Limits of the HEDIS Criteria in Determining Asthma Severity for Children

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ABSTRACT. Objective. Although the Health Plan Employer Data Information Set (HEDIS) is a common method for evaluating the quality of asthma care, its accuracy in characterizing persistent asthma in children is unknown. The objective of this study was to compare the assessment of asthma severity (persistent vs nonpersistent asthma) using the HEDIS criteria versus clinical criteria using National Heart, Lung, and Blood Institute (NHLBI) guidelines.

Methods. In a cross-sectional study, we analyzed baseline data from interviews with the parents of 896 children who had asthma and participated in a randomized controlled trial. Patients had an active clinical diagnosis of asthma, were between 2 and 12 years of age, and had no other pulmonary diseases. Patients had persistent asthma by parent report according to the HEDIS criteria when, within the last year, they had 1 asthma inpatient admission or emergency department visit or 4 asthma medication dispensing events, or 4 outpatient asthma visits and at least 2 asthma medication dispensing events. Patients had persistent asthma by parent report according to the NHLBI criteria when, within the last 2 months, they had nighttime asthma symptoms ≥2 nights/mo or daytime asthma symptoms ≥2 days/wk. We calculated the sensitivity of each HEDIS criterion, separately and then combined, using the NHLBI criteria as a gold standard.

Results. On the basis of HEDIS criteria, 656 (73%) patients had persistent asthma, compared with 338 (38%) using NHLBI criteria. Although the HEDIS criteria for persistent asthma were fairly sensitive (0.89), they were not very specific (0.70). For children without daily controller medications (n = 346), the sensitivity was even lower (0.45), but the specificity was similar (0.68). We found that the test characteristics were fairly consistent across different age group strata (2–4, 5–9, and 10–12 years of age).

Conclusions. HEDIS criteria used to determine the quality of asthma care should be interpreted with caution. Although the criteria for persistent disease—used to determine which children require daily controller medications—are fairly sensitive, they are not very specific and include children who may not require such medications. Pediatrics 2004;114:1049–1055; asthma, risk adjustment, severity of illness, HEDIS.

ABBREVIATIONS. NHLBI, National Heart, Lung, and Blood Institute; HEDIS, Health Plan Employer Data Information Set; ED, emergency department; IQR, interquartile range; CI, confidence interval.

Measuring the quality of asthma care provided by physicians is a challenging yet crucial step in improving patient outcomes. One aspect of asthma management that has received increased attention is physician prescription of medications for asthma. Despite that the National Heart, Lung, and Blood Institute (NHLBI) asthma guidelines recommend the use of daily anti-inflammatory or controller medications for children with persistent asthma,1 many studies suggest that physician prescription of controller medications is not ideal.2–6

The Health Plan Employer Data Information Set (HEDIS) “Use of Appropriate Medications for People with Asthma” is a commonly used measure for assessing appropriate prescribing of daily controller asthma medications for children with persistent asthma. This HEDIS asthma measure, developed in 2000, is meant to be consistent with the NHLBI guidelines and “evaluates if members with persistent asthma are prescribed medications acceptable as primary therapy for long-term control of asthma.”6

The NHLBI guidelines recommend a daily controller medication only for patients with persistent symptoms, not intermittent symptoms. As a result, distinguishing which patients have persistent versus intermittent symptoms is a crucial factor in determining accurately whether physicians are appropriately prescribing controller medications. However, the HEDIS measure is based on medical claims data, which are used primarily for administrative purposes. Important information used in clinical assessment is not present. In addition, the HEDIS measure identifies a continuously enrolled population with persistent asthma, whereas the NHLBI criteria are used at an individual patient level.

Although the HEDIS measure is a common method for evaluating the quality of asthma care, its accuracy in characterizing which patients have persistent asthma is unknown. The purpose of this study was to compare the assessment of asthma severity (persistent vs nonpersistent asthma) using HEDIS criteria versus the NHLBI guidelines clinical criteria.
METHODS

Using the baseline health status of a nationwide sample of pediatric asthma patients, we compared 2 different criteria to assess asthma severity. The institutional review board of the University of Michigan approved the study protocol.

Patients and Respondents

The patients were a random sample of children with asthma from the patient panels of pediatricians who participated in a randomized, controlled trial to evaluate the effect of physician asthma education. The pediatricians were identified using yellow-page listings of pediatricians and membership lists of local professional societies from the following 10 regions: Corpus Christi, TX; Bakersfield, CA; Nashville, TN; Jacksonville, FL; Omaha, NE; St Paul, MN; Kent County, MI; New Castle County, DE; Columbus, OH; and Indianapolis, IN. A letter and a brochure were sent to pediatricians inviting them to participate in the study. They received continuing medical education credits for attending the program, as well as a certificate, a shirt, and $50 honorarium for completing a follow-up survey about the program each year.

Participating pediatricians were asked to provide a list of their patients with asthma for baseline and follow-up interviews. Before any contact by the study office, the pediatric offices sent a letter explaining the study to each of the households in their practice with potential study patients. Parents of patients could contact the physician’s office to have their name removed from the list of potential subjects. From this final list of potential subjects, we contacted a random sample of parents of these patients with asthma. Patients and their parents were blind to physicians’ involvement in the intervention. Physicians were blind to patient selection.

All patients had an active diagnosis of asthma with at least 1 asthma visit within the last 2 years, as well as no other diseases associated with pulmonary complications, such as tuberculosis, sickle cell disease, or cystic fibrosis. We excluded children who were younger than 2 years, because the diagnosis of asthma can be difficult to establish before this age.

Data Collection

A trained interviewer contacted the households of randomly selected patients to administer the baseline questionnaire by telephone before the intervention. These baseline data were used for this analysis. After we obtained consent from the child’s parent or legal guardian, we conducted the interview with the person who “is usually responsible for [child’s] health-related care and takes him/her to the doctor.” The 86-item interview was conducted in English and took 25 minutes to complete. Respondents received an honorarium of $10.

Survey Instrument

We collected information on the frequency of the child’s asthma symptoms as well as health care utilization for asthma. The questionnaire items are available on request from the authors. To determine asthma medications, we asked parents to list 3 types of medications: asthma medications that their child takes on a daily basis, asthma medications that their child takes when asthma symptoms occur or worsen, and any other asthma medications that have been prescribed for the child in the past 12 months. For each medicine, we asked the specific name, the mode of delivery, and how long the child had been taking the medicine. We also collected demographic information, including patient age, gender, patient insurance type, respondent age and gender, household income, and number of others in the household.

Definitions

Patients were classified as having persistent asthma according to the HEDIS measure when they fulfilled any of the following 4 criteria according to the HEDIS definition: 1) any emergency department (ED) visit for asthma during the last year, 2) any hospitalization for asthma at any time during the last year, 3) 4 or more outpatient asthma visits and 2 or more asthma medication-dispensing events in the last year, or 4) 4 or more asthma medication-dispensing events in the last year.

The number of asthma medication-dispensing events was based on parent report. A list of the asthma medications used in the HEDIS measure is available at www.ncqa.org/Programs/HEDIS/hedis2002NDClists.html and www.ncqa.org/Programs/HEDIS/hedis2003NDClists.html.

When the parent listed a medication that was on the HEDIS list of asthma medications and stated that the medication was used daily, each month of use (up to 12 months) represented 1 asthma medication-dispensing event. When the parent described an asthma medication that was on the HEDIS list of asthma medications and the medication was not currently being used but had been prescribed within the last 12 months, each month of use (up to 12 months) represented 1 asthma medication-dispensing event. When the parent described an asthma medication that was on the HEDIS list of asthma medications and the medication was recommended for use when asthma symptoms occur or worsen, and the medication was used within the last 12 months, each medication represented 1 asthma medication-dispensing event. When the parent described an asthma medication that was on the HEDIS list of asthma medications and the medication was recommended for use when asthma symptoms occur or worsen, each month of use (up to 12 months) represented 1 asthma medication-dispensing event.

To determine the total number of office visits for asthma in the last year, we combined the number of urgent and nonurgent asthma office visits on the basis of parent reports. The parent-described frequency of daytime and nighttime asthma symptoms were used to determine whether patients had persistent asthma according to the NHLBI definition. Patients had persistent asthma according to the NHLBI measure when they had nighttime asthma symptoms ≥2 nights per month or daytime symptoms ≥2 days per week.

Verification of Parent Survey Responses

Because our analysis was based on parent reports of asthma events, we conducted a medical record review of a sample of ~6% (n = 50) of the patients. We compared parent reports of asthma hospitalizations, asthma ED visits, and office visits for asthma. The mean difference between documented versus reported hospitalizations was 0.02 events (median: 0; interquartile range [IQR]: 0–0.2 to 0.2) for asthma ED visits (median: 0; IQR: 0–0.1) for asthma office visits, and 1.12 events (median: 0; IQR: 1 to 2) for asthma office visits. These small differences suggest that the aggregate parent reports were relatively accurate, especially for hospitalizations.

Analysis

We compared the NHLBI and HEDIS measures of asthma severity by calculating the sensitivity and specificity of the HEDIS criteria in measuring persistent asthma. We used the NHLBI measure, a clinical assessment, as our gold standard.8,9

Because the NHLBI guidelines recommend assessing “clinical features before treatment,” to determine severity of illness, we first compared the HEDIS and NHLBI measures only using data from patients who were not on a daily medication. In our second analysis, because it was possible that patients did not have symptoms as a result of taking appropriate daily controller medicines, we modified our calculations of sensitivity and specificity (Fig 1) and included all patients, including those who were taking a controller medication. In this second analysis (for all patients), we assumed that if a patient who was taking a daily controller medication was classified as having intermittent asthma using the NHLBI criteria but was classified as having persistent asthma using the HEDIS criteria, then the disagreement was attributable to the effect of taking an appropriate controller medication. We thus assumed that such patients had underlying “persistent asthma.” When determining whether a patient was taking an appropriate controller medication, we used the HEDIS list of controller medications (www.ncqa.org/Programs/HEDIS/hedis2002NDClists.html).

Our patient sample included children between the ages of 2 and 12. Because the HEDIS measure is stratified for children 5 to 9 years of age, we did separate analyses for children 2 to 4 years of age, 5 to 9 years of age, and 10 to 12 years of age.

HEDIS lists of asthma medications and controller medications differed in 2002 and 2003. Although the general categories of medications (eg, inhaled corticosteroids, xanthines) are the same, there were differences in product names and formulations listed in the 2003 version. We repeated our analysis using the 2003 lists and...
found no changes in the findings. As a result, we present results using the comparison of the 2002 HEDIS and 2002 NHLBI criteria.

Sensitivity and Specificity of Separate and Combined HEDIS Criteria

Using all patients in the analysis, we calculated the sensitivity and specificity for each criterion of the HEDIS measure: asthma hospitalizations, asthma ED visits, asthma outpatient visits, and asthma medication dispensing events. We also attempted to weight the HEDIS criteria differently to improve the sensitivity and specificity of the measure. We took a random sample of the data from one half of the patients in the study sample and determined an alternative formula for determining persistent asthma using multivariate logistic regression (SAS 8.0; SAS, Inc, Cary, NC). Our dependent variable was persistent (vs intermittent) asthma on the basis of the NHLBI criteria. Independent variables included number of asthma medication dispensing events, number of ED asthma visits, number of asthma hospitalizations, and number of office visits for asthma. Using a receiving operator characteristic curve, we determined an ideal cutoff for this sample that maximized the sensitivity and specificity.

Using the other half of the data from our study sample, we validated this new formula using HEDIS components to determine persistent asthma. We calculated the sensitivity and specificity using the formula described in Fig 1.

RESULTS

Patient and Respondent Characteristics

We developed a registry of 3368 patients of 106 health care providers in the study. The health care providers included 104 pediatricians, 1 family practitioner, and 1 nurse practitioner. From these 3368 patients, we randomly selected 2300 patients.

Between July 2001 and June 2002, we contacted the parents of 1933 patients and found that 856 patients did not meet our inclusion criteria, leaving 1077 po-
potentially eligible patients. Reasons for ineligibility included no diagnosis of asthma \( (n = 140) \), no visit for asthma in the last 2 years \( (n = 225) \), no visit with the study physician \( (n = 114) \), not between 2 and 12 years of age \( (n = 153) \), parent works for study physician \( (n = 5) \), sibling of current study patient \( (n = 3) \), other major disease \( (n = 3) \), or a combination of the above \( (n = 214) \). We completed interviews with the parents of 896 of the 1077 potentially eligible patients \( (83\% \text{ response rate}) \).

Table 1 presents the characteristics of the patients and respondents. Patients had a mean age of 7.2 years, 65\% were male, 13\% had Medicaid insurance, 3\% lived in households where English was the second language, 38\% had persistent asthma using the NHLBI definition, and 73\% had persistent asthma using the HEDIS definition.

### Comparison of HEDIS Criteria in Determining Persistent Asthma

Figure 2 shows the classification of patients using the HEDIS criteria (rows), compared with their classification using the NHLBI criteria (columns). The numbers of patients listed in the downward diagonal (gray boxes) indicate those patients for whom the HEDIS criteria matched the NHLBI criteria.

Table 2 shows the test characteristics of the HEDIS criteria compared with the NHLBI criteria, with the latter as a gold standard. Because the NHLBI measure is based on “clinical features before treatment,” we compared the measures with patients who were not taking a daily medication (column 1). For children who were not taking daily medications, the sensitivity of the HEDIS criteria is poor \( (0.45; 95\% \text{ confidence interval [CI]: 0.36–0.54}) \), and the specificity is fair \( (0.68; 95\% \text{ CI: 0.62–0.74}) \).

Because there were only 346 patients without a daily medication, we calculated the test characteristics for all children in our sample (Table 2, column 2) in the second analysis. We assumed that patients might not have asthma symptoms (ie, “intermittent” according to NHLBI criteria) because they were taking appropriate daily controller medicines. When a patient who was taking a daily controller medication was classified as having intermittent asthma using the NHLBI criteria but was classified as having persistent asthma using the HEDIS criteria \( (n = 315) \), top row, far right column in Fig 2), we assumed the disagreement was attributable to the effect of taking an appropriate controller medication. Thus, we assumed that such patients had underlying “persistent asthma” and modified our calculations according to Fig 1.

Including all patients (including those who were taking daily medications) in the analysis improves the sensitivity \( (0.45–0.89) \) and positive predictive value \( (0.41–0.89) \) of the HEDIS criteria but not the specificity or negative predictive value. In this sample, although the HEDIS criteria for persistent asthma were fairly sensitive \( (0.89; 95\% \text{ CI: 0.87–0.91}) \), they were still not very specific \( (0.70; 95\% \text{ CI: 0.64–0.75}) \).

Because our sample included children 2 to 12 years and the HEDIS criteria are applied only to children between 5 and 9 years of age, we stratified our analysis of the sensitivity and specificity. Table 2, columns 3 to 5, shows the HEDIS criteria for persistent asthma as applied to defined age groups, including children 5 to 9 years of age. We found that the test characteristics were consistent across different age group strata.

### Test Characteristics of Individual and Combined HEDIS Criteria

Table 3 compares the different criteria (hospitalizations, ED visits, office visits, and asthma medication–dispensing events) of the HEDIS definition of persistent asthma with the NHLBI assessment of asthma. Although only a single asthma hospitalization and single ED asthma visit both are very specific for persistent asthma \( (0.98 \text{ and 0.90, respectively}) \), they both have low sensitivity at any number of total events. The HEDIS definition uses 4 office visits as a criterion for persistent asthma. At this number of office visits, sensitivity is 0.69 and specificity is 0.85.

The HEDIS definition also uses 4 asthma medication–dispensing events as a criterion for persistent asthma. This single criterion has the highest combined sensitivity and specificity. At this cutoff of 4 asthma medication–dispensing events, sensitivity is 0.80 and specificity is 0.95. Although the medication–dispensing criteria have good specificity alone, the sensitivity is not as high as the combined criteria. Adding criteria to improve sensitivity carries the tradeoff of decreased specificity. When the criteria are combined (ie, hospitalizations, ED asthma visits, and outpatient visits are added), sensitivity improves to 0.89 and specificity drops to 0.70.
Combined HEDIS Criteria in Determining Persistent Asthma

Multivariate logistic regression analysis using the data from a random selection of half of the patients suggested a combined criteria model described in Appendix A. The analysis suggests that using logistic regression to create a combined, weighted model has the following test characteristics: sensitivity 0.78 (±0.06) and specificity 0.85 (±0.08). Although this model is not as sensitive as the current HEDIS model (0.78 vs 0.89), it has greater specificity (0.85 vs 0.70).

DISCUSSION

HEDIS measures are used to determine quality of care and the appropriateness of physician prescription of controller medications. However, we found that although the HEDIS criteria are fairly sensitive (0.89), they are not very specific (0.70) in characterizing persistent asthma in our analysis of this national sample of pediatric patients. For children without daily controller medications (n = 346), the sensitivity was even lower (0.45), but the specificity was similar (0.68).
As a result, many of these patients who had intermittent asthma symptoms on the basis of NHLBI clinical assessment would be labeled as having persistent asthma using HEDIS criteria. Physicians who apply the NHLBI clinical assessment when determining whether to prescribe controller medications would also seem to be underprescribing such medications when HEDIS criteria are used to audit their performance.

There are frequent reports of poor physician use of asthma controller medications. However, reports that rely on HEDIS criteria to determine the quality of asthma care should be interpreted with caution. Discordance between criteria that are clinical assessments, based on the NHLBI guidelines, versus those that are based on medical claims data, such as the HEDIS criteria, may account for some of the apparent differences between ideal and actual physician practice.

An additional complication is that HEDIS criteria for persistent asthma are based on data collected in the previous year. It is well documented that clinical symptoms of asthma can change frequently. The NHLBI clinical assessment of persistent asthma is based on recent symptoms, which may not account for seasonal variations in asthma. This difference in time frames may also help to explain disagreement between the 2 measures. In our study, we also asked patients for a 52-week recall and found good agreement between short-term and long-term recall (k = 0.55; 95% CI: 0.49–0.61) in our patient sample. This suggests that the effect of seasonal variation may not entirely explain the differences between the HEDIS and NHLBI criteria.

There are several limitations to this study. We did not use actual claims data but instead parent recall of asthma health care utilization over the past year. Parent reports of medication use may not be accurate and may overestimate actual asthma medication use. In addition, parent descriptions of asthma events might not match the actual claims that are submitted. However, parent recall for asthma hospitalizations and ED visits has been shown to be accurate. In addition, a medical record review for a sample of our patients confirmed parent reports of asthma health care utilization. Nevertheless, an ideal analysis would use both claims data and data from a parent survey.

In the absence of claims data, we also assumed that each medication used on an “as needed basis” was equivalent to 1 medication-dispensing event over a 1-year period. Because this assumption potentially underestimates the number of medication-dispensing events (which could be as great as 12 per medication), we may have underestimated the number of patients whom the HEDIS criteria would have labeled as having persistent asthma, which may improve its sensitivity but further decrease its specificity.

In addition, we did not have data from pulmonary function tests, another NHLBI criterion that can be used for determining severity of asthma. Frequency of symptoms may not fully capture all cases of serious asthma, especially when onset of severe symp-
isances across plans, and to track improvements over time. As long as the imperfections (from the perspective of clinical care) are consistent, they still may serve the latter purposes. By improving the specificity of the measure by increasing the asthma utilization criteria to define persistent asthma, the total numbers of people in an average health plan with such a utilization profile would be too small to be useful for comparisons of between-plan differences in the measure.

Medical claims are an easily accessible source of data that can be used to describe efficiently aspects of health care use of large numbers of patients. Tradeoffs exist between the ease of data collection and the accuracy of such methods. Clinicians should not ignore HEDIS reports completely, but view such feedback as information from an alternative perspective, with inherent limitations. As the collection, analysis, and interpretation of claims data to describe quality of care become more common, the measures for identifying patients with persistent asthma need to be refined and improved continually.

APPENDIX A

We used a multivariate logistic regression analysis using the data from a random selection of half of the data from the patients in our sample to develop a combined criteria model to determine persistent asthma. An example model shown below was generated from this first set. In the model, X is the probability of having persistent asthma on the basis of the NHLBI criteria.

\[
\text{logit}(X) = \beta_1 + \beta_2 \times \text{number of asthma medication–dispensing events} + \beta_3 \times \text{number of asthma hospitalizations} + \beta_4 \times \text{number of ED asthma visits} + \beta_5 \times \text{number of outpatient asthma office visits}
\]

We selected a cutoff of \( x = 0.50 \) to maximize the sensitivity and specificity. Thus, if \( x > 0.50 \), then the model predicted that the patient would have persistent asthma; if \( x \leq 0.50 \), then intermittent asthma would be predicted. The second half of the data from the patients was used to determine the sensitivity and specificity of the model. This procedure was generated 100 times to develop a robust estimate of the test characteristics. The adapted combined model had an average sensitivity of 0.78 (±0.06) and a specificity of 0.85 (±0.08). Although this model is not as sensitive as the current HEDIS model (0.78 vs 0.89), it has greater specificity (0.85 vs 0.70).

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