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SPECIAL ISSUE: BRIDGING THE GAP BETWEEN RESEARCH AND HEALTH POLICY-INSIGHTS FROM ROBERT WOOD JOHNSON FOUNDATION CLINICAL SCHOLARS PROGRAM

The Association of Health Insurance and Disease Impairment with Reported Asthma Prevalence in U.S. Children

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Objective. To test the hypotheses that reported asthma prevalence is higher among insured than uninsured children and that insurance-based differences in asthma diagnosis, treatment, and health care utilization are associated with disease severity.

Data Sources. National Health and Nutrition Examination Survey, 2003–2008.

Study Design. We used multivariate logistic regression to examine the relationship between insurance and asthma symptom severity with asthma diagnosis, treatment, and acute care utilization.

Principal Findings. In multivariate analysis, insured children had greater odds of reporting a current diagnosis of asthma than uninsured children (odds ratio [OR] = 2.08, 95% confidence interval [CI]: 1.47–2.94). When interactions between insurance and asthma impairment were included, insurance was associated with greater odds of diagnosis among children with intermittent (OR = 4.08, 95% CI: 1.57–10.61), but not persistent, symptoms. Among children with intermittent symptoms, insurance was associated with inhaled corticosteroid use (OR = 4.51, 95% CI: 1.18–17.24) and asthma-related acute care utilization (OR = 5.21, 95% CI: 1.21–23.53); these associations were nonsignificant among children with persistent symptoms.

Conclusion. Being insured increases only the likelihood that a child with intermittent, not persistent, asthma symptoms will receive an asthma diagnosis and control medication, and it may not reduce acute care utilization. Although universal insurance may increase detection and management of undiagnosed childhood asthma, theorized cost savings from reduced acute care utilization might not materialize.

Key Words. Asthma, children, insurance, asthma impairment, health services utilization

Providing health insurance to uninsured children with known asthma can result in improved asthma outcomes, including fewer asthma attacks and less frequent asthma-related hospitalizations and emergency department (ED) visits (Szilagyi et al. 2006). In addition, there may be a large reservoir of symptomatic but undiagnosed asthma in children, ranging from 12 to 17 percent of

all children, especially in urban, low-income, and minority populations (Webber et al. 2002; Yeatts et al. 2003a,b; Joseph et al. 2005; Mvula et al. 2005; Quinn et al. 2006; Clark et al. 2010).

The Children's Health Insurance Program Reauthorization Act (CHIPRA) and the Affordable Care Act (ACA) may lead to a large number of uninsured children becoming insured (Kaiser Family Foundation 2010; Sebelius 2010). Few data explore the relationship between health insurance and asthma diagnosis and outcomes for undiagnosed children. One of the few published studies found that symptomatic children in Bronx, New York schools with an asthma diagnosis were more likely to have health insurance than those without an asthma diagnosis (Webber et al. 2002).

Even if insurance status does increase the chance of an asthma diagnosis, whether that diagnosis leads to reduced asthma-related acute care utilization (i.e., acute care for exacerbation of asthma symptoms) is unclear. Previous studies have documented lower rates of ED and physician visits for wheezing, and fewer missed school days among undiagnosed symptomatic children compared with diagnosed asthmatic children (Yeatts et al. 2003b; Joseph et al. 2005; Gerald et al. 2009). It is plausible that enhanced diagnosis may increase asthma-related acute care utilization rather than prevent it. Children with undiagnosed asthma may be underutilizing acute care services, for reasons related to poor access to care or inadequate knowledge regarding asthma. Another explanation may be that additional utilization of services for children diagnosed with asthma is

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related less to clinical need than to patient and physician factors (Emanuel and Fuchs 2008).

The purpose of this study was to examine the differences in asthma diagnosis and outcomes among children with and without insurance, and to determine the association between health insurance and asthma diagnosis, impairment level, and asthma-related outcomes among children with asthma symptoms. Accounting for factors known to be associated with asthma prevalence (e.g., race/ethnicity), we hypothesized that uninsured children would have a lower reported asthma prevalence than insured children (due to less screening and detection), and that this disparity would be seen primarily in children with intermittent rather than persistent symptoms (because children with persistent symptoms would be more likely to be detected regardless of health insurance status). In addition, we hypothesized that differences in acute care utilization would be modest, given the tendency of greater screening to detect intermittent rather than persistent asthma.

METHODS

We used NHANES, a population-based survey of U.S. households conducted by the National Center for Health Statistics. NHANES uses a complex, multistage probability sample of the U.S. civilian, noninstitutionalized population. We used the following questionnaire components: (1) Respiratory Health and Disease, (2) Medical Conditions, (3) Hospital Utilization and Access to Care, (4) Prescription Medications, and (5) Demographics. Data from surveys in 2003–2004, 2005–2006, and 2007–2008 were aggregated for our analysis. For children <16, data are reported by an adult in the household, usually a parent or guardian. Our analysis is restricted to 11,719 children aged 1–17.

Measures

We used NHANES to assess asthma diagnosis, symptoms, inhaled corticosteroid use, and asthma exacerbation-related acute care visits (at a doctor's office or ED).

Asthma Diagnosis. Participants were asked whether a doctor or other health professional had ever told them that they have asthma and, if so, whether they still had the diagnosis. Only participants who answered yes to both questions

were considered to have a current diagnosis of asthma, henceforth referred to simply as "diagnosis" of asthma.

Asthma Severity. The National Heart, Lung, and Blood Institute (NHLBI) Asthma Guidelines (National Heart Lung, Blood Institute 2007) categorize children with asthma symptoms as intermittent or persistent, based on the level of impairment and risk. The guidelines specify impairment and risk criteria for distinguishing intermittent from persistent asthma in children not currently on asthma control medication. For children ≥ 5 years of age, those with intermittent asthma use a short-acting beta2 agonist <3 days/week, have asthma symptoms <3 days/week, have <3 nighttime awakenings/month, have no interference with normal activity, and have <2 asthma exacerbations requiring oral steroids per year. The NHLBI guidelines differ for children <5 in that children with any night-time awakenings, with >1 exacerbation requiring oral steroids in 6 months, and, when asthma risk factors are present, with >3 wheezing episodes/year are considered to have persistent asthma.

NHANES does not include all of this information on asthma impairment and risk. Therefore, we used only the NHANES respiratory symptoms questions that matched reasonably well with NHLBI criteria (see Table S1). We used the following criteria to categorize children with varying levels of asthma severity: children <5 years were categorized as having persistent asthma symptoms if they reported wheezing in the past 12 months *and* reported any of the following in the past 12 months: (1) any limitation of activity due to wheezing, (2) >3 wheezing episodes, or (3) any sleep disturbances from wheezing. Children <5 years who reported wheezing, but did not report one of those impairments, were categorized as having intermittent symptoms. Children who reported no wheezing at all in the past 12 months were categorized as having no symptoms of asthma. For children ≥ 5 years old, criteria were the same except that sleep disturbances needed to occur at least weekly to be considered persistent asthma (when sleep disturbances are reported, NHANES only asks if they occur <1 night per week or ≥ 1 night per week), and the number of wheezing attacks was not considered.

Medications and Asthma-Related Acute Visits. Participants were asked the names of prescribed medications taken in the past 30 days. We considered only the following asthma-related medication categories: (1) inhaled corticosteroids (alone or in combination with long-acting bronchodilators), (2) short-acting

bronchodilators, and (3) other long-term control medications, including long-acting bronchodilators (without corticosteroids), leukotriene inhibitors, and mast cell stabilizers. Each medication category was coded as 1 if the child reported taking the medication in the past 30 days. Participants also provided the number of times in the past 12 months they visited a doctor's office or ED for an "attack of wheezing or whistling."

Demographics. We used the following NHANES demographic data: child age, child gender, child race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, and other), child insurance status (insured versus uninsured), and family income as a percentage of the family composition-adjusted federal poverty level (FPL). Insurance status was initially categorized as uninsured, publicly insured (Medicaid and SCHIP), privately insured, and other. As differences between (1) uninsured and publicly insured and (2) uninsured and privately insured were both significant in the same direction for our main outcome, and because previous literature has documented that publicly and privately insured children often receive similar quality of primary care (with publicly insured children receiving even higher quality care in some cases; Perry and Kenney 2007; Newacheck et al. 2009; Berdahl et al. 2010), we combined publicly and privately insured children into a single insured category.

Statistical Analysis

All analyses used survey-specific weights to account for potential nonresponse bias and noncoverage of households without a telephone, and to provide national estimates. Analyses were conducted using *Stata/SE* version 11 (StataCorp LP, College Station, TX, USA) to adjust for the complex survey design. To account for potential bias caused by item nonresponse, we used imputation by chained equations (Royston 2009). With the exception of family poverty level, no variable used in our imputations and analyses was missing >1 percent of observations.

Using logistic regression, we estimated the odds of having a diagnosis of asthma by insurance status, with interaction terms between insurance status and each level of symptom impairment (no symptoms, intermittent asthma symptoms, persistent asthma symptoms). Using logistic regression and controlling for demographic variables, we examined whether insured children, regardless of asthma diagnosis, had higher odds of reporting any intermittent or persistent asthma symptoms.

NHLBI classification of severity as determined by symptom impairment and risk applies only to children not currently taking long-term control mediations. For children on long-term control medications, lack of symptom impairment might simply reflect adequacy of control. As this information was not available through NHANES, we conducted sensitivity analyses to determine whether our multivariate logistic regression results would be altered by limiting our analyses to children not currently on control medications.

Next, we used logistic regression to examine the odds of children with and without insurance (1) having used an inhaled corticosteroid in the past 30 days, and (2) having a doctor's office or ED visit in the past 12 months for an asthma attack. In these multivariate regression models, we included demographic variables as covariates. We also conducted additional sensitivity analyses to examine whether any difference detected in the odds of having an asthma exacerbation-related acute visit would be affected by the inclusion of controller asthma medication use in our model.

RESULTS

Sample Characteristics

Table 1 describes the characteristics of the 11,714 children under the age of 18 in the sample. Fifty-nine percent of children were non-Hispanic White, 15 percent were non-Hispanic Black, and 19 percent were Hispanic. Eleven percent of children were uninsured, and 45 percent of children had a household income under 200 percent of the FPL. Ten percent had a current diagnosis of asthma, 13 percent reported wheezing in the past 12 months, 7 percent reported sleep disturbances due to wheezing, and 6 percent reported that wheezing limits their activity. Two percent of children were currently taking an inhaled corticosteroid, and 3 percent were taking another long-term asthma control medication (long-acting beta-agonists and immunomodulaters). Of note, very few children without a current diagnosis of asthma reported using these asthma-related medications (e.g., 0.04 percent for inhaled corticosteroids) (data not shown). Using our categorization for symptom severity, 87 percent reported no symptoms, 5 percent reported having intermittent symptoms, and 8 percent reported having persistent symptoms.

Among children with a diagnosis of asthma, 6 percent ($n = 104$) were uninsured, and 94 percent ($n = 1110$) were insured. Forty-nine percent

Table 1: Sample Characteristics (n = 11,714)

General Characteristics	*%*	*N*
Child gender (female)	49	5,803
Child race/ethnicity		
Hispanic	19	4,258
Non-Latino Black	15	3,505
Non-Hispanic other	7	621
Non-Hispanic White	59	3,330
Child age (years)		
<5	24	3,271
5–11	40	4,074
12–18	37	4,369
Income as % FPL		
0–99	22	3,798
100–199	23	3,137
200–399	30	2,990
≥ 400	25	1,789
Health insurance		
Uninsured	11	1,670
Private	56	4,945
Medicaid/SCHIP	22	3,525
Other (Military, Indian Health Service, other*)	10	1,502
Survey year		
2003–2004	33	4,022
2005–2006	33	4,256
2007–2008	33	3,436
Asthma-related characteristics		
Has a current diagnosis of asthma	10	1,214
Wheeze in past year	13	1,540
Sleep disturbance		
Never	93	10,803
<1 per week	4	480
At least 1 per week	3	431
Activity Limitation, any	6	679
Currently taking ICS	2	290
Currently taking other long-term controller medication*	3	245
Currently taking short-acting bronchodilator	5	577
Asthma symptom severity		
No symptoms	87	10,174
Intermittent symptoms	5	562
Persistent symptoms	8	978

Notes. *Includes long-acting bronchodilators and immunomodulators.
ICS, inhaled corticosteroids; FPL, federal poverty level.

(n = 721) of children with asthma symptoms (intermittent or persistent) did not have a diagnosis of asthma. Among all symptomatic but undiagnosed children, 11 percent were uninsured (Table 2).

Table 2: Child Insurance Status by Asthma Diagnosis

	Insured, % (n)	*Uninsured, % (n)*
Current asthma diagnosis	94 (1,110)	6 (104)
Undiagnosed, symptomatic	89 (647)	11 (74)
Undiagnosed, asymptomatic	88 (8,287)	12 (1,492)

Table 3: Adjusted Odds Ratio of Having a Current Asthma Diagnosis by Insurance Status and Disease Impairment

Predictor	*Unadjusted Odds Ratio (95% CI)*	*Adjusted Odds Ratio (95% CI)*
Insured (uninsured at each of three symptoms levels is reference category)		
With no asthma symptoms	1.91 (1.16–3.14)	2.01 (1.23–3.31)
With intermittent asthma symptoms	3.57 (1.34–9.51)	4.08 (1.57–10.61)
With persistent asthma symptoms	1.39 (0.81–2.40)	1.45 (0.88–2.39)
Household income as % of FPL		
0–99	Reference	Reference
100–199	0.86 (0.65–1.14)	0.77 (0.54–1.09)
200–399	0.90 (0.67–1.20)	0.83 (0.58–1.19)
≥ 400	0.84 (0.66–1.06)	0.77 (0.54–1.08)
Race/ethnicity		
White non-Hispanic	Reference	Reference
Hispanic	0.85 (0.72–1.02)	1.03 (0.79–1.35)
Black non-Hispanic	1.70 (1.44–2.01)	1.84 (1.49–2.27)
Other	0.81 (0.51–1.30)	1.01 (0.62–1.64)
Child age (years)	1.04 (1.03–1.06)	1.11 (1.09–1.12)
Child gender (female)	0.86 (0.73–1.01)	0.98 (0.81–1.18)
Survey wave		
2003–2004	Reference	Reference
2005–2006	1.20 (1.01–1.42)	1.29 (1.02–1.63)
2007–2008	1.14 (0.96–1.37)	1.28 (0.96–1.69)

Note. CI, confidence interval; FPL, federal poverty level.

Asthma Diagnosis

In multivariate regressions controlling for demographics, the odds of having a diagnosis of asthma were 2.08 times greater for insured versus uninsured children (95% CI: 1.47–2.94). When interactions between insurance and asthma impairment were included; however, the association held true only for children with no or intermittent symptoms (Table 3). Insured children with no and intermittent asthma symptoms, respectively, had 2.01 (95% CI: 1.23–3.31) and 4.08 (95% CI: 1.57–10.61) times the odds of

having an asthma diagnosis compared with uninsured children. Among those with persistent symptoms, the association was not significant (OR: 1.45, 95% CI: 0.88–2.39).

In a sensitivity analysis (not shown), we repeated these multivariate regressions using only children who were currently not taking any long-term asthma control medications (NHLBI severity classifications only apply to children not taking long-term control medications). Our results were similar to the analysis with the full sample of children; insured children were more likely to have a diagnosis of asthma (AOR: 1.88, 95% CI: 1.29, 2.73), and this association was also true for insured children with no (AOR: 1.73, 95% CI: 1.03–2.90) and intermittent symptoms (AOR: 3.49, 95% CI: 1.31–9.30), but not for children with persistent symptoms (AOR: 1.40, 95% CI: 0.80–2.44).

The fact that insured children were more likely to be diagnosed with asthma than uninsured children could not be attributed to a greater reported prevalence of asthma symptoms. In multivariate regressions controlling for both demographics and asthma medication use (not shown), insured children were no more likely to report any (OR: 1.05, 95% CI: 0.75–1.46), intermittent (OR: 0.88, 95% CI: 0.54–1.44), or persistent (OR: 1.23, 95% CI: 0.89–1.70) asthma symptoms than uninsured children.

Inhaled Corticosteroid Use

In multivariate regressions controlling for demographics (Table 4), insured children with no or intermittent symptoms had, respectively, 10.54 (95% CI: 2.24–49.71) and 4.51 (95% CI: 1.18–17.24) times greater odds of using inhaled corticosteroids as uninsured children. Among children with persistent symptoms, however, no significant difference was detected (OR: 1.18, 95% CI: 0.53–2.61).

Asthma-Related Outpatient and ED Visits

In multivariate regressions controlling for demographics (Table 5), insured children with intermittent symptoms were more likely than uninsured children to have had an acute care visit at a doctor's office or ED for an asthma attack (OR: 5.21, 95% CI: 1.21–22.53). This difference was not found among children with persistent asthma symptoms (OR: 1.03, 95% CI: 0.42–2.52). In sensitivity analyses, we found similar results when including inhaled corticosteroid use as a covariate in our model.

Table 4: Adjusted Odds Ratio of Using Inhaled Corticosteroids (Past 30 Days) by Insurance Status and Disease Impairment

Predictor	*Unadjusted Odds Ratio (95% CI)*	*Adjusted Odds Ratio (95% CI)*
Insured (uninsured at each of three symptoms levels is reference category)		
With no asthma symptoms	11.21 (2.36–53.19)	10.54 (2.24–49.71)
With intermittent asthma symptoms	4.96 (1.36–18.08)	4.51 (1.18–17.24)
With persistent asthma symptoms	1.21 (0.55–2.64)	1.18 (0.53–2.61)
Household income as % of FPL		
0–99	Reference	Reference
100–199	0.83 (0.50–1.38)	0.79 (0.46–1.35)
200–399	0.83 (0.55–1.26)	0.79 (0.50–1.27)
≥ 400	1.09 (0.70–1.70)	1.07 (0.65–1.78)
Race/ethnicity		
White non-Hispanic	Reference	Reference
Hispanic	0.73 (0.51–1.04)	0.88 (0.60–1.29)
Black non-Hispanic	1.39 (1.03–1.87)	1.27 (0.94–1.72)
Other	0.51 (0.21–1.24)	0.58 (0.25–1.36)
Child age (years)	1.00 (0.97–1.03)	1.03 (0.99–1.06)
Child gender (female)	0.79 (0.56–1.10)	0.91 (0.64–1.30)
Survey wave		
2003–2004	Reference	Reference
2005–2006	1.85 (1.34–2.56)	1.90 (1.39–2.59)
2007–2008	1.84 (1.28–2.65)	1.99 (1.33–2.98)

Note. CI, confidence interval; FPL, federal poverty level.

DISCUSSION

Insured children with intermittent asthma symptoms have a greater likelihood of being diagnosed with asthma and receiving long-term inhaled corticosteroid treatment than those without insurance. Furthermore, insured children with intermittent symptoms are also more likely to make acute outpatient and ED visits for asthma attacks. These differences in asthma diagnosis, treatment, and utilization by health insurance were not observed for those with persistent symptoms.

Our findings suggest that, although health insurance may be an important factor in asthma diagnosis among children with intermittent symptoms, it may play a much smaller role in asthma diagnosis among children with persistent symptoms. Insured children with persistent symptoms are about as likely to have a diagnosis of asthma as uninsured children with similar symptoms. One likely explanation is that, because children with persistent symptoms

Table 5: Adjusted Odds Ratio of Having a Doctor's Visit or Emergency Department Visit for an Asthma Attack (Past 12 Months) by Insurance Status and Disease Impairment

Predictor	*Unadjusted Odds Ratio (95% CI)*	*Adjusted Odds Ratio (95% CI)*
Insured (uninsured at each of three symptoms levels is reference category)		
With no asthma symptoms	1.87 (0.23–14.97)	2.20 (0.28–17.36)
With intermittent asthma symptoms	5.26 (1.17–23.65)	5.21 (1.21–22.53)
With persistent asthma symptoms	0.95 (0.41–2.21)	1.03 (0.42–2.52)
Household income as % of FPL		
0–99	Reference	Reference
100–199	0.91 (0.62–1.33)	0.93 (0.62–1.39)
200–399	0.52 (0.34–0.79)	0.57 (0.36–0.91)
≥ 400	0.52 (0.31–0.89)	0.68 (0.39–1.19)
Race/ethnicity		
White non-Hispanic	Reference	Reference
Hispanic	1.30 (0.83–2.02)	1.43 (0.86–2.38)
Black non-Hispanic	2.77 (1.92–3.98)	2.44 (1.65–3.59)
Other	0.99 (0.45–2.16)	1.27 (0.54–3.01)
Child age (years)	0.97 (0.94–1.00)	1.02 (0.98–1.05)
Child gender (female)	0.59 (0.40–0.88)	0.74 (0.48–1.13)
Survey wave		
2003–2004	Reference	Reference
2005–2006	1.11 (0.73–1.69)	1.15 (0.79–1.68)
2007–2008	0.94 (0.61–1.46)	0.98 (0.61–1.57)

Note. CI, confidence interval; FPL, federal poverty level.

have a higher level of need for acute asthma care, they tend to present to clinics, urgent care centers, and EDs regardless of their insurance status, thus creating similar opportunities for diagnosis.

Among children with intermittent asthma symptoms, insured children were more likely than uninsured children not only to take an inhaled corticosteroid but also to have had a recent acute care visit or ED visit for "wheezing attacks." This finding is somewhat counterintuitive, given that inhaled corticosteroids have been shown to reduce acute care utilization. There are at least three plausible explanations for this observation. First, some uninsured children may have a similar need for acute care as insured children but may be unable to receive it consistently because they do not have insurance (Stoddard, St. Peter, and Newacheck 1994; Kenney 2007; Hoffman and Paradise 2008). Alternatively, some children with intermittent symptoms may overutilize acute care services once they are provided with both insurance and a

diagnosis; for instance, a diagnosis of asthma may sensitize parents and heighten their anxiety about minor symptoms. Third, the increased acute care utilization may have occurred before the patient began using the inhaled corticosteroid.

Our findings suggest that there may be a significant "reservoir" of undiagnosed asthmatic children, especially among those who lack health insurance. The benefits of identifying these children, however, are unclear—they are more likely to have intermittent symptoms, which may not benefit greatly from control therapy. As access to insurance expands through health care reform, asthma diagnoses may increase from their current plateau, and we may see additional increases in inhaled corticosteroid use. Such increases, however, may incur a cost that might not greatly improve societal health.

This study has several important limitations. First, based on the age of the participant (1–15 years versus 16–17 years), the data were collected via parent-report or self-report. We do not have data on differences in the accuracy of the reporting methods based on these age groups for reporting asthma-related symptoms, medication, and utilization. Second, our findings are based on cross-sectional data, and we are unable to determine the temporal ordering of events. For example, some children with no or intermittent symptoms were taking inhaled corticosteroids, and possibly had persistent asthma that was now well-controlled on inhaled corticosteroids. However, our sensitivity analysis suggested that our findings were similar when restricted to children not currently on a control medication. Next, our analysis used a limited number of covariates that could have missed important confounders. For example, our study confirms previous studies showing that asthma diagnosis and symptoms vary by race/ethnicity (Akinbami, Rhodes, and Lara 2005; Gold and Wright 2005; Quinn et al. 2006; Crocker et al. 2009; Flores and The Committee on Pediatric Resarch 2010). Some evidence suggests that much of this disparity can be attributed to socioeconomic factors (Litonjua et al. 1999; Smith et al. 2005); however, other factors related to race/ethnicity, such as stress, also appear to be critical (Gold and Wright 2005; Williams, Sternthal, and Wright 2009). Finally, we were unable to use NHLBI guidelines to categorize asthma severity. Some of the indicators of symptom severity that we used are also in the NHLBI classification, but there are also some indicators from NHLBI that were not available in the NHANES dataset. A side-by-side comparison of the criteria used in this study compared with the criteria used in the NHLBI 2007 guidelines is available as Table S1.

In conclusion, we found that having health insurance is associated with an increased likelihood that a child with intermittent asthma symptoms will

receive an asthma diagnosis and asthma control medication, but it is not associated with improvements in asthma-related acute care utilization. We also found that, for children with persistent symptoms, having health insurance is not associated with diagnosis, treatment, or utilization. These findings suggest that while increasing access to insurance could lead to the identification of more children with intermittent asthma symptoms, benefits with respect to acute care utilization remain unclear. CHIPRA and expanded Medicaid coverage of parents under the ACA may lead to many previously uninsured children in the United States becoming insured (Kaiser Family Foundation 2010; Sebelius 2010). This increase in the proportion of insured children may reduce the number of undiagnosed children with intermittent asthma symptoms and ensure that they receive more appropriate treatment; large cost savings from reduced acute care utilization, however, may not be a realistic expectation. Potential long-term benefits and costs of detecting and treating undiagnosed asthma in these newly insured children should be explored.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table S1: Severity Classification for Children with Asthma, Not Taking Controller Medication.

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