3)	<.001	30.0 (16.4)	31.7 (17.3)	<.001	28.8 (16.4)	30.2 (17.4)	.001
Female sex, %	57.4	57.0	.34	57.2	56.9	.55	59.3	58.6	.20
Asthma ED visit or hospitalization, %	8.2	6.9	<.001	8.6	7.0	<.001	11.8	10.1	<.001
>14 SABA canisters, %	5.1	4.6	.01	6.1	5.4	.005	4.9	4.5	.054
≥1 OCS dispensing event, %	42.8	41.3	.002	43.6	42.0	.002	50.8	49.6	.03
Ratio ≥0.5, %	66.7	69.8	<.001	69.6	73.4	<.001	66.0	68.9	<.001

Abbreviations: ED, emergency department; OCS, oral corticosteroid; SABA, short-acting β_2-agonist.
[a] See the "Denominators" subsection of the text for definitions of the 3 denominator populations.

as asthma ED visits or hospitalizations (emergency hospital care) than when they are defined as asthma ED visits, hospitalizations, or an OCS dispensing (asthma exacerbation). In all the databases, the ratio measure was most discriminative for emergency hospital care in the DX4 population and for asthma exacerbations in the 2DX2 population.

The differences between patients continuously enrolled for only 1 year vs 2 years in each population in each data set are given in Table 3. Patients not enrolled for 2 years were significantly more likely than those enrolled for 2 years to require emergency hospital care in the measurement year in all the populations in all the databases. There was also a statistically significant difference in age between these groups in all the populations, but the magnitude of the difference is not likely to be clinically significant. Excess SABA use (>14 canisters) was modestly but significantly increased in patients

Table 4. Outcomes in the Follow-up Year Stratified by Asthma Medication Ratio Group in Each Denominator Population[a] in Each Database

Database/outcome[b]	DX3			DX4			2DX2		
	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]	Ratio ≥0.5	Ratio <0.5	*P* value[c] (*c*)[d]
Ingenix									
Emergency hospital care, %	1.7	4.3	<.001 (0.608)	1.8	5.0	<.001 (0.618)	2.0	4.9	<.001 (0.606)
Asthma exacerbation, %	28.7	33.4	<.001 (0.522)	29.6	36.2	<.001 (0.529)	31.4	35.9	<.001 (0.521)
MarketScan									
Emergency hospital care, %	1.6	4.0	<.001 (0.611)	1.7	4.7	<.001 (0.620)	2.1	5.2	<.001 (0.611)
Asthma exacerbation, %	30.3	33.7	<.001 (0.516)	31.4	37.0	<.001 (0.524)	33.7	37.9	<.001 (0.519)
Pharmetrics									
Emergency hospital care, %	1.2	2.9	<.001 (0.603)	1.3	3.3	<.001 (0.614)	1.5	3.3	<.001 (0.600)
Asthma exacerbation, %	29.5	33.4	<.001 (0.519)	30.3	36.3	<.001 (0.527)	32.3	36.7	<.001 (0.521)

[a] See the "Denominators" subsection of the text for definitions of the 3 denominator populations.
[b] See the "Outcome Measures" subsection of the text for definitions of the outcomes.
[c] Rate comparison between asthma ratio groups.
[d] Discrimination test between ratio group and outcome.

not enrolled for 2 years in many of the populations. The difference among enrollment groups in OCS requirements was statistically significant only in the Pharmetrics database, and the magnitude did not seem to be clinically significant. The proportion of patients with ratios of 0.5 or greater seemed to be statistically and clinically significantly higher in patients with 2 years of continuous enrollment compared with those with only 1 year of continuous enrollment in all the populations in all 3 data sets.

The relationships of ratios of 0.5 or greater vs less than 0.5 to acute asthma episodes in the follow-up year in patients continuously enrolled for 2 years in each population in each database are given in Table 4. As before, more striking differences are seen when acute episodes are defined as asthma ED visits or hospitalizations (emergency hospital care) than when they are defined as asthma ED visits, hospitalizations, or an OCS dispensing (asthma exacerbation). In all the databases, the ratio measure was most discriminative for emergency hospital care and asthma exacerbations in the DX4 population.

CONCLUSIONS

1. Some clinically important differences in patients continuously enrolled for 2 years vs 1 year and the variable loss of patients if 2 years of continuous enrollment are required (18%–34%) suggest that a 1-year denominator may be not only larger but also more representative and comparable between plans than a denominator that requires 2 years of continuous enrollment.
2. Despite some differences in regional representation across databases, the 3 different databases were similar in age, sex distribution, relative denominator population sizes, relative proportions of ratios of 0.5 or greater in the 3 denominator populations, and relative discrimination of the ratio measure in the 3 denominator populations.
3. The ratio measure was most discriminating in the DX4 denominator population ($\geq$1 asthma encounter and $\geq$4 medication dispensing events) regarding emergency hospital care in the measurement year and regarding emergency hospital care and asthma exacerbations in the follow-up year. Thus, this denominator is recommended as the 1-year denominator in which to use the ratio measure.

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