



Asthma Regional Council  
of New England

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# Living with Asthma in New England:

Results from the 2006 BRFSS and Call-Back Surveys

*A report by the Asthma Regional Council (ARC) of New England*

**Author: Laurie Stillman, MM**

**Data Analysis: Mary Adams, MS, MPH**

**Contact Information:**

Stacey Chacker  
Director of Environmental Health  
and Asthma Regional Council  
Health Resources in Action  
622 Washington Street  
Dorchester, MA 02124  
617.451.0049 ext. 536

[www.asthmaregionalcouncil.org](http://www.asthmaregionalcouncil.org)

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Report authored by  
**Laurie Stillman, M.M.**  
Public Health Policy and Strategies Center at  
Health Resources in Action – Boston, MA.

Data analysis provided by  
**Mary Adams, M.S., M.P.H.**  
On Target Health Data, LLC – Suffield, CT.

## **Asthma Regional Council's Mission is:**

*“To reduce the impact of asthma across New England through collaborations of health, housing, education, and environmental organizations, with particular focus on the contribution of schools, homes, and communities to the disease and with attention to its disproportionate impact on populations at greatest risk.”*

ARC is a program of Health Resources in Action, Inc of Boston. ([www.hria.org](http://www.hria.org))

ARC's Director:  
**Stacey Chacker**

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# EXECUTIVE SUMMARY

The New England Asthma Region Council (ARC) continued its surveillance of asthma in the region by using data collected from the 2006 standard Behavioral Risk Factor Surveillance System (BRFSS) for all six New England states and from the 2006 BRFSS Asthma Call-back surveys conducted in five of the six New England states (excluding Rhode Island).

A number of themes emerged from this BRFSS analysis, all of which have important policy implications: (1) New England continues to have the highest regional prevalence rate of adult asthma in the nation, even when statistically corrected for confounding variables that might be thought to impact regional differences (national comparisons could not be undertaken for children.); (2) persistent problems with control and severity of the disease can be clearly detailed for the first time; (3) the analysis highlights a negative effect on the labor force and employment from poorly controlled and severe asthma; and (4) socio-demographic and gender disparities persist in prevalence and burden.

**Finding 1:** The current asthma rate among New England adults is 9.7%, which is significantly higher than the 8.1% rate for the rest of the U.S. combined. This was true on an unadjusted basis and also when statistically controlled for potentially confounding factors. In addition, the overall adult rate of current asthma has increased significantly during the period 2001-2006, since ARC began monitoring asthma in New England using the BRFSS. This increase appears to be accounted for solely by the increase in women's asthma rates from 10.8% to 11.7%, while the rates for men were statistically similar at 7.0%-7.5%.



**Finding 2:** One of the most serious findings emerging from the analysis of the BRFSS data sets is that the lack of control of disease symptoms is a critical issue for both New England's adults and children, and that asthma cannot be assumed to be well-managed, even with excellent, well-disseminated national guidelines for asthma control. Almost two-thirds of adults and children who currently have asthma were considered to have "not well controlled" or "very poorly controlled" disease.

**Finding 3:** Significant numbers of working adults – as many as 40% – reported that they believed that their asthma was either initiated or exacerbated by their work ("work-related asthma").

Finally, this report confirms earlier findings that lower socioeconomic status is directly associated with higher asthma prevalence rates and more severe symptoms among those that have the disease. Obesity and smoking—or exposure to smokers in the home, are also important factors.

The following report provides a more detailed analysis of the data, along with recommendations for addressing the important findings.



# I. Introduction

## Background:

The Asthma Regional Council of New England (ARC) has issued two reports about the status of asthma and its burden in New England. The first report, issued in two parts in 2003 and early 2004<sup>ii</sup>, was based on adult and child results from the 2001 standard Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is an ongoing state based telephone survey conducted in all 50 states, the District of Columbia and some territories and interviews randomly-selected non-institutionalized adults about their health, preventive health care, health conditions and risk factors. The 2001 BRFSS survey noted an estimated 941,000 New England adults and 288,000 children currently had asthma, or approximately 9% of all adults and children. However, the 2001 data focused on asthma prevalence rather than disease burden.

To address some of these limitations, ARC issued a second report in 2006<sup>iii</sup>, which used both 2004 standard BRFSS data on adults as well as the 2003-2004 National Survey of Children's Health. This report, which provided additional information on the *burden* of asthma on children and their families, indicated that current asthma had increased among both adults and children since 2001 to 1 million adults and 330,000 children. (Lifetime asthma rates were even higher.) Results presented in those two reports, and a further analysis<sup>iv</sup>, suggested that New England asthma rates were both consistently and significantly higher than in the other nine U.S. Department of Health and Human Services (DHHS) regions of the country.

In an effort to continue its asthma surveillance and expand on those earlier reports, ARC made use of an even richer source of data that was not available before. These new data were derived from **Asthma Call-back Surveys** that were conducted as a follow-up to the 2006 standard BRFSS. Soon after the standard BRFSS was administered, additional follow-up phone interviews were conducted to obtain extensive information about children and adults who were reported as having asthma at the initial interview. Five of the six New England states (all except Rhode Island) conducted these asthma call-back surveys in 2006, which were funded by the Centers for Disease Control and Prevention (CDC) at the U.S. Department of Health and Human Services (DHHS). Information was obtained in these follow-up interviews on 1,986 adults (range: 235 in ME to 572 in VT) and 516 children (range: 63 in ME to 124 in VT) in New England who had reported either current or lifetime asthma.

In addition to the information from the adult and child call-back surveys for the five New England (NE) states, this report includes an update on NE adult and child asthma prevalence rates from all six states through the standard BRFSS. This report compares the NE region's adult asthma rates with the

rest of the U.S., and makes comparisons between NE adults with and without asthma. There is also a trend analysis of adult prevalence rates across the 2001-2006 time period. Because not all states across the nation are asked about child asthma on the BRFSS, the comparisons between states or over time are not possible with the child data.

## II. Adult Asthma Prevalence & Trends

### (Results for six NE states from the standard 2006 BRFSS)

#### A. Adult Asthma Prevalence.

##### *Key Findings:*

- An estimated 1 million New England adults are currently affected by asthma.
- The current adult asthma rate in NE was significantly higher than in the rest of the U.S. (9.7% vs. 8.1%, Figure 1). This held true even when rates were controlled for a number of potentially confounding factors that could influence differing rates across the country.
- New England had the highest current adult asthma rate of any of the ten DHHS Regions and this rate was significantly higher than six of the other nine regions. The current adult asthma rate in DHHS Region 1 (New England) was significantly higher than the rate of the other nine DHHS regions combined. New England's rate was highest both in unadjusted analyses (Table 1) as well as when controlling for potentially confounding factors.
- Both lifetime and current asthma rates were higher among New England women than men (16.2% vs. 12.5% for lifetime rates, and 11.7% vs. 7.5% for current rates).
- High-risk populations for having current asthma included younger adults, those with lower income and education, those unable to work, the obese, and smokers. These populations were also identified in the 2004 analysis.

*Within New England, rates were statistically similar in all six New England states for both lifetime and current asthma (Figure 2).*

##### Current and Lifetime Adult Asthma Rates:

##### New England and U.S.

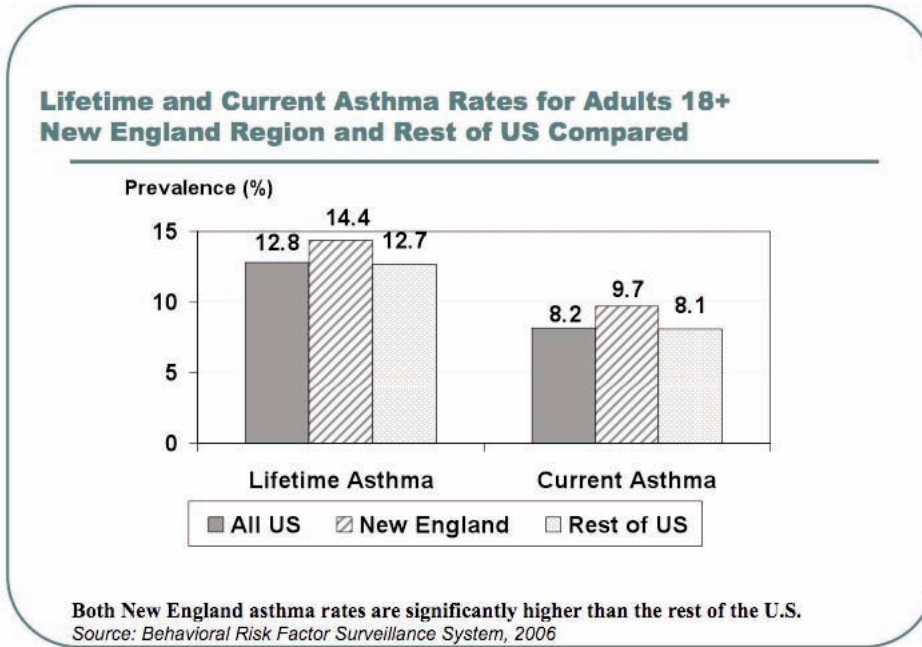
The results of this analysis demonstrate that, in 2006, New England continued to have the highest current asthma rates and the second highest lifetime asthma rates among adults of the ten DHHS regions (Table 1). New England also had significantly higher rates when compared with the other nine DHHS regions combined (Figure 1) and compared with six of the nine other regions when taken separately.

Because the comparisons in asthma rates between NE and the rest of the country did not take into account the demographic differences in other regions of the country, additional analyses of the 2006 data were conducted. This multivariate statistical analysis took into account other factors, which have been

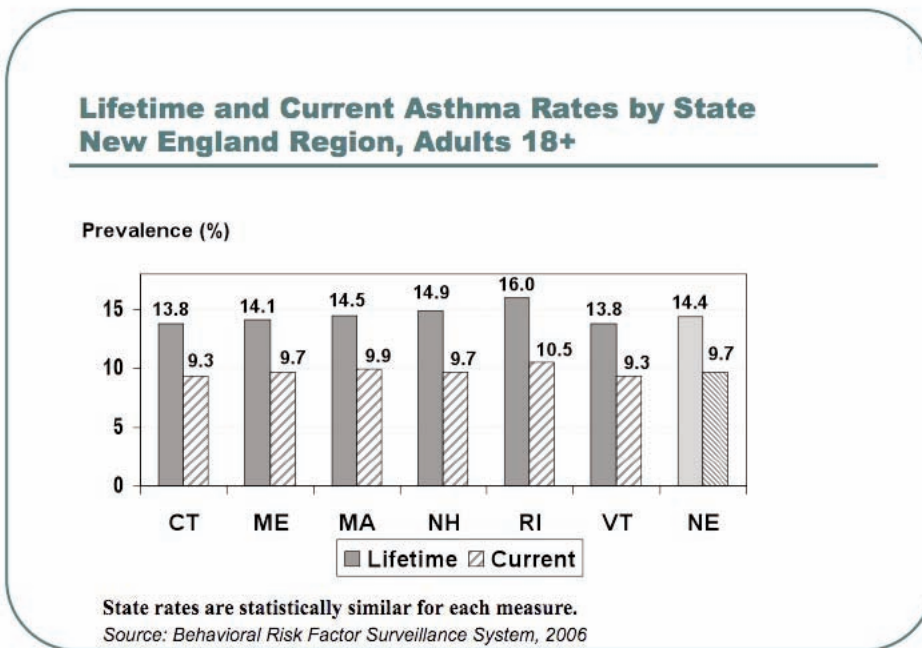
shown to influence asthma rates, and could potentially explain why NE rates might be higher than other regions of the country. These factors included gender, age, race/ethnicity, income, education, and marital, overweight and smoking status. The analysis uncovered that, even after controlling for these factors, current asthma rates in New England are still significantly higher than elsewhere in the U.S., and cannot be easily

explained by the most frequently recognized factors that might affect asthma rates differently across the country.<sup>2</sup> The odds ratio of 1.26 produced in the analysis indicates that the “odds” of having current asthma in NE is 26% higher than the odds in the rest of the country. (Details of this analysis, along with tables showing intermediate and final results, are in the Technical Notes of this report in Appendix C).

**Figure 1.**



**Figure 2.**



<sup>2</sup> Analyses were also conducted comparing *each* of the other nine DHHS regions with New England (as the reference). These results showed that the current asthma rate in each region was significantly less than the New England rate, with ORs ranging from 0.7-0.9, again indicating that the New England asthma rates are highest.

## Statistical Explanations:

The following section provides an overview of some of the key statistical concepts that are used in this report.

### Confidence Intervals

The BRFSS and Adult and Child Asthma Call-back Surveys collect information from a random sample of respondents. Because of this, results are considered estimates of the larger population. Special software that takes the surveys' sampling methods into account was used to calculate point estimates and their corresponding 95% Confidence Interval (CI). This range of values (CI) has a 95% probability of containing the "true" population value.

The Supplemental Tables also include information on the sample sizes of the overall surveys as well as among each sub-group. In these tables, the N refers to the actual number of respondents in the denominator (or total) and the n refers to the numerator. Because these numbers were weighted and then the complex sampling design of the BRFSS was taken into account in our analysis, these unweighted numbers will not reproduce the results presented in this report. Whenever the total N for a group was <500, results in the figures were rounded off to whole numbers for percents and to one decimal place for means. Sample sizes for the results presented in Section II from the standard BRFSS ranged from 4,000 -12,000 for the New England states, (42,713 total for New England), with similar N's for the other states (345,593 total).

### Sub-Group Analyses

Comparisons between sub-groups (e.g., by age group, gender, race/ethnicity) were also conducted to detect whether there were statistically significant differences between groups. In the discussion of findings, when the terms "**more likely**" or "**higher than**" are used, this indicates that differences between groups were found to be statistically significant. The significance level (P-value) for all tests was set at 0.05. That is, when two or more groups are compared and the P-value is <0.05, results indicate that the difference is unlikely to result from chance alone. However, it should be noted that when more than two groups are compared, a P-value of <0.05 does not signify which of the groups is significantly different from the others.<sup>1</sup>

Conducting statistical tests for differences by sub-group is affected by the sample size of each group. Because the number of adult respondents for the Call Back surveys was 1,986 for the five states, the sample size for some sub-groups was small. In some instances, two rates may look like they should be significantly different, but they are not because of small sample sizes. Additionally, sometimes sub-groups needed to be combined in order to run statistical tests. For example, adults who had asthma and whose race was something other than non-Hispanic

white were grouped together into one category called "Other" – or other than Non-Hispanic white (which consisted of 26 blacks, 67 Hispanics, and 46 of other race/ethnicities). It is possible that a larger sample size, or combining multiple years of data, might show significant differences that are not apparent with smaller samples.

### Multivariate Analyses

Examining whether there are significant differences between two or more groups indicates whether there is an association between two (or more) factors but does not provide any information about cause or effect and does not automatically take other factors into consideration.

For example, many results show differences by age and income, yet age and income also vary significantly among different racial and ethnic groups, marital status, gender, etc. More complex statistical tests can show us whether two variables are associated with each other while also taking into account other potential factors confounding that relationship. In Section IIA of this report, more sophisticated multivariate analyses called *logistic regression* were conducted to take these other factors into consideration. Logistic regression allows us to understand what factors are associated with asthma rates while "controlling for" or "adjusting for" other variables that might confound this relationship, or, in other words, assuming all other factors are equal.

Logistic regression results are reported as adjusted *odds ratios* (OR), which are the odds of an event occurring in one group compared with the odds of it occurring in another group. An OR of 1.0 indicates that the odds of an event is equally likely in both groups, which means that these groups are not significantly different. An OR>1 means that the odds of the event is more likely in that group compared to the reference group, while an OR <1 indicates the event is less likely in that group compared with the referent. As an example, suppose that in Group A, 10 out of 100 persons have asthma, while in Group B, 20 out of 100 have it. The odds of having asthma in group A = 10/90 or 0.11, while the odds of having asthma in Group B is 20/80 or 0.25. Thus the OR (B compared with A) = 0.25/0.11 which equals 2.25. If one simply compared the prevalence rates in each group (10% in group A and 20% in Group B) then people in Group B are twice as likely to have asthma as those in group A, which is another way of reporting the same results. However, the advantage of using logistic regression is that other factors related to asthma rates can be controlled for in the analysis. Some of the logistic regression results are in the body of the report while other results are included in Technical Notes in Appendix C. Additional information is available on request.

<sup>1</sup> In a few cases in this report, when the P-value was <0.05, groups were not considered statistically significant. This was because their 95% confidence intervals overlapped, indicating that the "true" value could potentially be the same in both groups. When this situation arose, the groups were conservatively assumed to have statistically similar rates.

**Table 1. Regional Adult Asthma Rates**

2006 BRFSS (N=345,593)				
Region	Lifetime asthma		Current asthma	
	Percent	95% CI	Percent	95% CI
<b>I (New England)</b>	14.4	13.9-15.0	<b>9.7</b>	9.3-10.2
II (NY, NJ)	12.8	12.0-13.6	8.2	7.6-8.9
III (DE, DC MD, PA, VA, WV)	12.8	12.2-13.5	8.8	8.2-9.3
IV (AL, FL, GA, KY, MS, NC, SC, TN)	12.0	11.6-12.4	7.6	7.3-8.0
V (IL, IN, MI, MN, OH, WI)	13.1	12.5-13.7	8.9	8.4-9.4
VI (AR, LA, NM, OK, TX)	12.4	11.4-13.6	7.4	6.5-8.3
VII (IA, KS, MO, NE)	11.7	11.0-12.4	7.9	7.3-8.5
VIII (CO, MT, ND, SD, UT, WY)	12.4	11.8-13.0	8.0	7.5-8.5
IX (AZ, CA, HI, NV)	13.0	12.1-13.9	7.8	7.1-8.5
X (AK, ID, OR, WA)	14.5	13.9-15.0	9.2	8.8-9.7
Total	12.8	12.5-13.0	8.2	8.0-8.4
P value	0.001		<0.0001	

**B. Comparison of adults with and without asthma**

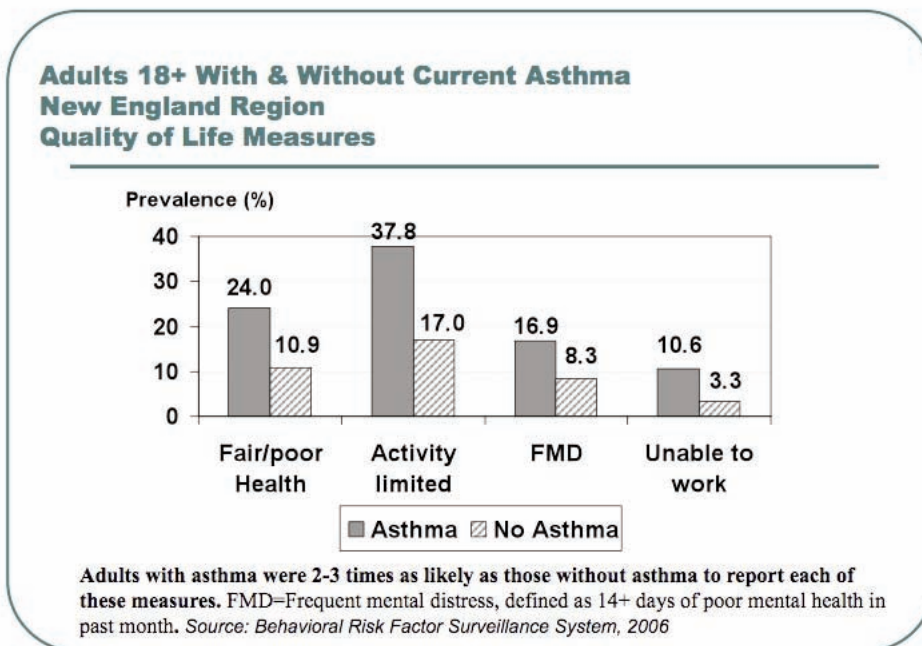
*Key Findings:*

- New England adults with current asthma were more likely than those without asthma to report fair or poor health, poorer mental health, being disabled, dissatisfied with life, or unable to work (Figure 3).

New England adults with current asthma were about twice as likely to report having fair or poor health, an activity limitation

due to physical, mental, or emotional problems than adults without asthma, and 14 or more days in the past month when their mental health was not good (frequent mental distress or FMD). Adults with current asthma were about three times more likely to report being *unable* to work as those without the disease (Figure 3). Adults with current asthma were also more likely to report being dissatisfied with life (9.0% vs. 4.4% for adults without asthma).

**Figure 3.**



### C. Change in New England adult asthma rates between 2001- 2006

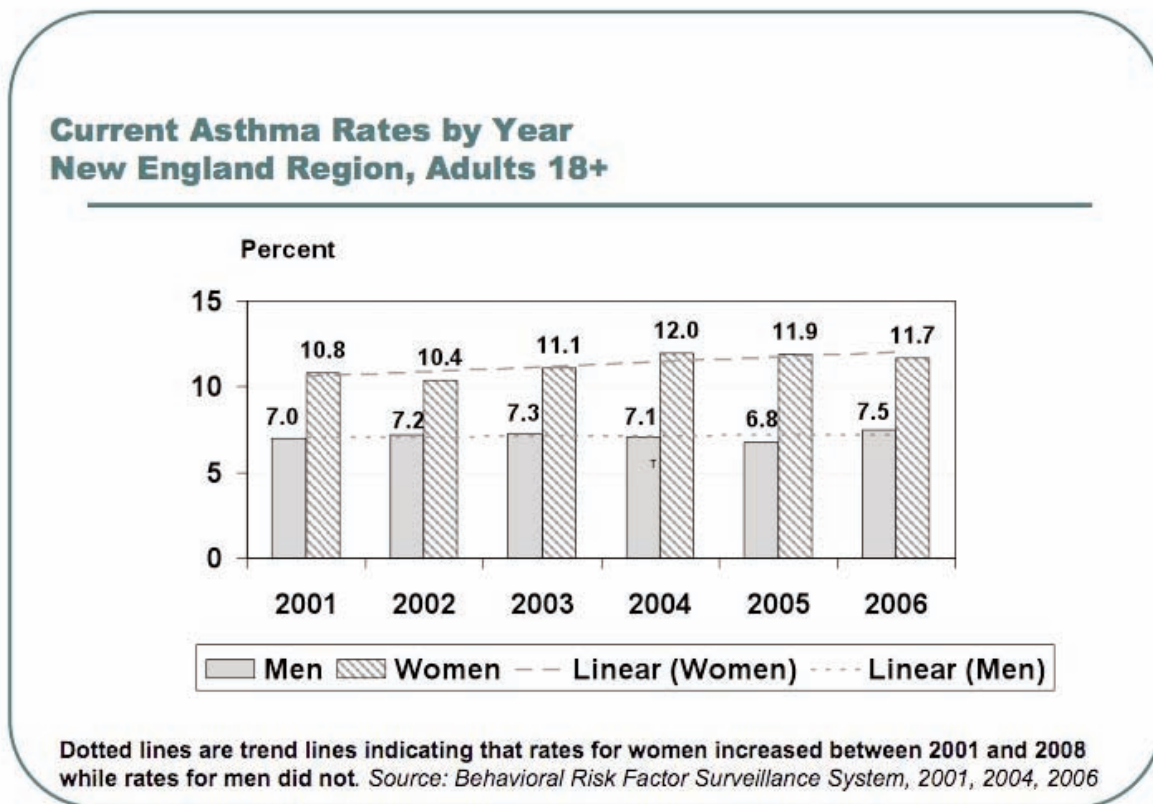
#### Key Findings:

- In each year from 2001-2006, adult asthma rates have been significantly higher for women than for men.
- Overall current adult asthma rates in NE have increased in a linear fashion from 8.9% in 2001 to 9.7% in 2006 (See Figure 4). When examining gender trends separately, however, results indicate that only the rates for women have increased over that period of time. The rates for men were statistically unchanged between 2001 and 2006.

Since 2001 when ARC began examining asthma in NE, current adult asthma prevalence rates increased significantly

(8.9%-9.7%) between 2001-2006, yet there were significant gender differences in this trend. The increasing overall rates were primarily due to the statistically significant increases found in women over the six years (10.8%-11.7%), while rates for men were statistically similar over this time period (7.0%-7.5%). The increase in rates for women can be seen in the upward slope on the linear regression line shown on Figure 4, which has a correlation coefficient ( $R^2$ ) of 0.66, indicating that 66% of the increase is due to the change in year. The previous ARC report containing results from 2004 noted that the current asthma rate had significantly increased between 2001 and 2004 and the estimated number of adults in New England with asthma increased from 941,500 in 2001 to 1 million in 2004. In 2006, the estimated number of New England adults with asthma was still about 1 million.

Figure 4.



### III. Adults with Asthma: Results from Call-Back Surveys in 5 New England States

In 2006, five of the New England States (all except Rhode Island) re-contacted adults who indicated on the standard BRFSS telephone survey that they had ever been told that they had asthma. This “call-back” survey allowed us to obtain a much deeper understanding of the disease as it manifests itself than we ever had before.

A total of 1,986 adults with lifetime asthma, including 1,439 with current asthma, completed this call-back survey. By combining all five states’ data, the sample size we analyzed was much stronger than if each state analyzed their own data separately. Unless otherwise indicated, results in this section pertain to adults with *current* asthma, since many of the measures (e.g. medication use, symptoms) pertain specifically to those who are currently experiencing asthma symptoms. Adults with lifetime asthma were included in some analyses, specifically those looking at age of diagnosis and work related asthma, in order to obtain the most comprehensive information on those topics.

#### A. Asthma diagnosis and control

##### National Guidelines

The call-back survey allowed us to assess two key asthma management status indicators among persons who reported they still had asthma: Symptom Severity and Asthma Control. The Asthma Expert Panel commissioned by the National Asthma Education and Prevention Program (NAEPP) at the National Heart, Lung, and Blood Institute (NHLBI) developed national asthma management guidelines that include a classification

system for assessing these two measures. Symptom Severity defines the intrinsic severity of the disease process which helps clinicians to devise an appropriate treatment plan. Asthma Control defines the degree to which asthma symptoms are being minimized and properly managed. Both measures incorporate responses to several survey questions on the frequency of asthma symptoms, the frequency of sleep disturbances, and activity limitations due to asthma, plus actual measures of lung function. However, symptom severity also examines visits to an emergency room or urgent care center, as well as the frequency and intensity of activity limitations and other asthma symptoms. Asthma control also includes a measure on the use of inhaled short-acting beta 2 agonists (“rescue” medications) which generally should not be relied upon too heavily by persons with well-controlled asthma symptoms except, perhaps, for exercise-induced asthma.

Call-back survey questions pertaining to these measures were primarily aligned with the NAEPP’s 2002 guidelines. However, the NAEPP updated their guidelines in 2007, after the call-back survey was administered. This change created a challenge; especially since the 2007 guidelines call for a lung function assessment, which is impossible to ascertain in a phone survey. Nevertheless, our analysis of severity and control was fairly well-aligned with the 2007 updated guidelines—excluding lung function, and was based on classifications also deemed appropriate by others, including the CDC and the Michigan Asthma Program.<sup>v,vi</sup>

#### **Definition of terms used in this section:**

##### NAEPP Categories of Symptom Severity and Control:

**Asthma Severity:** Asthma symptom severity for persons with current asthma was classified as intermittent or persistent, as well as mild, moderate or severe. Levels of both severity and control are defined in this report as the highest category response from any of the 4 questions (see below), which exclude lung function because that cannot be determined from a survey. Thus an adult with 7 or more emergency room visits/year would automatically be placed in the severe persistent symptom category, even if they did not report symptoms all of the time.

<b>Category: Severity&gt;&gt;&gt;&gt;&gt;&gt;</b>	<b>Mild Intermittent</b>	<b>Mild Persistent</b>	<b>Moderate Persistent</b>	<b>Severe Persistent</b>
<i>Question</i>	<i>Response</i>	<i>Response</i>	<i>Response</i>	<i>Response</i>
# ER & urgent care visits/year	0	1-2	3-6	?7
# Days activity limited/year	0	1-5	6-75	76-365
Anytime symptoms/week	≤2/week	3-6/wk	daily, not all time	daily, all the time
Nighttime symptoms/30 days	0-2	3-4	5-10	>10

**Asthma Control:** A similar schematic for asthma control based on the call-back survey questions assigned persons with current asthma into three categories: well controlled, not well controlled, and very poorly controlled. Again, the person is assigned the highest category from any of the 4 questions (which exclude lung function). Thus, adults reporting symptoms all the time would be placed in the very poorly controlled category, even if they did not report a lot of activity limitation.

Category: Control>>>>>>	Well Controlled	Not well controlled	Very poorly controlled
Question	Response	Response	Response
SABA* use (times/day)	<0.29 X/day	0.29-1.99 X/day	2 or more X/day
Activity limitation	Not at all	Up to a moderate amount	A lot
Anytime symptoms/30 days	≤9 days/30 days	>9 days/30, not all time	daily, all the time
Nighttime symptoms/30 days	0-2	3-14	15 or more

\*Short acting beta 2 agonist (“rescue” medication, taken via inhaler). Patients who are well controlled should not be relying on frequent use of “rescue” medications.

*Key Findings:*

- Most women with lifetime asthma were diagnosed as adults, while men were more likely to be diagnosed as children (Figure 8).
- The majority of t adults with current asthma have *mild* intermittent or *mild* persistent symptoms. Over one third of adults with current asthma are classified as having either moderate or severe persistent asthma. The severity breakdown is shown in Table S-1.
- The majority of adults with current asthma do not have their disease considered to be appropriately under control. As many as 70% of adults are classified as either “not well controlled” or “very poorly controlled”, despite the fact that many of them have mild intrinsic symptoms, often times because of their frequent use of rescue medications. (Table S-2)
- Smokers and those with less than a high school education were associated with the highest severity and having poorest control of their disease.
- Nearly three in ten (29.0%) adults with current asthma reported using rescue medication two or more days per week (i.e. 0.29X/day), including 16.1% who used rescue medications two or more times per day (Table S-3). This latter level of frequent usage of rescue medications indicates very poorly controlled asthma, per the NAEPP guidelines.
- Over one-quarter (26%) of adults with severe persistent symptoms and 39% with moderate persistent symptoms had not used any asthma medications (rescue or control) within the past day (Figure 7).

- Over one third (36.2%) of adults with current asthma reported using some type of herbal or alternative therapy for their asthma (data not shown).

Asthma Diagnosis

Over half of all adults with *lifetime* asthma were diagnosed as adults (Table S-4), with men more likely to be diagnosed as children age 12 or younger (51%), and women more likely (60.7%) to be diagnosed as adults (Figure 8). The mean age at diagnosis was 26.0 years for adults with current asthma and 23.0 years for adults with lifetime asthma.

Symptom Severity and Asthma Control – Using the 2002 NAEPP symptom severity classification for NE adults (Table S-1):

- 18.4% had symptoms in the severe persistent category
- 17.3% were moderate persistent
- 19.2% were mild persistent
- 45.2% were mild intermittent

Severe persistent symptoms were significantly more common among adults with:

- Less than a high school education (44%)
- Those age 55 and over (27.5%)
- The obese (25%)
- Smokers (34%).

Adults with current asthma fell into the following disease control categories (Table S-2), (Figure 5):

- 30.1% were classified as *well controlled*
- 44.1% were *not well controlled*
- 25.9% were *very poorly controlled*

The majority of NE adults with asthma do not have their asthma under appropriate control. Symptom severity and asthma control were highly correlated because the measures used to categorize them were similar (Figure 6). Both severe symptoms and poor control were associated with lower education and smoking status. However, severe symptoms were related to advanced age and being overweight, while asthma control was not. Asthma control was worse for those with severe persistent symptoms, smokers, those with cost barriers to receiving care or medications, and those reporting an acute care visit for their asthma in the past year. Asthma control was the only measure included in this report that varied by state, with adults in Maine having the lowest percentage for well-controlled asthma and higher rates for not as well-controlled asthma compared with the other states.

There were additional findings that indicate adult asthma is poorly controlled in New England.

- Half (50.2%) of all adults with current asthma reported an asthma attack in the past 12 months (data not shown).

- About one in three (32.8%) adults with current asthma had symptoms within the past day.
- Adults age 55+ (42%), those with income below \$25,000 (43%), the obese (41%), smokers (46%), and those with very poorly controlled asthma (64%) were most likely to report asthma symptoms within the past day (Table S-5).

#### Medication Use

Medication use was measured in a number of ways and excludes alternative therapies unless specifically noted. The medications primarily investigated were either long-term “controller” medications meant to prevent symptoms from occurring, or “rescue” medications meant to bring symptoms quickly under control. Controllers work to reduce ongoing inflammation and symptoms that arise from triggers. Rescue medications, or short acting beta 2 agonists (SABA), are fast-acting drugs that dilate airways and make it easier to breathe quickly. Although questions about medication usage included how often each brand name of inhaler medication was taken and why, they were not sufficiently specific to ascertain why they were used so frequently and under what circumstances.

Figure 5.

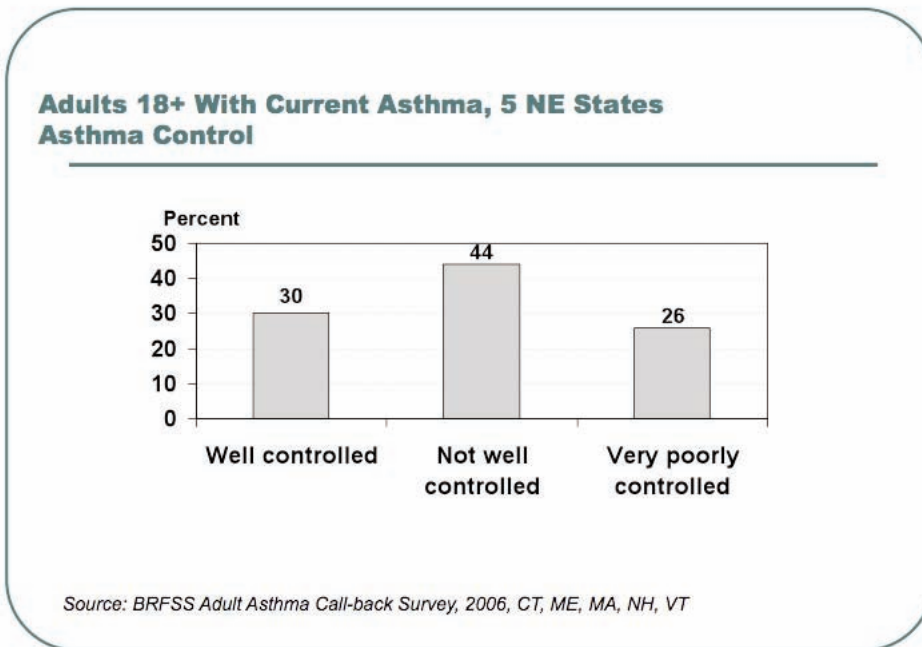
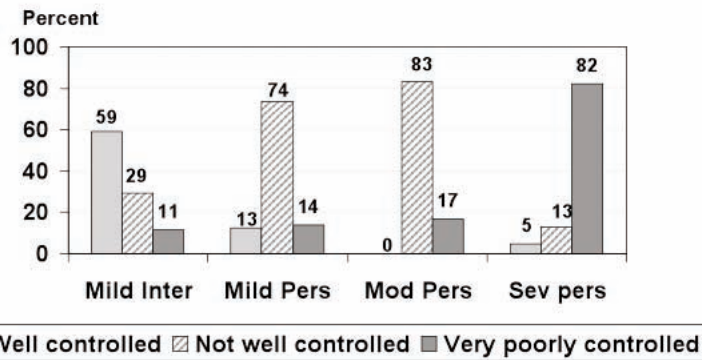


Figure 6.

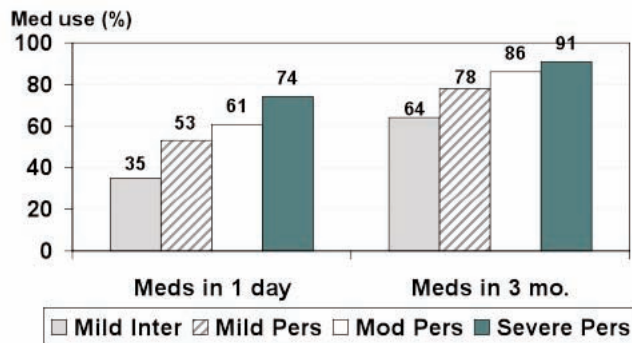
**Adults 18+ With Current Asthma, 5 NE States  
Asthma Control by Symptom Severity (NAEPP Scale)**



Asthma control was significantly associated with symptom severity.  
Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

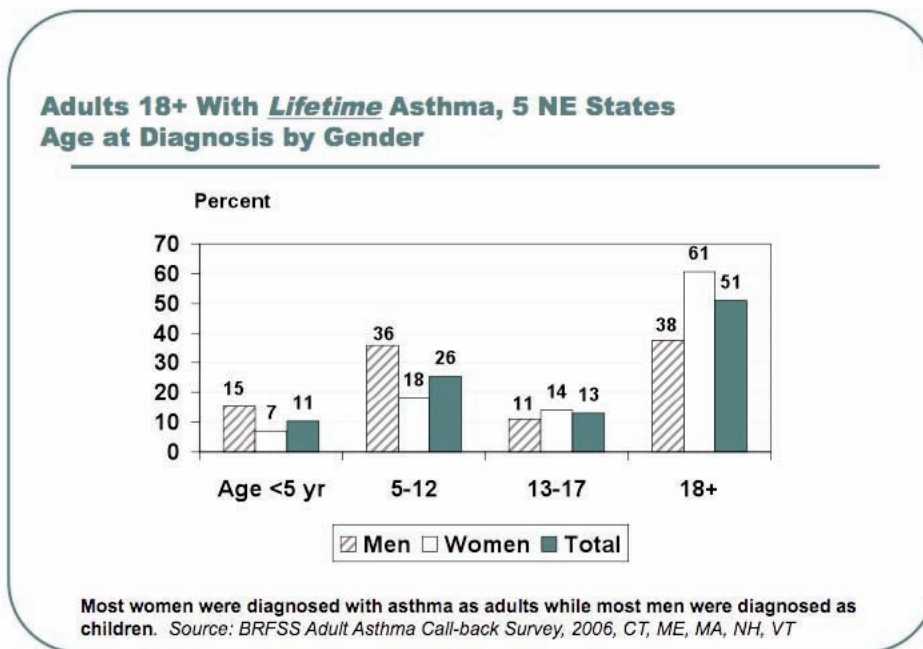
Figure 7.

**Adults 18+ With Current Asthma, 5 NE States  
Medication Use by Symptom Severity (NAEPP Scale)**



Medication use was significantly associated with symptom severity.  
Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

Figure 8.



## B. Adult Asthma health care, access, & barriers in New England

### Key Findings:

- Over one in ten (10.6%) adults with current asthma reported a visit to an emergency room (ER) or urgent care center for their asthma in the past year, and 3.2% were hospitalized for their asthma. (Table S-6). Most of these visits were made by adults with very poorly controlled asthma, 24.2% of whom had an ER visit and 8.9% of whom were hospitalized. Acute care visits also were more likely among adults with lower household income (Figure 9).
- Non-whites with current asthma were more likely to report being hospitalized for their asthma compared with non-Hispanic whites (7.0% for non-whites vs. 2.7% for whites) (Table S-7).
- Over one in ten adults with current asthma (10.5%) was uninsured, 8.6% reported an economic barrier to seeing a doctor and 14.0% reported a cost barrier to getting asthma medications (Table S-10).
- Among adults with very poorly controlled asthma, 18.2% reported a cost barrier to seeing their doctor for their asthma and 27.8% reported that they needed to buy medication for their asthma in the past 12 months but could not due to the cost. (Figure 11 and Table S-10).
- Less than three in ten (29.6%) of all adults with asthma reported they had a written Asthma Management Plan from their health provider, a rate that varied significantly by income and level of control. Those with very poorly

### Definition of terms used in this section:

**Acute care visit:** An unscheduled urgent medical care visit for asthma in the past year: to either an urgent care center or hospital-through the Emergency Room (ER) or as an inpatient.

#### Economic barriers to care:

–**To seeing doctor:** respondent indicated there was a time in the past 12 months when they needed to see their primary care doctor for their asthma but could not because of the cost.

–**To getting medication:** respondent indicated there was a time in the past 12 months when they needed to buy medication for their asthma but could not because of the cost.

controlled asthma (41%) and those with incomes >\$75,000 (40%) were most likely to report having a management plan (Table S-9).

- Although annual flu shots are recommended<sup>vii</sup> for persons with asthma, only half (50.1%) of adults with current asthma reported receiving one in the past year (Table S-8).

### Medical Care

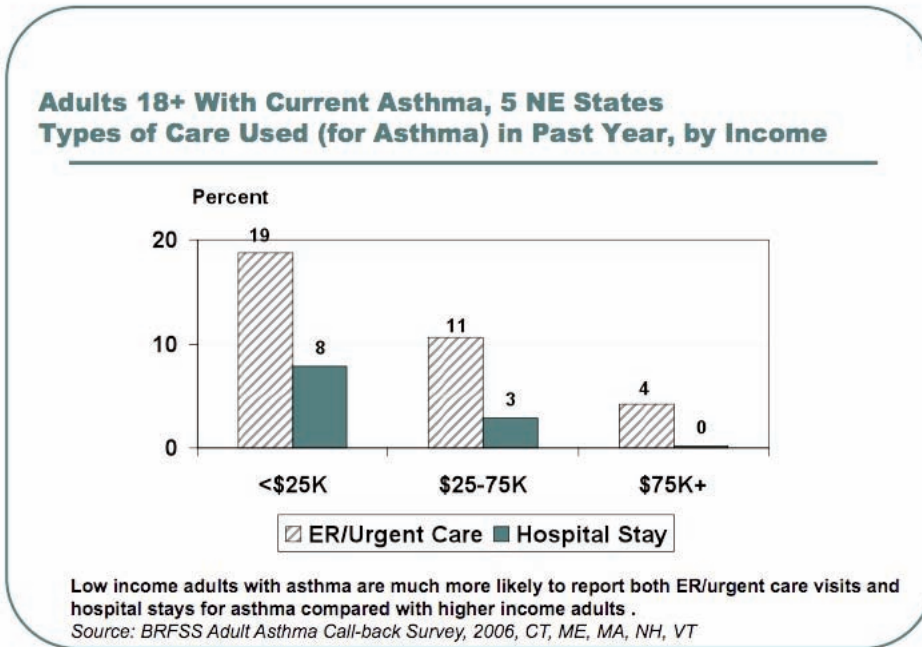
A majority of NE adults with current asthma (77%) had talked with a doctor about their asthma in the past year and 64% reported at least one routine doctor visit for their asthma in the past year (data not shown). Adults with very poorly controlled asthma were most likely to report routine medical visits and receipt of a flu shot (Table S-8), with 82.8% reporting

a routine doctor visit for their asthma, over 90% reporting they talked with a physician about their asthma in the past year, and 63% reporting a flu shot in the past year. These results also point to a considerable percentage of adults with uncontrolled asthma who were not making routine contact with a doctor about their disease, nor getting their flu shots. Moreover, less than three in ten (29.6%) of all adults with current asthma reported they had been given a written Asthma Management Plan by their provider to help them appropriate-

ly manage their disease. The likelihood of having an Asthma Management Plan was higher among those with very poorly controlled asthma and/or those with incomes >\$75,000 (Figure 10 and Table S-9).

One in ten respondents with current asthma (10.5%) had no health insurance, 14.9% reported a gap in coverage in the past 12 months, 8.6% reported an economic barrier to seeing a doctor and 14.0% reported cost as a barrier to getting asthma medications.

**Figure 9.**



**Figure 10.**

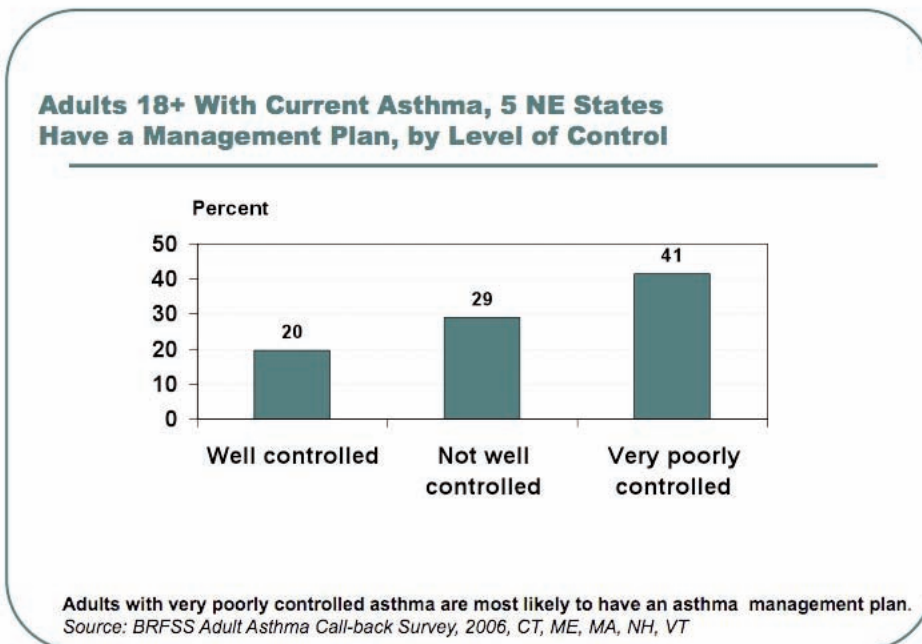
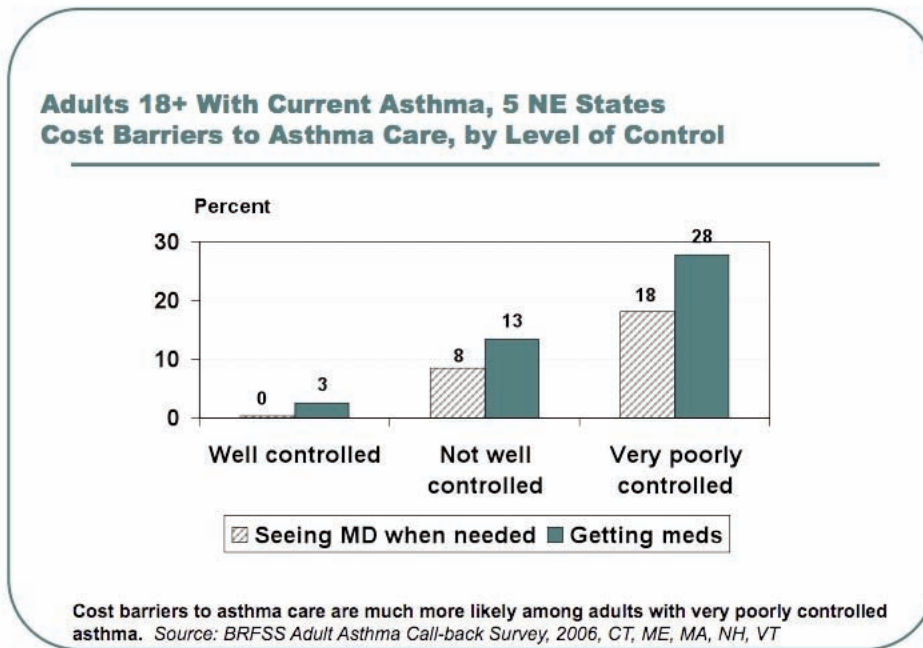


Figure 11.



### C. Work environment

#### Key Findings:

- Among the 98% of New England adults with lifetime asthma who also had a work history, 37.2% reported job-related asthma and an additional 3.8% were not sure (self-reported).
- Among those who self-reported job-related asthma, 16% had been told by a doctor their asthma was work-related.
- Among those with lifetime asthma and a work history, 6.4% reported changing or quitting their jobs because work conditions caused their asthma or made it worse (Table S-12). This rate was 17.2% among those who self-reported job-related asthma and 20% for those with less than a high school education. Adults with low incomes were much more likely than those in higher income households to report changing jobs due to their asthma or having a physician tell them their asthma was job-related (Figure 12 and Table S-11).
- One in ten (10.6%) of all adults with *current* asthma reported they were unable to work:
  - o High rates of being unable to work were found for adults in low-income households (below \$25K/annum; 23%), adults with asthma who have severe persistent symptoms (29%) and those who have poorly controlled asthma (24%; data not shown).

All adults with lifetime asthma were asked a number of questions about their work history and its relationship to their asthma. While the majority of the questions addressed the

#### Definition of terms used in this section:

Except as noted, all results in this section pertain to adults with lifetime asthma:

**Job-related asthma:** Adults with lifetime asthma with an employment history (98%) who said their asthma was either caused by, or made worse by, chemicals, smoke, fumes or dust in a current job or in any previous job they ever had. Respondents who didn't know were included in a separate category.

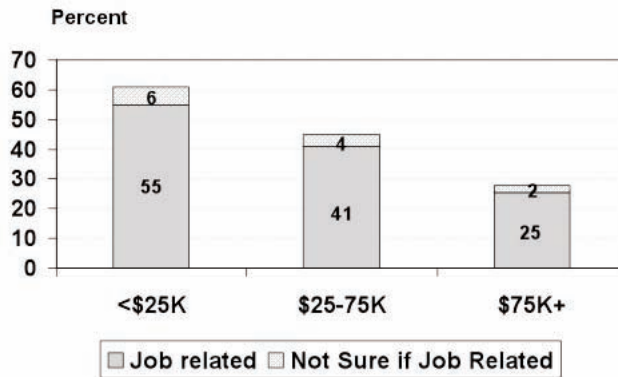
**MD said asthma was job related:** Adults with lifetime asthma, ever told by a doctor or other health professional that their asthma was related to any job they ever had.

respondent's perception of cause and effect, one question specifically asked if a doctor or other health professional ever told them that their asthma was job-related. While 6.9% of those with lifetime asthma and a work history were told by their physician about an occupational link, nearly 40% of respondents self-reported they believed that their asthma was job-related.

Among all adults with *current* asthma, 43.9% reported job-related asthma and 7.7% changed jobs due to their asthma. For those with very *poorly controlled current asthma*, 56% reported job related asthma and 13% changed jobs because of their asthma. From the standard BRFSS, 10.6% of all adults with *current* asthma were unable to work, including 23% of those with incomes below \$25,000, 24% with very poorly controlled asthma, and 29% of those with severe persistent symptoms (data not shown).

Figure 12.

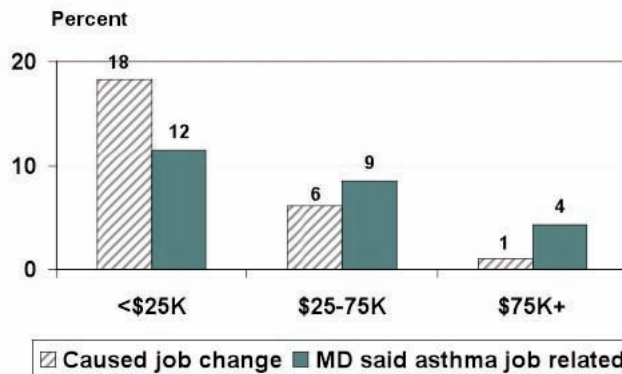
### Adults 18+ With *Lifetime* Asthma, 5 NE States Respondent View of Connection between Work Exposure and asthma, by Income



Lower income adults were more likely than higher income adults to report job-related asthma.  
Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

Figure 13.

### Adults 18+ With *Lifetime* Asthma, 5 NE States Effect of Asthma on Employment, by Income



Compared with higher income adults with asthma, those with lower incomes were more likely to have changed jobs due to asthma and to have a doctor confirm their asthma was job related. Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

## D. Home environment

Questions in this section included having an air cleaner, dehumidifier, kitchen exhaust fan, using gas for cooking, mold in the home (except on food) in the past 30 days, pets in the home, cockroaches, mice or rats, wood burning stove or fireplace, gas stove, using a mattress cover for controlling dust mites, and anyone smoking in the home in the past week.

### Key Findings:

- An association was found between symptom severity and recent exposure to a smoker in the home. As symptom severity increased from mild intermittent to severe persistent, the percent of adults who reported someone smoking in the home increased almost linearly.
- More than half of adults with current asthma had a household pet and carpeting in their bedroom (Table 2).

A number of environmental conditions in the home can trigger asthma attacks. The percentages of NE adults with current asthma reporting home-based environmental exposures are shown in Table 2. However, these questions were only asked of those who have asthma (on the call back survey), so associations between environmental exposures and the likelihood of asthma development could not be made.

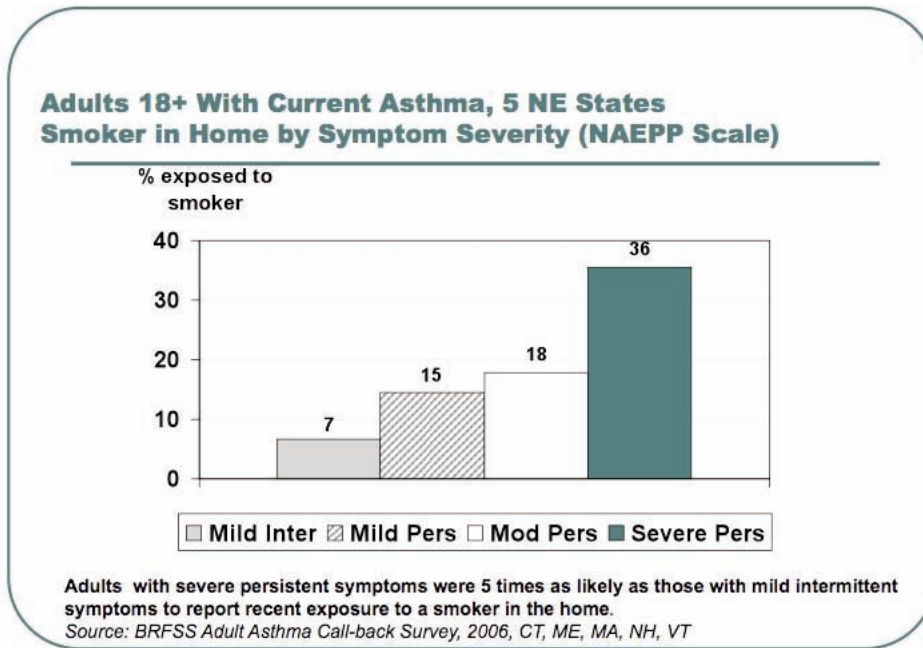
We were able to conduct analyses to see whether there was a relationship between exposure to potential home environmental triggers and asthma *symptom severity*. The only environmental factor that we found to be positively associated with symptom severity among adults with current asthma was recent exposure to a smoker in the home. As symptom severity increased from mild intermittent to severe persistent, the percent of adults who reported someone smoking in the home increased almost linearly from 7% to 36% (Figure 14). This does not necessarily mean that no correlations exist between other environmental exposures and asthma; other correlations may not have been observed because the sample sizes for each exposure may very well have been too small to see statistical correlations. Other published studies have demonstrated strong relationships between certain environmental exposures and the development and/or exacerbation of asthma symptoms.<sup>viii</sup>

A separate environmental question asked if adults had ever been advised by a health professional to change conditions in their home, school or work to improve their asthma. Nearly half (45.4%) of adults with current asthma reported they had been advised to change something in their environment, yet the survey did not ascertain what the advice was and whether any changes were made as a result of that advice.

**Table 2.**

<b>Environmental Factors among New England Adults with Current Asthma</b>				
<b>Factor</b>	<b>Percent</b>	<b>95% CI</b>	<b>n</b>	<b>N</b>
Gas used for cooking	35.4	30.7-40.4	516	1,420
Woodstove or fireplace	29.3	24.4-34.7	341	1,421
Gas stove (unvented)	6.7	4.4-10.0	87	1,414
Air cleaner/purifier in home	24.5	20.7-28.7	370	1,418
Dehumidifier used regularly	33.3	28.9-38.0	447	1,419
Kitchen fan used regularly	52.5	47.3-57.6	758	1,414
Mold seen in past 30 days (except food)	14.4	11.5-17.8	232	1,414
Household pets (indoors)	59.6	54.5-64.5	849	1,422
Cockroaches in past 30 days	4.2	1.5-11.1	30	1,420
Rodents in home in past 30 days	7.7	5.3-11.1	114	1,417
Carpet in bedroom	57.2	51.9-62.3	844	1,421
Use mattress cover (for dust mites)	29.7	25.4-34.4	425	1,402
Use pillow cover (for dust mites)	29.3	25.1-33.9	420	1,406
Smoking inside home in past week	15.1	12.2-18.6	256	1,419

Figure 14.



### E. Functional status of adults with current asthma

Unlike the measures reported in Section IIB and Figure 3 earlier in this report, measures introduced in this section are defined as asthma related, and thus no comparisons with adults without asthma are available.

**Days of activity limitation:** number of days that adult with current asthma was unable to work or carry out their usual activities because of their asthma in the past year (range 0-365).

**Degree of activity limitation:** Adults with current asthma whose activities in the past 12 months were limited by asthma either a moderate amount or a lot (as opposed to not at all or a little).

#### Key Findings:

- The mean number of days of activity limitation in the past year for adults with current asthma was 7.7 days. This figure ranged from 0 for those with mild intermittent symptoms and 0.2 days for those with well-controlled asthma to 23.7 days for those with poorly controlled asthma and 39.3 days for those with severe persistent symptoms (Table S-14).
- One in five (19.3%) adults with current asthma reported their usual daily activities were limited to a moderate or great degree by their asthma. This measure was significantly associated with symptom severity, asthma control, income, education, and obesity.

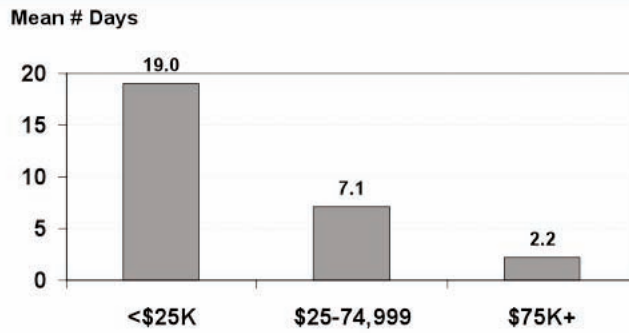
Asthma appears to affect the quality of life for some individuals more than others. Low-income adults, those with poorly controlled asthma and those with severe symptoms, those with less education and those who are obese were most likely to report some degree of activity limitation and more days of activity limitation or missed work (Tables S-13 & 14).

High average numbers of days of activity limitation (or missed work) were reported for adults with very poorly controlled asthma (23.7 days), those age 55+ (12.9 days), those with incomes less than \$25,000 (19.0 days; Figure 15), less than a high school education (17.5 days), smokers (15.0 days), the obese (11.0 days), and those unable to work (34.6 days; Figure 16). (Note that these are averages, which can be greatly affected by a few respondents with high values).

One in five (19.3%) adults with current asthma described their degree of activity limitation as moderate or a lot (Table S-13). Women with current asthma (23.1%), those with incomes of less than \$25,000 (39%), those with less than a high school education (34%), the obese (31%), those with very poorly controlled asthma (43%) and those with severe persistent symptoms (58%) were significantly more likely than comparison groups to report activity limitations as “moderate” or “a lot” (as opposed to a little or not at all).

Figure 15.

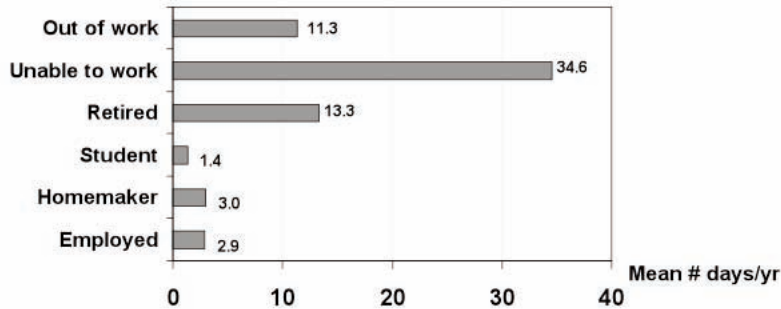
**Adults 18+ With Current Asthma, 5 NE States  
Mean Number of Days of Activity Limitation, by Income**



Lower income adults with asthma reported more days of activity limitation than higher income adults. Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

Figure 16.

**Adults 18+ With Current Asthma, 5 NE States  
Mean Number of Days of Activity Limitation,  
by Current Employment Status**



Number of days of activity limitation (or missed work) due to asthma was much higher for those unable to work or out of work, but was still 2.9 days/year for those who were employed. Source: BRFSS Adult Asthma Call-back Survey, 2006, CT, ME, MA, NH, VT

## F. Co-morbidities of New England Adults with Current Asthma

**Co-morbid conditions** (illnesses found in addition to an asthma diagnosis) include respiratory conditions such as Chronic Obstructive Pulmonary Disease (COPD), emphysema, and bronchitis from the Call-back surveys and other chronic diseases such as diabetes and cardiovascular disease (heart disease and stroke) from the BRFSS.

**Depression** (ever told by doctor or health professional that you were depressed) is considered separately.

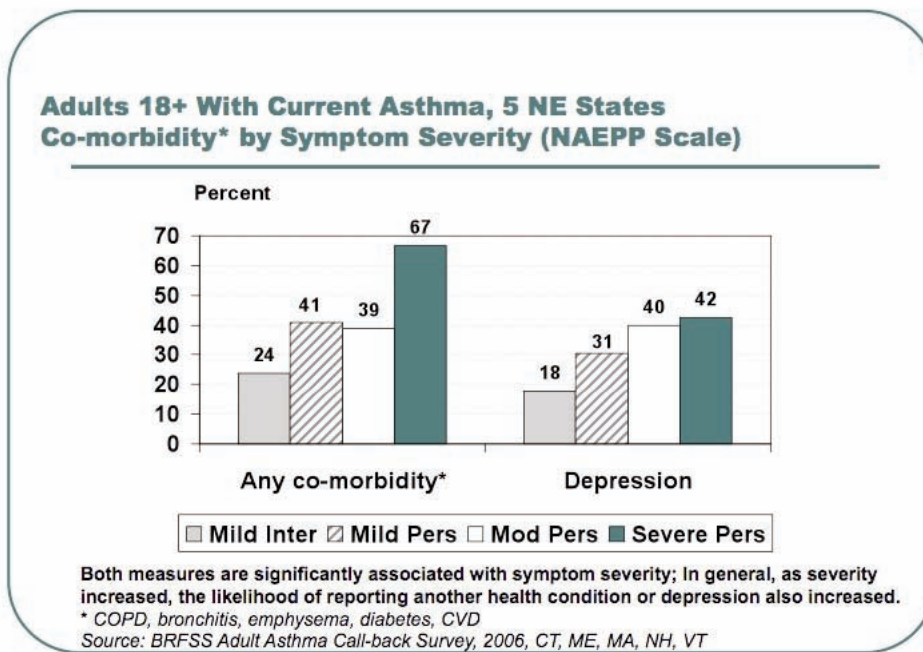
### Key Findings:

- Over one third (37.7%) reported one or more illnesses (co-morbidities) other than asthma (Table S-15).
- Over one fourth (28.4%) reported a doctor had told them that they were depressed (Table S-15).

- Among those with very poorly controlled asthma, 62% reported a co-morbid condition and 35% reported depression.

Co-morbidity and depression were each associated with increased symptom severity (Figure 17) and with poorer asthma control (Table S-15). Co-morbid conditions were also more likely among adults age 55+ (61.2%), those with incomes less than \$25,000 (51%), those with less than a high school education (65%), those who were overweight or obese (43%), and smokers (58%). Depression among adults with current asthma was also more likely among women (32.5%), those with incomes below \$25,000 (47%), less than high school education (59%), the obese (38%), and smokers (53%).

Figure 17.



## IV. Children with Asthma: Results from Call-Back Surveys in 5 New England States

All six New England states included questions about child asthma on the standard BRFSS and five of the six states (all except Rhode Island) also conducted Call-back Surveys to collect additional information on children that were reported to have asthma. These surveys were conducted with the adult in the household who said they were most knowledgeable about the child's asthma. (To simplify reporting, results are sometimes reported as if the child reported them.) Because only a fraction of households include children, the number of children with asthma for whom information was obtained on the Call-back surveys is much less than the number of adults with

asthma. The total number of child Call-back surveys in the five states was 516, which included 340 children with current asthma. The lifetime and current child asthma rates for each state are shown in Figure 18 and Table 3; these data are not from the Call Back surveys but were kindly provided by the state BRFSS Coordinators. Table 3 also includes the number of Call-back surveys addressing children with lifetime and with current asthma. Because most of the results are based on the 340 children with current asthma, they are presented only as totals for all five states and not broken down by gender, age, state, or other demographic measures because the numbers for

each of these subgroups would be too small to draw conclusions (Table 4). For convenience, comparable results from the adult Call-back surveys are also included.

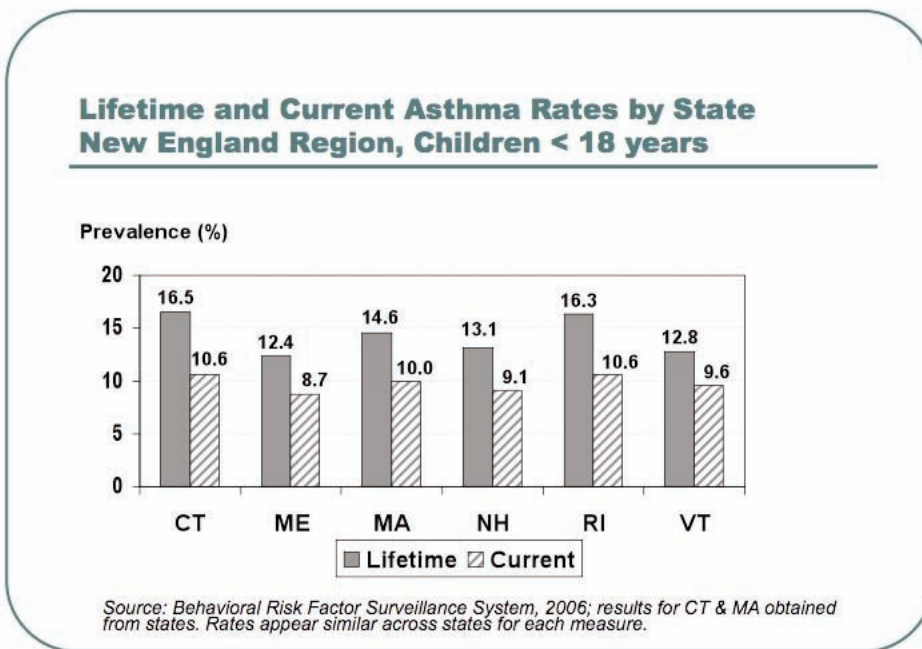
*Key findings on New England children from the Call-back surveys:*

- Nearly two out of three (64.8%) NE children with current asthma have asthma that is considered to be not well controlled or very poorly controlled, based on the criteria used in this report.
- About one in four (25.3%) children had either moderate or severe persistent asthma symptoms; however, children were less likely than adults to have severe persistent symptoms (5.4% for children vs. 18.4% for adults).

- Despite the fact that few children with current asthma reported daily symptoms, 18.1% were reported to be using “rescue” medication 2 or more times per day.
- About half (48.9%) of children with current asthma had an asthma attack, 14.1% had an urgent care or emergency room visit, and 4.3% were hospitalized for their asthma in the past year.
- Less than half of children had a written Asthma Management Plan from their health provider, but children were more likely to have one than adults (43.8% vs. 29.6% for adults).
- Half (49.6%) of children with current asthma had received a flu shot in the past year.

**Child Asthma Prevalence Rates in New England**

**Figure 18.**



**Table 3.**

Child Asthma Rates in New England, 2006 BRFS						
State	Lifetime Asthma		Current Asthma		Call Back survey numbers	
	Percent	95% CI	Percent	95% CI	Total	w/ Current asthma
CT	16.5	14.6-18.5	10.6	9.0-12.3	148	92
ME	12.4	10.5-14.7	8.7	7.0-10.7	63	39
MA	14.6	12.4-16.9	10.0	8.1-11.9	109	71
NH	13.1	11.3-15.1	9.1	7.5-10.8	72	47
RI	16.3	14.1-18.9	10.6	8.8-12.6	0	0
VT	12.8	11.2-14.6	9.3	7.9-10.9	124	91

### Symptom Severity among Children

Unless otherwise noted in Table 4, the measures used for children were the same as those used for adults. A key difference was that *degree* of activity (none/a little/a moderate amount/a lot) was substituted for number of days of activity limitation used for adults in the determination of symptom severity for children. As with adults, children were assigned to severity and control categories based on the highest level of response from the four questions that were included in each of the measures. Results indicated that:

- 36.4% of children with current asthma had mild intermittent symptoms
- 38.3% had mild persistent
- 19.9% were moderate persistent
- 5.4% had severe persistent symptoms.

### Symptom Control among Children

Only about one-third of those children with current asthma have symptoms that are considered to be well controlled (35.2%)—thus, nearly two-thirds have inadequately controlled asthma:

- 44.6% have not well-controlled asthma
- 20.2% have very poorly controlled asthma.

The results for asthma control for children were similar to those for adults (Figure 19), but the symptom severity results indicate that adults were more likely to be categorized as hav-

ing severe asthma (18.1% of adults reported severe persistent symptoms vs. 5.4% for children). Closer examination of the findings shows that adults reported having symptoms more frequently and experiencing more nights of disturbed sleep than did children. In addition, only 9.1% of children reported asthma symptoms in the past day, while 32.8% of adults did.

### Medication Use among Children

Frequency of asthma symptoms and their expected medication use were not always consistent. While only 9.1% of children were reported to have asthma symptoms in the past day, and only 2.5% had symptoms every day, as many as 18.1% were reported to have used rescue medication two or more times a day. This relatively high rate of the use of rescue medication accounts for most of the 20.2% of children who were classified as having very poorly controlled asthma, according to the NAEPP definition and our method of assignment. (Only 1.2% of children with asthma had nighttime symptoms even 10 days/month, 1.0% had symptoms daily and all the time, and 2.4% had a lot of activity limitation, the other factors that would put them in the very poorly controlled asthma category). This reported use of rescue medication may reflect inappropriate use of SABA (rescue) medication, lack of awareness by the adult of the actual use by the child, or use for preventive purposes before exercise. We were not able to draw conclusions for possible inappropriate use because the call back survey did not ask about the reasons each time a medication was used. Instead, the reason for medication use was asked in a more general way in other questions.

Figure 19.

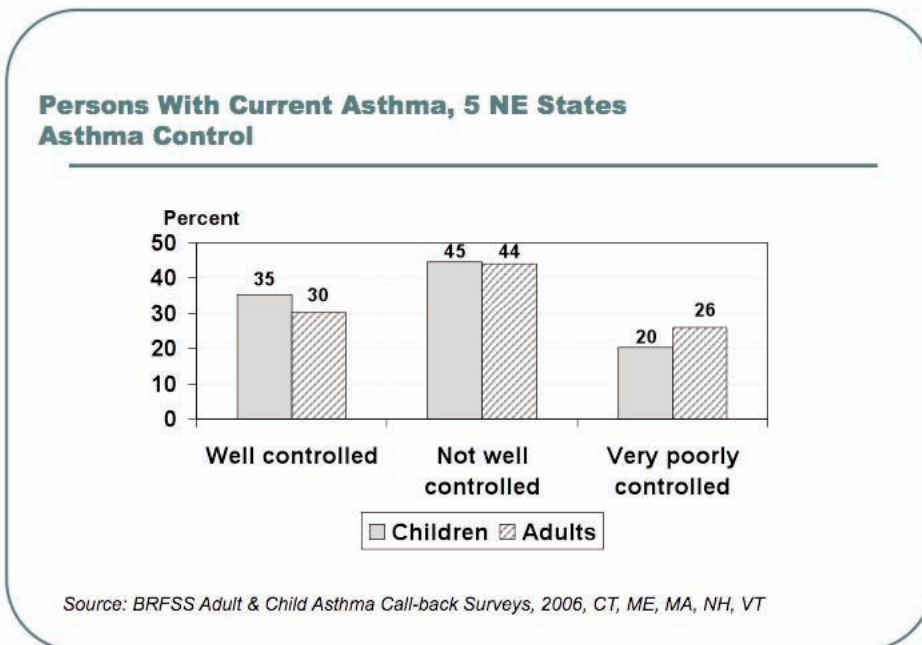


Table 4.

Results for New England Children with Asthma (Adults for comparison) 2006 Asthma Call Back Surveys, 5 NE states					
	Children				Adults
Children with current asthma unless otherwise noted	Percent	95% CI	n	N	Percent
<b>Asthma symptoms, etc.</b>					
Asthma attack past year	48.9	39.4-58.6	169	336	50.2
Asthma symptoms past day	9.1	5.5-14.8	39	333	32.8
Symptoms every day AND all the time	1.0	0.4-2.4	6	327	8.1
Symptoms daily but not all the time	1.5	0.6-3.7	9	327	10.3
Symptoms 3-6 days/week	12.0	7.2-19.4	43	327	20.3
Symptoms 0-2 days/week	85.5	78.2-90.7	269	327	61.4
Nighttime symptoms >10 days/30	1.2	0.4-3.4	8	337	10.1
Nighttime symptoms 5-10 days/30	7.4	3.4-15.3	22	337	7.6
Nighttime symptoms 3-4 days/30	3.8	1.5-9.1	15	337	3.2
Nighttime symptoms 0-2 days/30	87.6	79.6-92.8	292	337	79.2
Rescue med use $\leq$ 2 days/wk	73.1	64.4-80.3	246	340	71.1
Rescue meds >2days/wk &<2X/day	8.8	5.3-14.2	48	340	12.9
Rescue meds 2+X/day	18.1	12.0-26.4	46	340	16.1
Symptoms mild intermittent*	36.4	27.4-46.4	120	340	45.2
Symptoms mild persistent*	38.3	29.5-48.0	132	340	19.2
Symptoms moderate persistent*	19.9	13.4-28.5	61	340	17.3
Symptoms severe persistent*	5.4	2.8-10.4	27	340	18.4
Asthma well controlled	35.2	26.3-45.3	115	340	30.1
Asthma not well controlled	44.6	35.4-54.3	165	340	44.1
Asthma very poorly controlled	20.2	13.9-28.4	60	340	25.9
<b>Health Care</b>					
Talked to MD about asthma past year	85.2	77.5-90.6	283	335	77.0
Routine MD visit for asthma, past yr.	74.7	65.7-81.9	246	332	64.2
Any ER or urgent care visit, past year	14.1	8.8-22.0	46	336	10.6
No ER or urgent care visit, past yr.	85.9	78.0-91.2	290	336	89.4
1-2 ER or urgent care visit past yr	12.0	7.0-19.8	38	336	7.0
3-6 ER or urgent care visit past yr	2.1	0.7-6.0	7	336	3.5
ER/urgent care visits >6	0.0	0.0-0.3	1	336	0.1
Hospitalized for asthma, past yr.	4.3	1.8-9.8	13	337	3.2
Any acute care visit for asthma 1 yr.	14.4	9.0-22.3	48	336	11.0
Flu shot in past yr.	49.6	39.9-59.4	150	330	50.1
Have asthma management plan (HP 27-7a)	43.8	34.6-53.5	147	320	29.6
Took class in how to manage asthma (HP 24-6)	11.3	7.0-17.8	40	334	6.5
Uninsured	1.4	0.7-2.7	10	338	10.5

Health Care con't	Children				Adults
	Percent	95% CI	n	N	Percent
Children with current asthma unless otherwise noted					
Cost barrier to seeing MD	1.6	0.6-4.0	9	333	8.6
Cost barrier to medications	5.8	2.9-11.4	21	334	14.0
<b>Environment</b>					
Advised to modify environment (HP 27-7f)	44.1	34.9-53.8	158	329	45.4
<b>Functional status (limitation due to asthma)</b>					
Activities limited moderately or more	16.5	10.9-24.3	53	334	19.3
Activities limited a lot	2.4	0.6-8.9	8	334	5.9
Any activity limitation due to asthma (HP 24-4)	52.9	43.1-62.5	185	334	60.1
<b>Means (averages)</b>	Mean	95% CI		N	Mean
Mean age at diagnosis (all w/ lifetime asthma)	4.1	3.6-4.6		505	23.0
Mean age at diagnosis (all w/ current asthma)	4.1	3.5-4.6		331	26.0
Mean # days of school missed, children in school (HP 24-5)	2.1	1.4-2.8		294	
Mean # of days unable to do usual activities/work					7.7

\*Severity was measured slightly differently for children than adults: instead of using the *number* of days of activity limitation, the *degree* of limitation was used to define severity categories for children: *none* for intermittent asthma, a *little* for mild persistent, a *moderate amount* for moderate persistent, and a *lot* for severe persistent asthma.

Table 4 Shading indicates CDC Healthy People 2010 Objective<sup>ix</sup>

## V. Discussion

The Asthma Regional Council has been tracking asthma in the New England region over a six year period, primarily analyzing survey data (2001-2006) collected through the state-based BRFSS telephone survey. The advantage of conducting a multi-state analysis is that the larger numbers of respondents provide a more meaningful result, and it also allows the region to understand whether its geographical characteristics may be impacting the epidemic and helps determine whether there is potential for collective interventions.

The first report utilizing 2001 data focused primarily on the prevalence rates of adult and child asthma in the New England region. The report uncovered that adult asthma was significantly higher in the region compared to the rest of the U.S. (We could not determine if regional asthma rates were also higher for children because all U.S. states had not conducted a similar analysis on children as they had for adults).

The second report analyzed 2004 BRFSS data as well as 2003-2004 data from the National Survey of Children's Health to focus more on the burden that asthma places on individuals and families with members who suffer from the disease. This

second report confirmed that the New England region has higher rates of adult asthma when compared with the rest of the U.S. and that lifetime asthma rates for children in New England are higher than in the rest of the U.S. Additional findings were that the disease is more likely among people who are of low socio-economic status (SES), obese, smokers or children that live with smokers. In addition, low income individuals -- as well as Black and Hispanic families -- have the greatest burden of disease, including higher hospitalization rates, more lost work and school days, activity limitations, and are more likely to be in poor mental health or have other medical conditions (co-morbidities).

**This third report, analyzing 2006 BRFSS survey data, provides a more substantial understanding of how asthma manifests itself in the New England region, because it analyzes the results of in-depth follow-up telephone interviews of those who indicated on the standard BRFSS that they, or a child in their household, had asthma.** The analysis identifies new areas of investigation, and it raises a host of questions and concerns.

This report analyzes data from five of the six New England states that conducted the asthma call-back survey, excluding Rhode Island. But because we have found few statistical differences among the six New England states' data in the past, and indeed only one of the measures examined in this report showed differences among the states (asthma control), the authors feel comfortable in concluding that the results are representative of the entire NE region.

This newest report illuminates asthma severity and the extent to which the disease is being effectively managed or controlled. In the past, asthma severity had been roughly gauged by some proxy measures: hospitalizations, activity limitations and the like. Fortunately, many of the questions on the call-back survey aligned with the National Heart, Lung and Blood Institute's (NHLBI) asthma expert panel's national asthma guidelines recently released in 2007, on how to determine, using a defined set of metrics, disease severity and whether symptoms are considered *well controlled*. (The key exception is lung function, a factor in assessing both symptom severity and asthma control guidelines, which cannot be measured through a self-reported telephone survey).

Understanding asthma severity at diagnosis is an important measure in understanding asthma, primarily when a clinician needs to determine a course of medical intervention. The NHLBI asthma experts determined in 2007 that a more critical measure for assessing asthma is how well it is being controlled, so as to improve quality of life for those living with the disease. For the most part, asthma is a chronic condition that can be well controlled and should not result in death and disability, hospitalizations, or significant impairment in quality of life. This report allowed us to utilize these guidelines, for the most part, to assess these factors in our region. The results of this analysis give ARC cause for great concern, and a call to action to better address the disease clinically, environmentally and from a policy perspective. Some of the most pressing issues and questions raised by this report are the following:

- New England continues to have among the highest regional rates of adult asthma in the nation. This is true even when controlling for other factors that might affect the rates differently around the country including SES, gender, race, etc. (A preliminary model also examined whether higher insurance rates in our region may have been responsible for the region's higher asthma rates, assuming higher access to care might result in higher diagnoses; it was ascertained that this was not a factor.) Because the analysis controlled for factors which might have been responsible for the higher rates in New England (e.g. racial/ethnic differences, age, education, etc.), the reasons for these higher rates remain unknown, and give further credence to the need for understanding the unique role of indoor and ambient environmental factors, including workplace conditions, as they relate to asthma in our region. Higher rates

for NE children could not be determined using the BRFSS in this analysis, because the childhood survey is not employed by all states as it is for adults. However, our analysis using 2003 data from the National Survey of Children's Health across the country did indicate higher rates for children in NE.<sup>ix</sup>

- Why are rates for women increasing, while asthma rates for men appear to be leveling off?
- Although asthma is an eminently controllable disease, why is it that the majority of adults and children are considered to have poorly or very poorly controlled disease, and why are the majority of patients not given basic recommended clinical care such as annual flu shots and written asthma management plans which guide patients on what to do if they experience symptoms?
- While asthma symptoms and severity are reported to be much greater for adults than children, this analysis uncovers that adults have less frequent access to medications, doctors, flu shots and asthma management plans than do children. Children's greater access to health insurance coverage may partially explain this difference. Another factor is that the child information was reported by a parent who may not be fully aware of all of their child's symptoms, such as poor sleep. Thus, asthma symptoms and severity in children may be underestimated.
- As many as 22% of adults with severe persistent asthma could not afford their prescribed medications. Often times drug formulary tiers for asthma medications result in high co-payments—especially for controller drugs, making them out of reach for patients who are low income or who require on-going expensive medications.
- While the large majority of adults with asthma who have severe persistent disease report using medications regularly, their disease most frequently remains out of control. These findings raise questions about whether medications are being accessed, prescribed and/or utilized appropriately, and whether environmental triggers are being adequately addressed. Lack of office time and insurance coverage for proactive and follow-up asthma education, as well as home-based education and environmental assessments/remediations for those with persistent symptoms, may partially explain these findings.
- Often given short shrift, workplace asthma appears to have a greater role in the development and exacerbation of symptoms than understood in the past. Nearly 40% of all working adults in the call-back survey believed that their asthma was either initiated or exacerbated because of their working conditions. (This was much more common in low income individuals.) Moreover, as many as 29% of those with severe persistent asthma were unable to work. Why

do so few clinical professionals inquire about or diagnose workplace asthma, as revealed by this survey, and what policy interventions should be put in place to limit exposures given the health and potential economic impacts of occupational asthma?

- Over 1/3 of people with severe persistent asthma had a smoker in the home, compared with only 7% with mild intermittent asthma. Should policies that limit involuntary exposures in the home be contemplated? This is especially relevant for children who do not have options to remove themselves from adult secondhand smoke.

#### Note on Asthma Disparities

ARC's mission is to improve asthma outcomes across New England, with particular attention to those at highest risk. As we examine asthma data, we always attempt to identify our most vulnerable populations, so that policies and practices are developed to hopefully prevent and address any disparities uncovered in disease prevalence or burden.

Of the two data sets we analyze in this report, we review the general BRFSS data first. With six years of consecutive BRFSS asthma prevalence data for New England to review, we have determined that asthma rates for women are higher than rates for men and continue to climb, while the rates for men have leveled off over time. Moreover, this report continued to identify that those populations who are most likely to be diagnosed with asthma here in New England are those of lower socio-economic status—specifically those who have less education and lower income, plus obese adults and smokers.

The previous finding that there were no ethnic/racial disparities found in New England adult asthma rates was confirmed, based on the standard BRFSS data we examined. Unfortunately, we did not have enough data to make similar comparisons about ethnic/racial differences in children, however it should be noted that in our last report, Hispanic children had higher asthma rates than all other groups.

In addition, when we used the full BRFSS national data set (50 states + D.C.) to compare asthma prevalence in New England with the rest of the U.S., we statistically controlled for a variety of factors that might account for different rates of asthma across the country. Though these national data indicate that black adults had higher unadjusted asthma prevalence rates compared with whites, this has not been found to be the case in New England. However when the multivariate statistical analysis of the national data was conducted, adjusting for socio-demographic factors (income and education), we found that the asthma prevalence disparity between blacks and whites was eliminated in the adjusted rates. This suggests that

the higher crude national asthma rates in the black population may be explained by socio-economic factors, or other factors included in the analysis such as age, obesity or smoking. This observation, as well as the possible role that socio-economic factors may play in asthma outcomes, deserves further analysis.

With respect to the second data set examined by this report (the asthma “call-back” data), the New England sample sizes were so small that in order to examine disparities in adult asthma burden, we had to group all ethnic/racial groups (blacks, Hispanics, Asians, and all others) into one single “Other” category to compare to the non-Hispanic white population. Only two measures were found to be significantly different between non-Hispanic white adults and those in the “Other” group: The “Other” group was less likely to have had a flu shot and was more likely to have been hospitalized for asthma than their non-Hispanic white counterparts. (There was not a racial/ethnic “Other” category created for children because the numbers were too small, even when grouped together, to draw meaningful conclusions.)

#### Report Limitations

As with any telephone survey, there are general limitations to be considered. Persons in institutions (e.g. prisons, college dormitories, and nursing homes) are excluded from the survey, as are persons without telephones or with only cell phones. These can have varying effects, depending on the factor being measured. Also, persons without telephones are often in lower income households, but this may not be true of persons with cell phones only. Persons who cannot be reached or who refuse to respond may differ from the respondents, which can introduce survey bias. Unfortunately, there is no easy way to determine if this has happened. Self-reported data is always subject to error, but when the question refers to someone other than the respondent (i.e. child), there is also the question of how well aware the adult is of the child's behavior and condition.

The survey raised important issues that could not be fully explained in the way that the questions were posed to the respondents. For example, respondents were asked if a health professional had ever advised them to change conditions in their home, school, or work to improve their asthma. But there is no follow-up about whether or not any of the suggested changes were actually made. The survey questions about medication use were very detailed, but still did not help us understand why SABA use appeared to be excessively high compared to what would be expected by reported symptoms.

## VI. Recommendations

### 1: More research is needed about New England's high asthma rates.

Problem: Asthma rates continue to remain disproportionately higher in New England than the rest of the country, for reasons still unknown. Based on this multivariate analysis, the reasons for these higher rates are most likely *not* based on demographic factors unique to our region.

#### **Specific Recommendations:**

- More research needs to be conducted to ascertain why New England experiences higher rates of asthma, with closer scrutiny paid to contributing factors such as the region's unique ambient and built environments, as well as the changing climate in our region.
- Because indoor air quality has a demonstrated role to play in both the development and exacerbation of symptoms, particularly in the Northeast, healthy homes programs which use a more holistic approach to assess and remediate home environments, should be encouraged across the region. Professionals employed in a variety of home inspection programs (such as housing code, lead, weatherization and injury prevention programs) should be cross-trained to identify home-based asthma triggers in low income communities.

### 2: Disparities need to be addressed.

Problem: There are sub-populations in both children and adults that continue to experience higher rates of, and suffer disproportionately from, asthma. These populations include those in lower SES categories, smokers and the obese. Those who suffer from other chronic diseases or from depression also suffer from asthma disproportionately. Their greater reliance on expensive emergency care has economic and social consequences for affected families, the health care system and society as a whole.

#### **Specific Recommendations:**

- Proactive identification of vulnerable populations and more intensive and sustained intervention approaches must be provided to help them better manage their disease. Services must be culturally and linguistically appropriate. Hospitals, clinics, health agencies, as well as home visiting, housing and inspection agencies all have a role to play in identifying those at risk and ensuring they have access to a "medical home."
- These services must be available in the clinic, and supported in the community while reinforced in the home. Hospitals should ensure that asthma patients are connected to their providers and that providers are informed about their patients' urgent care status. A range of appropriately trained providers including nurses, respiratory therapists and community health workers, should be offering educational and support programs at a more robust level than

they are currently being offered. And more health professionals need to become Certified Asthma Educators.

- Public and private health insurers should reimburse providers in the variety of venues that are appropriate to deliver services, including for asthma education and home-based environmental assessment services.
- On a separate but related matter, the cost of necessary medications and co-pays is a barrier to effective asthma control for disparate populations that do get appropriate diagnosis and medical management. Healthcare providers need to know how to formally request medication assistance from pharmaceutical companies that can provide needed medications for those who need but cannot afford them. Insurance and employer health policies for medications should provide incentives for consistent use of controller medications.
- School nurses should be available in every school.
- Policy makers must address the unfair environmental burdens that poorer communities experience, which probably contribute to disparate health outcomes.
- Additionally, the federal government and private foundations should fund more "translational research" that will provide more information and guidance about what strategies work best in the field.

### 3: Adult asthma needs special attention, particularly related to potential occupational links.

Problem: Asthma symptoms appear to be more severe in adults. Many adults believe that their jobs exacerbate or cause their asthma symptoms, leading to lost workdays and the need to change jobs. Additionally, adults have a more difficult time accessing medical services and medications when needed.

#### **Specific Recommendations:**

- Asthma in the adult population needs to be accorded more attention and study.
- The role of occupational asthma must be given greater attention, and exposures to asthmagens in the workplace must be studied and regulated more closely. Health care providers should be asking their patients whether they believe that they are working with substances, or in settings, that might be exacerbating their symptoms, and document these discussions in their medical records. In some states, work-related asthma is a reportable disease, but whether or not reporting is required, providers should be trained and reimbursed for assessing whether the workplace is contributing to their patients' asthma.
- Providers may need to support their patients in connecting with resources and organizations which can help occupa-

tionally affected patients pursue issues related to occupationally-induced/exacerbated asthma, including in some cases advocating for those patients and/or properly referring them to occupational health providers as needed.

- Workers, and their unions, should be trained on the occupational hazards associated with their jobs, and how to minimize exposures to them.

#### **4: Clinical management needs to be improved, in conjunction with aggressive school and home based efforts.**

Problem: Despite the fact that asthma symptoms, in most cases, should be well controlled, the reality is that the majority of children and adults who have the disease continue to be symptomatic and rely extensively on “rescue” rather than “controller” medications for managing their symptoms. Further, many patients are not receiving basic proactive disease management care for their asthma, such as flu shots, written asthma management plans, follow-up, or environmental trigger assessments in the home.

##### **Specific Recommendations:**

- Primary care providers and specialists should be current on the updated national guidelines for best practices for asthma assessment and care, and have systems in place to proactively educate and follow up with their patients who are diagnosed with persistent asthma.
- Written asthma management plans should be provided to every patient with an asthma diagnosis, since severe episodes can occur even in mild cases. Copies should be made available to the school nurse, and workers should consider having one available at work.
- Reinforced educational visits and phone calls should cover proper use of medications, assessing and mitigating asthma triggers, monitoring symptoms, minimizing allergens, and receiving flu shots.
- Home visiting services, including environmental trigger assessments and remediation, should be offered to those at highest risk and with poor control.
- Public and private payers should consider reimbursement for providing or arranging for such services.

#### **5: Involuntary tobacco smoke exposure continues to be a significant source of asthma exacerbation.**

Problem: Smokers, and those living with smokers, have higher asthma rates and more severe disease. Children, especially, are an unprotected class when it comes to involuntary smoke exposure, and are most commonly exposed in their own homes and cars, as well as on clothing.

##### **Specific Recommendations:**

- Policies (both voluntary and mandatory) which limit children’s exposure to tobacco smoke are becoming more commonplace and should be encouraged.

- States, localities and housing organizations should consider implementing smoking restrictions in the home and in motor vehicles—especially where there are children involved—or opportunities for smoke to migrate within attached housing units.
- Clinical providers should be trained, in ‘certified’ programs for which they could be reimbursed by payers, to (a) encourage adult patients to limit ETS exposure for children, and (b) encourage efforts at smoking cessation among adult patients.
- Public and private payers should reimburse for smoking cessation programs and states should broaden their smoke-free educational programs and policy efforts.

## **VII. Conclusion**

State asthma programs, funded by the U.S. Centers for Disease Control and Prevention (CDC), have an important role to play in assuring that efforts at asthma prevention and control are monitored, promoted and improved upon. In addition, asthma coalitions play an important advocacy role. There are many components and multi-disciplinary stakeholders that need to be pulled together in order to more effectively and efficiently improve asthma outcomes. These include health systems and payers, health care providers, employers, regulators, schools, environmental organizations, community groups and families. It is important that multi-disciplinary policy makers work together to:

- advance access to high-quality clinical care and encourage proactive disease management approaches;
- design payment systems which incentivize best practices and outcomes;
- encourage reimbursement for asthma education and environmental interventions in the home where appropriate; and
- foster increased capacity to provide a range of clinical and environmental services at the community level by a multitude of appropriate providers (health departments, hospitals, community health centers, and NGOs) and policy-makers.

In many ways, the deficiencies in addressing asthma and its impact on quality of life are, in fact, emblematic of a more pervasive problem within our health system that favors treating illnesses rather than strategically preventing and proactively managing them in the first place. Our health system is not well focused on a public health approach that values individual and community education, proactive disease management, and addressing the systemic barriers to community health, including environmental interventions. As our country and our region engage in health care reform initiatives, meaningful approaches to improving quality and promoting prevention must be placed high on our universal access agenda. Only then will we realize improvements in asthma and other chronic diseases.

## Appendix A. Glossary

**Activity limitation (BRFSS):** Adult reported being limited in any way in any activities due to physical, mental, or emotional problems.

**Activity limitation (days):** number of days that an adult with current asthma was unable to work or carry out their usual activities because of their asthma.

**Activity limitation (degree):** Adults with current asthma whose activities in the past 12 months were limited by asthma either “a moderate amount” or “a lot” (as opposed to “not at all” or “a little”).

**Acute care visit:** Emergency room (ER) or urgent care center visit or a hospitalization for asthma in the past year.

**Asthma attack:** episode of asthma or attack in past 12 months.

**Asthma – Lifetime:** Response of “yes” to the following question on the regular BRFSS: “Have you ever been told by a doctor, nurse or other health professional that you had asthma?”

**Asthma – Current:** Adult or child with lifetime asthma with “yes” response to “Do you still have asthma?”

**Asthma Control:** the degree to which the manifestations of asthma are minimized by therapeutic intervention and the goals of therapy are met.

**Asthma Symptom Severity:** the intrinsic intensity of the disease process. Severity is most easily and directly measured in a patient who is not receiving long-term control therapy. Severity can also be measured, once asthma control is achieved, by the step of care (i.e., the amount of medication) required to maintain control.

**Co-morbid conditions** (illnesses found in addition to an asthma diagnosis) include respiratory conditions such as Chronic Obstructive Pulmonary Disease (COPD), emphysema, and bronchitis plus diabetes and cardiovascular disease (CVD including heart disease and stroke).

**Depression:** adults who were ever told by a doctor or health professional that they were depressed.

### **Economic barriers to care:**

– **To seeing doctor:** respondent indicated there was a time in the past 12 months when they needed to see their primary care doctor for their asthma but could not because of the cost.

– **To getting medication:** respondent indicated there was a time in the past 12 months when they needed to buy medication for their asthma but could not because of the cost.

**Job-related asthma:** Adults with lifetime asthma who ever worked (98%) who said their asthma was either caused by, or made worse by, chemicals, smoke, fumes or dust in a current job or in any previous job they ever had. Respondents who said they didn't know were included in a separate category.

**Job-related asthma as told by doctor/health professional:** Adults with lifetime asthma who were ever told by a doctor or other health professional that their asthma was related to any job they ever had.

**Fair/poor health:** Reported fair or poor health as opposed to excellent, good or very good.

**Frequent mental distress (FMD):** Adult reported 14 or more days in the past month when mental health was not good.

**Sample size:** N refers to the denominator (total) and n refers to the numerator, or the number of respondents in that category.

**Unable to work:** From demographic employment question, adult respondents who reported they were unable to work: reason not specified.

**Uninsured:** Child or adult has no health care coverage, including HMO or Medicaid.

**Weight categories (Obese, overweight, etc):** For all, body mass index (BMI) was determined from self-reported height and weight; overweight was defined as a BMI  $\geq 25$  and  $< 30$ , obese as a BMI  $\geq 30$ , and extreme obesity as BMI  $\geq 40$ .

## Appendix B. Supplemental Tables 2006 Asthma Call-back, CT, MA, ME, NH, VT

**Table S-1: NAEPP categories of asthma symptom severity, adults with current asthma**

Measure	Mild intermittent		Mild persistent		Moderate persistent		Severe persistent		Total
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	N
<b>Total</b>	45.2	40.0-50.4	19.2	15.6-23.3	17.3	13.6-21.6	18.4	15.2-22.1	1,439
<b>Gender</b>									
Males	52.4	42.8-61.9	21.9	15.0-31.0	9.4	5.5-15.5	16.2	11.8-21.9	402
Females	41.2	35.5-47.0	17.6	14.1-21.8	21.6	16.7-27.5	19.6	15.5-24.6	1,037
P value	0.009								
<b>Age (years)</b>									
18-34	51.7	39.3-63.9	20.8	13.0-31.7	18.1	10.0-30.6	9.4	5.5-15.6	195
35-44	47.0	39.9-54.3	17.0	12.7-22.5	17.6	12.6-24.0	18.4	13.1-25.1	577
55+	37.0	30.9-43.7	19.5	14.7-25.4	16.0	12.2-20.6	27.5	21.9-33.8	655
P value	0.03								
<b>Race/ethnicity</b>									
White, non-Hisp.	44.6	39.4-49.9	20.8	16.9-25.3	15.6	12.7-19.1	19.0	15.5-23.0	1,284
Other	50.0	30.5-69.5	6.4	3.4-11.8	29.6	12.7-55.0	13.9	7.9-23.4	139
P value	0.067								
<b>Income</b>									
<\$25K	30.9	21.8-41.8	14.3	9.5-21.0	24.8	14.3-39.5	30.0	22.5-38.7	439
\$25K-\$74-999	44.1	36.9-51.6	22.2	16.5-29.1	17.6	12.9-23.5	16.1	11.8-21.7	532
\$75K+	61.5	51.8-70.4	20.0	13.4-28.7	11.7	7.5-18.0	6.7	3.9-11.5	317
P value	<0.0001								
<b>Education</b>									
< High school	13.8	8.2-22.3	13.9	6.9-26.1	28.7	15.3-47.4	43.5	29.8-58.4	145
High School grad	35.5	23.7-49.4	18.2	11.5-27.7	18.0	9.3-31.9	28.3	19.4-39.3	368
Some college	48.0	38.1-58.0	14.3	9.3-21.2	20.6	14.3-28.8	17.1	11.7-24.3	351
College grad	54.9	47.8-61.7	23.6	17.8-30.5	12.7	9.2-17.4	8.9	6.1-12.6	574
P value	<0.0001								
<b>Weight status</b>									
Not overweight	57.4	48.0-66.3	15.1	10.4-21.5	14.5	10.0-20.6	12.9	8.8-18.7	435
Overweight only	46.6	38.2-55.2	24.2	16.8-33.5	13.0	8.6-19.0	16.2	11.4-22.5	423
Obese	32.6	25.5-40.6	19.1	13.6-26.0	23.1	15.1-33.7	25.2	18.7-33.1	515
P value	0.0007								
<b>Smoking</b>									
Non-smoker	48.5	42.7-54.4	19.1	15.1-23.7	16.6	12.6-21.6	15.8	12.5-19.8	1,168

Measure	Mild intermittent		Mild persistent		Moderate persistent		Severe persistent		Total
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	N
Current smoker	25.7	17.8-35.4	20.0	13.6-28.5	20.4	13.3-30.0	33.9	25.4-43.5	262
P value	0.0001								
<b>Meds past day</b>									
Yes 31.6	25.6-38.3	20.2	15.4-26.0	21.2	15.5-28.2	27.0	21.6-33.2	762	
No 58.8	51.4-65.8	18.1	13.2-24.2	13.5	9.4-19.0	9.6	6.9-13.3	669	
P value	<0.0001								
<b>State</b>									
CT 45.5	37.5-53.7	23.5	16.6-32.1	17.1	12.4-23.2	13.9	10.0-19.1	328	
ME 35.7	27.5-44.8	25.8	17.4-36.6	16.6	11.2-24.0	21.9	15.7-29.6	182	
MA 46.8	37.1-56.7	14.4	9.3-21.6	17.5	10.8-26.9	21.3	15.2-29.1	272	
NH 47.1	38.9-55.4	21.1	15.4-28.3	18.6	12.9-25.9	13.2	9.3-18.5	238	
VT 47.4	41.1-53.7	18.0	14.2-22.6	14.9	10.4-20.9	19.7	15.8-24.3	419	
P value	0.21								

**Table S-2: Asthma Control, adults with current asthma**

Measure	Well controlled		Not well controlled		Very poorly controlled		
	Percent	95% CI	Percent	95% CI	Percent	95% CI	N
<b>Total</b>	30.1	25.6-35.0	44.1	39.1-49.1	25.9	21.3-31.0	1,439
<b>Gender</b>							
Males	37.7	28.9-47.4	37.2	28.9-46.4	25.1	16.3-36.4	402
Females	25.9	21.0-31.4	47.9	42.0-53.7	26.3	21.5-31.7	1,037
P value	0.085						
<b>Age (years)</b>							
18-34	30.3	20.4-42.5	47.0	35.0-59.4	22.6	12.5-37.5	195
35-54	30.6	24.1-37.9	44.8	37.8-51.9	24.7	18.9-31.5	577
55+	29.4	23.5-36.2	39.8	33.8-46.1	30.8	25.0-37.2	655
P value	0.69						
<b>Race/ethnicity</b>							
White, non-Hisp.	30.5	26.0-35.4	43.9	39.0-48.9	25.6	20.8-31.1	1,284
Other	28.2	13.0-50.7	44.0	25.3-64.7	27.8	15.0-45.5	139
P value	0.957						
<b>Income</b>							
<\$25K	20.2	12.2-31.5	49.5	38.6-60.4	30.3	22.9-38.9	439
\$25K-\$74-999	27.2	20.9-34.5	47.0	39.8-54.4	25.8	19.7-32.9	532
\$75K+	42.5	33.0-52.6	39.3	30.4-49.0	18.2	9.3-32.3	317
P value	0.036						
<b>Education</b>							
< High school	11.5	6.4-19.7	45.8	31.2-61.1	42.7	29.0-57.7	145
High School grad	17.6	12.1-24.9	43.6	31.8-56.1	38.8	26.4-52.9	368
Some college	30.7	21.4-41.9	40.0	31.1-49.7	29.2	21.4-38.5	351
College grad	40.4	33.4-47.8	46.4	39.6-53.4	13.2	9.7-17.7	574
P value	<0.0001						
<b>Smoking</b>							
Non-smoker	32.8	27.6-38.4	44.6	39.0-50.3	22.6	17.6-28.5	1,168
Current smoker	14.6	8.8-23.1	40.0	31.0-49.9	45.4	35.9-55.3	262
P value	<0.0001						
<b>Meds in past day</b>							
Yes	18.9	14.0-25.1	45.1	38.3-52.0	36.0	29.8-42.7	762
No	40.7	33.4-48.4	43.3	36.2-50.8	16.0	9.7-25.2	669
P value	<0.0001						
<b>State</b>							
CT	31.1	23.8-39.6	49.9	41.8-58.0	19.0	14.1-25.1	328
ME	14.1	9.5-20.5	55.6	46.4-64.4	30.4	22.8-39.1	182
MA	34.6	26.2-44.1	36.6	27.9-46.2	28.8	20.1-39.5	272
NH	28.5	21.2-37.2	45.4	37.4-53.7	26.1	19.8-33.5	238
VT	25.0	20.1-30.6	49.2	42.9-55.5	25.9	21.2-31.1	419
P value	0.01						
<b>NAEPP category</b>							
Mild intermittent	59.3	50.6-67.4	29.3	23.3-36.1	11.4	5.0-23.7	578
Mild persistent	12.6	5.5-26.3	73.6	62.0-82.7	13.8	8.8-21.0	285
Moderate persistent	0		83.2	75.5-88.8	16.8	11.2-24.5	236
Severe persistent	4.7	2.1-10.3	12.9	8.5-19.2	82.4	75.0-87.9	340
P value	<0.0001						

**Table S-3: Short acting Beta 2 Agonist (SABA) use in past 3 months, adults with current asthma**

Measure	None		2 or more times per day		N
	Percent	95% CI	Percent	95% CI	
<b>Total</b>	52.6	47.4-57.7	16.1	11.9-21.4	1,439
<b>Gender</b>					
Males	54.7	44.6-64.4	16.7	8.7-29.6	402
Females	51.4	45.5-57.3	15.7	11.7-20.9	1,037
P value	0.875				
<b>Age (years)</b>					
18-34	44.9	33.2-57.3	17.7	8.3-33.8	195
35-54	48.5	41.4-55.7	14.8	10.1-21.4	577
55+ 64.8	58.3-70.9		16.1	11.6-22.0	655
P value	0.002				
<b>Race/ethnicity</b>					
White, non-Hisp.	52.7	47.4-57.9	15.5	11.1-21.3	1,284
Other	51.1	31.4-70.5	20.6	9.6-38.5	139
P value	0.304				
<b>Income</b>					
<\$25K	57.7	46.2-68.3	15.7	11.1-21.7	439
\$25K-\$74-999	43.6	36.6-50.8	15.6	10.5-22.5	532
\$75K+	57.2	46.3-67.5	15.1	6.8-30.4	317
P value	0.191				
<b>Education</b>					
< High school	61.6	46.4-74.7	22.9	12.1-39.0	145
High School grad	45.9	34.2-58.0	25.6	13.8-42.5	368
Some college	51.8	41.9-61.6	17.7	11.4-26.4	351
College grad	55.3	48.2-62.1	8.3	5.7-11.9	574
P value	0.003				
<b>Weight status</b>					
Not overweight	54.0	43.7-63.9	15.4	7.3-29.7	435
Overweight only	49.2	40.7-57.8	17.5	11.5-25.8	423
Obese	52.5	43.6-61.2	16.0	10.7-23.4	515
P value	0.785				
<b>Smoking</b>					
Non-smoker	53.3	47.4-59.1	14.7	10.1-20.9	1,168
Current smoker	47.6	38.0-57.3	24.1	16.8-33.2	262
P value	0.013				
<b>State</b>					
CT	56.8	48.6-64.6	10.9	7.2-16.4	328
ME	44.7	35.8-54.0	19.9	13.5-28.3	182
MA	51.7	41.8-61.4	18.4	10.6-30.1	272
NH	55.2	46.8-63.3	15.7	11.1-21.8	238
VT	50.6	44.3-56.9	14.6	11.0-19.1	419
P value	0.385				

**Table S-4: Age at diagnosis, adults with lifetime asthma, CT, ME, MA, NH, VT 2006**

Measure	age <5		age 5-12 years			age 13-17age		18+	
	Percent	95% CI	Percent	95% CI	Percent	95% CI	Percent	95% CI	N
Total	10.5	7.9-13.8	25.6	21.1-30.6	12.9	9.4-17.5	51.0	46.1-55.8	1,847
<b>Gender</b>									
Males	15.3	10.3-22.1	36.0	27.7-45.3	11.2	5.8-20.6	37.5	30.4-45.1	566
Females	7.1	4.9-10.1	18.1	14.1-22.8	14.2	10.2-19.5	60.7	54.9-66.1	1,281
P value	<0.0001								
<b>Age (years)</b>									
18-34	14.8	9.5-22.4	42.9	32.9-53.5	20.1	12.4-30.8	22.3	15.2-31.4	291
35-54	8.0	4.7-13.4	16.5	11.9-22.3	11.1	7.6-16.1	64.4	57.5-70.7	743
55+ 8.2	5.6-11.9	14.9	11.1-19.9	3.1	1.6-5.9	73.7	68.1-78.6	802	
P value	<0.0001								
<b>Race/ethnicity</b>									
White, non-Hispanic	9.5	7.1-12.6	25.9	21.2-31.1	12.0	8.6-16.5	52.6	47.5-57.6	1,640
Other	17.8	8.2-34.6	25.9	13.5-44.0	14.0	4.7-35.0	42.3	28.1-57.9	183
P value	0.481								
<b>Income</b>									
<\$25K	15.9	9.1-26.2	17.5	12.4-24.1	13.6	5.9-28.2	53.1	43.0-62.9	509
\$25K-\$74-999	9.6	5.9-15.4	24.7	18.1-32.7	9.4	6.0-14.3	56.3	48.8-63.6	720
\$75K+	11.3	7.1-17.4	29.4	21.2-39.3	15.6	9.2-25.3	43.7	35.3-52.4	440
P value	0.217								
<b>Education</b>									
< High school	10.5	5.4-19.5	15.4	8.3-26.8	13.0	6.7-23.6	61.1	47.8-73.0	163
High School grad	12.9	7.1-22.3	23.9	15.6-34.8	16.3	7.5-32.0	46.9	36.3-57.7	455
Some college	11.8	6.6-20.1	23.8	16.1-33.7	14.1	7.7-24.3	50.3	41.1-59.5	442
College grad	8.6	5.8-12.7	28.6	21.8-36.5	10.6	7.3-15.0	52.2	45.1-59.3	787
P value	0.687								
<b>Weight status</b>									
Not overweight	11.7	7.2-18.4	23.7	17.3-31.5	16.9	10.1-27.0	47.8	39.3-56.4	587
Overweight only	11.6	7.2-18.2	30.2	22.2-39.7	9.8	6.0-15.5	48.4	40.2-56.7	551
Obese	9.1	5.4-14.9	23.3	15.2-34.0	9.6	4.6-18.6	58.0	48.5-67.1	627
P value	0.376								
<b>Smoking</b>									
Non-smoker	10.3	7.5-14.0	25.2	20.5-30.6	12.9	9.0-18.2	51.5	46.1-56.9	1,523
Current smoker	11.7	6.6-20.0	28.3	17.2-43.0	13.1	7.9-21.0	46.8	36.1-57.9	314
P value	0.878								
<b>State</b>									
CT	10.0	6.4-15.2	24.7	18.6-32.0	10.5	6.9-15.6	54.9	47.6-61.9	419
ME	14.1	8.9-21.6	21.3	15.0-29.3	11.9	7.5-18.3	52.8	44.5-60.8	229
MA	9.6	5.6-16.0	26.4	18.8-35.6	15.0	9.0-24.1	49.0	40.5-57.6	358
NH	12.8	8.7-18.3	29.5	21.7-38.7	7.8	4.8-12.3	50.0	42.1-57.9	297
VT	10.8	7.7-15.0	22.5	17.8-27.9	17.0	12.5-22.6	49.8	44.2-55.3	544
P value	0.62								

**Table S-5: Symptoms within past day, adults with current asthma**

Measure	Percent	95% CI	n	N
Total	32.8	28.3-37.8	524	1,413
<b>Gender</b>				
Males	27.0	20.4-34.7	142	393
Females	36.1	30.3-42.2	382	1,020
P value	0.061			
<b>Age (years)</b>				
18-34	25.0	15.5-37.6	47	193
35-54	31.2	24.9-38.2	197	575
55+ 42.1	35.7-48.8	273	634	
P value	0.038			
<b>Race/ethnicity</b>				
White, non-Hispanic	32.3	28.0-37.0	472	1,262
Other	35.5	17.6-58.8	44	135
P value	0.773			
<b>Income</b>				
<\$25K	42.7	31.8-54.3	203	428
\$25K-\$74-999	39.9	32.9-47.5	186	523
\$75K+	15.8	11.0-22.2	73	314
P value	<0.0001			
<b>Education</b>				
< High school	38.2	25.9-52.2	73	142
High School grad	42.3	30.2-55.3	154	359
Some college	33.2	25.0-42.6	131	344
College grad	26.3	20.9-32.4	166	567
P value	0.057			
<b>Smoking</b>				
Non-smoker	30.6	25.6-36.1	392	1,148
Current smoker	45.6	36.1-55.5	127	259
P value	0.006			
<b>State</b>				
CT 29.9	23.4-37.3	117	322	
ME 40.0	31.5-49.3	85	178	
MA 33.6	25.1-43.3	102	266	
NH 29.5	22.8-37.3	78	236	
VT 32.2	26.7-38.2	142	411	
P value	0.456			
<b>Level of control</b>				
Well controlled	2.8	1.2-6.3	16	351
Not well controlled	34.9	28.0-42.5	207	641
Very poorly controlled	63.9	50.6-75.3	301	421
P value	<0.0001			

**Table S-6: Any acute care visit for asthma in past year, adults with current asthma**

Measure	Percent	95% CI	n	N
Total	11.1	8.7-14.0	186	1,423
<b>Gender</b>				
Males	5.3	2.9-9.5	29	397
Females	14.3	11.1-18.3	157	1,026
P value	0.0013			
<b>Age (years)</b>				
18-34	10.9	6.3-18.1	24	193
35-54	11	7.8-15.5	81	572
55+ 11.4	7.9-16.3	80	647	
P value	0.982			
<b>Race/ethnicity</b>				
White, non-Hispanic	10.6	8.1-13.7	145	1,270
Other	15.2	8.3-26.2	40	137
P value	0.277			
<b>Income</b>				
<\$25K	20.4	14.2-28.3	91	431
\$25K-\$74-999	10.8	7.0-16.2	58	528
\$75K+	4.2	2.1-8.5	16	315
P value	0.0001			
<b>Education</b>				
< High school	18.6	10.5-30.8	35	141
High School grad	13.1	8.1-20.5	50	363
Some college	15.6	10.1-23.2	55	347
College grad	6.1	3.8-9.5	45	571
P value	0.007			
<b>Smoking</b>				
Non-smoker	8.5	6.3-11.4	129	1,156
Current smoker	26.5	18.3-36.7	56	258
P value	<0.0001			
<b>Weight Status</b>				
Not overweight	8.6	5.1-14.1	37	430
Overweight only	10.4	6.6-15.9	56	417
Obese	12.2	8.5-17.2	83	510
P value	0.529			
<b>State</b>				
CT 11.7	7.7-17.4	49	322	
ME 11.8	7.0-19.0	23	181	
MA 9.7	6.1-15.3	37	265	
NH 15.9	10.5-23.2	37	236	
VT 8.4	5.8-12.0	40	419	
P value	0.464			
<b>Level of control</b>				
Well controlled	0.4	0.2-1.1	7	352
Not well controlled	10.0	6.8-14.3	66	650
Very poorly controlled	25.3	18.1-34.1	113	421
P value	<0.0001			

**Table S-7: Adults with current asthma hospitalized for asthma, past year**

Measure	Percent	95% CI	n	N
Total	3.2	2.1-5.0	56	1,426
<b>Gender</b>				
Males	1.7	0.5-5.7	9	399
Females	4.0	2.6-6.3	47	1,027
P value	0.185			
<b>Age (years)</b>				
18-34	1.0	0.3-2.8	4	193
35-54	2.7	1.2-6.0	20	573
55+	6.0	3.4-10.4	32	649
P value	0.009			
<b>Race/ethnicity</b>				
White, non-Hispanic	2.7	1.6-4.7	37	1,273
Other	7.0	3.4-13.9	19	137
P value	0.035			
<b>Income</b>				
<\$25K	7.8	4.4-13.5	33	434
\$25K-\$74-999	2.9	1.2-6.8	12	527
\$75K+	0.2	0.1-0.5	4	317
P value	0.0002			
<b>Education</b>				
< High school	4.8	2.4-9.4	12	141
High School grad	6.5	3.1-13.0	21	363
Some college	2.7	1.2-5.8	13	349
College grad	1.3	0.5-3.7	9	572
P value	0.015			
<b>Weight status</b>				
Not overweight	1.5	0.3-6.4	7	431
Overweight only	1.7	1.0-2.9	19	419
Obese	4.6	2.6-7.9	26	510
P value	0.105			
<b>Smoking</b>				
Non-smoker	3.1	1.9-5.2	44	1,160
Current smoker	3.3	1.7-6.5	11	258
P value	0.88			
<b>State</b>				
CT	2.4	1.0-5.6	14	324
ME	2.2	1.0-5.0	6	181
MA	3.9	1.9-7.8	15	265
NH	4.4	2.2-8.8	12	237
VT	1.8	0.9-3.6	9	419
P value	0.511			

**Table S-8 Flu shot in past year, adults with current asthma**

Measure	Percent	95% CI	n	N
Total	50.1	44.9-55.2	799	1,435
<b>Gender</b>				
Males	43.4	33.8-53.4	201	400
Females	53.7	47.8-59.6	598	1,035
P value	0.082			
<b>Age (years)</b>				
18-34	33.8	22.4-47.5	67	195
35-54	43.3	36.2-50.6	257	575
55+ 73.6	67.3-79.0	469	654	
P value	<0.0001			
<b>Race/ethnicity</b>				
White, non-Hispanic	52.5	47.4-57.7	720	1,280
Other	31.6	17.9-49.5	73	139
P value	0.025			
<b>Income</b>				
<\$25K	46.0	35.8-56.6	241	438
\$25K-\$74-999	45.3	38.2-52.6	298	530
\$75K+	55.1	45.0-64.7	172	317
P value	0.241			
<b>Education</b>				
< High school	55.2	39.7-69.8	92	145
High School grad	54.5	41.9-66.4	198	366
Some college	43.8	34.4-53.6	176	350
College grad	50.2	43.1-57.2	332	573
P value	0.469			
<b>Weight status</b>				
Not overweight	48.0	38.1-58.1	235	433
Overweight only	50.5	41.9-59.0	219	423
Obese	52.3	43.4-61.1	307	514
P value	0.804			
<b>Smoking</b>				
Non-smoker	51.5	45.7-57.3	682	1,167
Current smoker	40.1	30.9-49.9	110	260
P value	0.048			
<b>State</b>				
CT	44.5	36.9-52.4	172	328
ME	49.2	39.9-58.5	102	181
MA	53.7	43.8-63.2	158	272
NH	52.0	43.7-60.2	138	238
VT	46.3	40.2-52.6	229	416
P value	0.338			
<b>Level of control</b>				
Well controlled	42.2	33.6-51.2	189	360
Not well controlled	47.7	40.7-54.7	353	652
Very poorly controlled	63.4	53.4-72.3	257	423
P value	0.005			

**Table S-9: Have asthma management plan, adults with current asthma**

Measure	95% CI	n	N	
Percent				
Total	29.6	24.7-34.9	387	1,396
<b>Gender</b>				
Males	21.8	12.7-34.8	67	385
Females	33.8	28.6-39.5	320	1,011
P value	0.086			
<b>Age (years)</b>				
18-34	29.4	18.4-43.5	53	187
35-54	36.7	29.7-44.2	181	567
55+	21.5	16.8-27.1	150	631
P value	0.068			
<b>Race/ethnicity</b>				
White, non-Hispanic	31.0	25.8-36.8	343	1,247
Other	19.6	11.1-32.3	43	134
P value	0.09			
<b>Income</b>				
<\$25K	26.7	19.4-35.5	133	421
\$25K-\$74-999	24.8	19.0-31.6	127	522
\$75K+	40.2	29.8-51.6	103	312
P value	0.019			
<b>Education</b>				
< High school	18.1	10.3-29.9	29	137
High School grad	34.3	21.5-49.9	92	355
Some college	30.7	22.2-40.7	98	337
College grad	28.3	22.7-34.6	167	566
P value	0.407			
<b>Smoking</b>				
Non-smoker	28.9	23.5-35.0	321	1,131
Current smoker	34.0	24.5-45.0	65	256
P value	0.389			
<b>State</b>				
CT	29.7	22.6-38.0	85	320
ME	32.1	24.1-41.2	62	178
MA	30.5	21.4-41.3	80	259
NH	25.9	19.8-33.1	71	235
VT	23.2	18.3-29.0	89	404
P value	0.733			
<b>Level of control</b>				
Well controlled	19.7	13.5-27.7	70	342
Not well controlled	29.1	23.3-35.5	189	640
Very poorly controlled	41.4	29.7-54.1	128	414
P value	0.006			

**Table S-10 Cost barrier to seeing MD/Cost barrier to medications, adults with current asthma**

	Cost barrier to seeing MD			Cost barrier to medications		
Adults w/current asthma						
Percent	95% CI	N	Percent	95% CI	N	
Total	8.6	4.7-15.1	1,390	14.0	9.6-20.0	1,390
<b>Gender</b>						
Males	9.6	3.0-26.8	391	14.9	6.8-29.6	392
Females	8.0	4.3-14.5	999	13.5	9.1-19.5	998
P value	0.774			0.811		
<b>Age (years)</b>						
18-34	18.4	7.8-37.4	189	23.8	12.4-40.8	188
35-54	5.8	3.9-8.5	565	12.8	8.6-18.5	564
55+	2.5	1.5-4.1	625	5.7	3.7-8.7	627
P value	0.0005			0.005		
<b>Race/ethnicity</b>						
White, non-Hispanic	7.3	3.8-13.7	1,244	12.1	8.0-17.8	1,243
Other	18.1	4.6-50.2	132	28.4	11.4-55.0	132
P value	0.211			0.077		
<b>Income</b>						
<\$25K	18.8	9.1-34.9	418	26.3	15.4-41.2	420
\$25K-\$74-999	5.4	3.0-9.3	519	12.3	8.3-17.7	518
\$75K+	7.2	1.3-31.9	313	8.9	2.2-29.8	313
P value	0.177			0.123		
<b>Education</b>						
< High school	19.1	10.3-32.6	134	35.3	20.2-54.2	134
High School grad	21.2	8.8-43.0	353	28.1	14.8-46.8	352
Some college	5.1	2.4-10.3	341	9.6	5.8-15.5	342
College grad	1.7	0.9-3.0	561	5.0	3.0-8.1	561
P value	<0.0001			<0.0001		
<b>Weight status</b>						
Not overweight	10.0	2.9-29.2	414	14.4	6.2-30.0	415
Overweight only	2.7	1.4-5.1	408	8.6	5.0-14.4	407
Obese	13.1	6.4-25.0	503	19.2	11.4-30.5	504
P value	0.171			0.248		
<b>Smoking</b>						
Non-smoker	7.2	3.2-15.5	1,134	11.9	7.1-19.2	1,134
Current smoker	17.0	10.6-26.3	247	27.0	18.6-37.5	247
P value	0.055			0.006		
<b>State</b>						
CT	4.2	2.3-7.3	309	6.5	3.9-10.7	311
ME	9.7	5.1-17.6	179	19.7	12.5-29.6	179
MA	11.9	4.6-27.2	252	17.1	8.8-30.6	253
NH	6.6	3.7-11.4	231	14.5	9.7-21.1	229
VT	5.2	3.1-8.7	419	12.1	8.3-17.2	418
P value	0.16			0.07		
<b>Level of control</b>						
Well controlled	0.3	0.1-1.3	344	2.5	1.2-5.3	343
Not well controlled	8.4	3.7-18.0	635	13.4	7.6-22.6	634
Very poorly controlled	18.2	8.1-36.2	411	27.8	16.7-42.5	413
P value	0.007			0.0002		

**Table S-11: Asthma is job related (self-reported)**

All respondents with lifetime asthma who ever worked					
	Yes		Not sure		
Percent	95% CI	Percent	95% CI	N	
Total	37.2	32.6-42.1	3.8	2.8-5.3	1,901
<b>Gender</b>					
Males	35.8	27.9-44.5	4.6	3.0-7.0	593
Females	38.3	32.9-43.9	3.3	2.0-5.4	1,308
P value	0.647				
<b>Age (years)</b>					
18-34	33.9	24.5-44.9	0.7	0.2-1.8	295
35-54	40.2	33.6-47.1	4.5	2.6-7.6	767
55+	39.0	33.4-44.9	7.1	4.6-10.8	825
P value	0.013				
<b>Race/ethnicity</b>					
White, non-Hispanic	36.5	31.8-41.4	3.9	2.7-5.5	1,707
Other	44.6	28.5-61.9	2.5	0.9-6.4	170
P value	0.935				
<b>Income</b>					
<\$25K	54.9	45.1-64.3	6.1	3.9-9.6	503
\$25K-\$74-999	40.7	33.6-48.1	4.3	2.5-7.1	750
\$75K+	25.4	17.9-34.6	2.3	0.9-5.8	461
P value	<0.0001				
<b>Education</b>					
< High school	61.2	47.8-73.1	7.3	3.5-14.7	154
High School grad	51.4	40.5-62.2	2.8	1.7-4.8	463
Some college	31.7	24.9-39.5	5.0	3.0-8.3	464
College grad	29.8	24.1-36.2	3.4	1.8-6.2	819
P value	<0.0001				
<b>State</b>					
CT	30.9	25.0-37.4	3.1	1.8-5.4	426
ME	45.6	37.7-53.7	4.6	2.4-8.7	235
MA	38.2	29.9-47.3	3.6	1.9-6.5	348
NH	41.5	34.2-49.2	4.5	2.5-7.9	320
VT	33.2	28.6-38.2	7.4	5.3-10.3	572
P value	0.127				

**Table S-12: Changed jobs due to asthma**

<b>All respondents with lifetime asthma who ever worked</b>			
	Percent	95% CI	N
Total	6.4	4.8-8.6	1,898
<b>Gender</b>			
Males	5.3	3.4-8.3	591
Females	7.2	4.9-10.5	1,307
P value	0.306		
<b>Age (years)</b>			
18-34	4.9	2.8-8.5	294
35-54	7.8	4.7-12.7	766
55+	6.7	4.4-10.1	824
P value	0.394		
<b>Race/ethnicity</b>			
White, non-Hispanic	6.4	4.6-8.9	1,704
Other	6.9	3.8-12.2	170
P value	0.854		
<b>Income</b>			
<\$25K	18.3	12.5-26.1	502
\$25K-\$74-999	6.1	3.3-10.9	748
\$75K+	1.1	0.4-2.7	461
P value	<0.0001		
<b>Education</b>			
< High school	20.2	11.5-32.9	153
High School grad	9.5	5.0-17.3	462
Some college	7.0	4.3-11.4	463
College grad	2.9	1.8-4.7	819
P value	0.0001		
<b>State</b>			
CT	5.0	3.0-8.3	426
ME	12.2	7.9-18.5	234
MA	5.4	2.9-9.8	347
NH	8.4	4.8-14.2	320
VT	7.5	5.2-10.5	571
P value	0.085		
<b>Job related (self-reported)</b>			
Yes	17.2	12.7-22.9	734
No	0	1,044	
Wasn't sure	0		120
P value	<0.0001		

**Table S-13: Activities limited to moderate degree (or more) due to asthma, adults with current asthma**

Measure	Percent	95% CI	N
Total	19.3	15.4-23.9	1,416
<b>Gender</b>			
Males	12.5	8.7-17.7	398
Females	23.1	17.7-29.4	1,018
P value	0.005		
<b>Age (years)</b>			
18-34	16.7	8.5-30.2	192
35-54	17.2	12.2-23.7	573
55+	24.2	19.3-29.9	640
P value	0.344		
<b>Race/ethnicity</b>			
White, non-Hispanic	18.2	14.7-22.4	1,266
Other	27.4	11.6-51.9	135
P value	0.337		
<b>Income</b>			
<\$25K	38.6	27.8-50.6	430
\$25K-\$74-999	16.1	11.7-21.8	523
\$75K+	8.8	4.6-16.0	316
P value	<0.0001		
<b>Education</b>			
< High school	34.3	22.5-48.4	137
High School grad	32.2	21.0-46.0	360
Some college	19.2	13.5-26.6	347
College grad	9.4	6.0-14.5	571
P value	<0.0001		
<b>Weight status</b>			
Not overweight	13.9	8.7-21.4	429
Overweight only	13.0	9.1-18.0	415
Obese	30.7	22.2-40.8	506
P value	0.0003		
<b>Smoking</b>			
Non-smoker	18.0	13.7-23.3	1,150
Current smoker	26.6	18.9-36.1	257
P value	0.072		
<b>State</b>			
CT	13.4	9.7-18.3	324
ME	21.4	15.4-28.8	178
MA	21.7	14.3-31.6	263
NH	22.2	16.1-29.7	235
VT	18.7	14.7-23.5	416
P value	0.169		
<b>Level of control</b>			
Well controlled	0		347
Not well controlled	18.2	11.9-26.6	651
Very poorly controlled	43.1	32.9-53.9	418
P value	<0.0001		

**Table S-14: Mean # days of activity limitation/missed work, adults with current asthma**

Measure	Mean	95% Conf.	Int.	N
Total	7.7	5.6	9.9	1,370
<b>Gender</b>				
Males	9.1	4.5	13.7	388
Females	6.9	4.8	9.1	982
<b>Age (years)</b>				
18-34	2.6	0.8	4.5	189
35-54	7.8	4.7	11.0	561
55+	12.9	7.6	18.2	610
<b>Race/ethnicity</b>				
White, non-Hispanic	7.7	5.3	10.0	1225
Other	7.9	2.1	13.7	131
<b>Income</b>				
<\$25K	19.0	11.4	26.7	399
\$25K-\$74-999	7.1	3.4	10.8	521
\$75K+	2.2	0.6	3.9	315
<b>Education</b>				
< High school	17.5	7.5	27.4	126
High School grad	8.9	3.4	14.3	337
Some college	9.3	4.5	14.1	341
College grad	4.6	2.4	6.8	565
<b>Weight status</b>				
Not overweight	5.1	2.1	8.1	421
Overweight only	7.1	3.7	10.5	404
Obese	11.0	6.2	15.8	480
<b>Smoking</b>				
Non-smoker	6.5	4.4	8.6	1120
Current smoker	15.0	7.2	22.9	241
<b>State</b>				
CT	9.3	4.3	14.3	317
ME	4.6	2.0	7.1	177
MA	6.4	3.2	9.5	254
NH	13.3	6.7	19.9	228
VT	6.9	3.6	10.3	394
<b>Level of control</b>				
Well controlled	0.2	0.0	0.3	352
Not well controlled	3.9	2.1	5.7	625
Very poorly controlled	23.7	14.9	32.4	393

**Table S-15 Any co-morbidity/Diagnosed depression, adults with current asthma**

Adults w/current asthma	Any co-morbidity *			Diagnosed depression		
	Percent	95% CI	N	Percent	95% CI	N
Total	37.7	32.8-42.8	1,439	28.4	24.3-32.8	1,401
<b>Gender</b>						
Males	39.0	29.4-49.5	402	20.9	14.5-29.2	392
Females	36.9	31.9-42.3	1,037	32.5	27.7-37.8	1,009
P value	0.719			0.018		
<b>Age (years)</b>						
18-34	22.1	11.9-37.2	195	23.4	15.6-33.4	190
35-54	30.4	24.7-36.9	577	29.9	23.9-36.6	565
55+ 61.2	54.6-67.4	655	31.3	25.4-38.0	635	
P value	<0.0001			0.306		
<b>Race/ethnicity</b>						
White, non-Hispanic	38.7	33.6-44.0	1,284	28.1	24.0-32.6	1,255
Other	28.6	17.5-43.1	139	30.7	16.9-49.1	131
P value	0.185			0.762		
<b>Income</b>						
<\$25K	51.4	40.3-62.4	439	47.3	36.4-58.5	422
\$25K-\$74-999	35.5	29.2-42.5	532	25.3	19.9-31.6	522
\$75K+	28.5	18.4-41.3	317	19.3	12.9-27.9	313
P value	0.016			<0.0001		
<b>Education</b>						
< High school	64.9	47.5-79.1	145	58.5	43.6-71.9	137
High School grad	49.7	37.2-62.2	368	26.5	18.7-36.2	356
Some college	38.3	30.0-47.3	351	31.8	24.1-40.7	340
College grad	25.3	19.6-32.0	574	22.2	16.9-28.5	567
P value	<0.0001			0.0001		
<b>Weight status</b>						
Not overweight	28.3	19.0-40.0	435	19.9	14.4-26.8	422
Overweight only	43.3	35.0-52.0	423	29.6	22.2-38.1	410
Obese	43.2	35.4-51.3	515	37.6	29.9-45.9	505
P value	0.043			0.004		
<b>Smoking</b>						
Non-smoker	34.2	28.9-40.0	1,168	24.4	20.2-29.1	1,142
Current smoker	57.7	47.5-67.2	262	53.1	43.1-62.9	250
P value	0.0001			<0.0001		
<b>State</b>						
CT	38.0	30.9-45.7	328	25.6	19.7-32.6	316
ME	37.7	29.5-46.7	182	33.4	25.3-42.6	178
MA	38.2	29.1-48.2	272	27.6	20.3-36.3	255
NH	36.2	29.2-43.7	238	30.1	23.3-38.0	234
VT	34.5	29.2-40.2	419	33.9	28.1-40.3	418
P value	0.955			0.533		
<b>Level of control</b>						
Well controlled	23.3	16.4-31.9	360	19.2	12.6-28.0	345
Not well controlled	33.1	27.4-39.4	655	30.4	24.7-36.8	641
Very poorly controlled	62.2	51.3-72.1	424	35.3	26.5-45.2	415
P value	<0.0001			0.025		

\*Bronchitis, emphysema, COPD, diabetes, heart disease, or stroke

## Appendix C. Technical Notes (Logistic Regression Results)

Logistic regression results reported in Section II D of this report were obtained using Stata, version 9.0, a software package that accounts for the complex design of the BRFSS. The first step in that analysis was a comparison of current asthma rates for the 50 states and DC as shown in Table A below. Those results indicate that the prevalence rate is affected by each of the demographic factors in the Table. From Table 1 earlier in this report, it was noted that rates also varied by DHHS region. The demographic factors and region were included in logistic regression analysis to determine if controlling for differing demographics between New England and the rest of the U.S. would change the results of the univariate analysis.

The logistic regression analysis showed that New England had a higher adult current asthma rate when compared with the rest of the U.S. (combined), having an odds ratio (OR) of 1.26, that is not explained by differing demographics. This analysis was then repeated for the other nine DHHS regions, comparing each with the “rest of the U.S.” Those results indicated that only one other region (X : AK, ID, OR, WA) had a current asthma rate that was higher than the rest of the U.S., having an adjusted OR of 1.13. Asthma rates in Region IV were significantly lower than the rest of the U.S. (OR=0.84) while rates in the other regions were all similar to those in the rest of the U.S. in this analysis.

In addition, a separate analysis was done which compared each of the other nine DHHS regions with New England, using the variable that divided the U.S. into ten regions and using New England as the reference. Those results indicated that the current asthma rate in each of the other nine DHHS regions was significantly LESS than the New England rate, with ORs ranging from 0.7-0.9, again indicating that the New England asthma rates are highest. Logistic regression using different variables, models, or data sources might produce different results.

The logistic regression analysis comparing each DHHS region with the rest of the U. S. found other statistically significant odds ratios when controlling for these other measures. Because this was part of an analysis to determine how asthma rates in each region compared with the rest of the US, the study included all 50 states and the District of Columbia. Controlling for all other factors in the logistic regression model, being female (OR=1.79), younger than age 65 (OR

1.19-1.44 depending on age group), having income below \$25K (OR=1.46), having less than a high school education (OR=1.31), being a current smoker (OR=1.21), and having a BMI over 25 (OR= 1.24-3.27) also increased the odds of reporting current asthma. The factor with the highest adjusted odds ratio was having a BMI of 40 or higher, with an OR of 3.27. (Table B). Controlling for all other factors, being black (OR=0.90), Hispanic (OR=0.55), and being married (OR=0.81), decreased the odds of current asthma compared with the referent groups.

The result for Hispanics is consistent with the unadjusted results, but the result for blacks is in contrast to the unadjusted U.S. asthma prevalence rate for black adults of 9.7% that was significantly higher than the unadjusted rate for whites of 8.4% shown in Table A. This simply illustrates the effect of controlling for possible confounding variables that occurs when using logistic regression. These race and ethnicity results for the U.S. are also in contrast to results reported earlier in this report for New England adults where asthma prevalence rates are similar across race and ethnicity groups.

**Table A.**  
**US Current Asthma Rates by Demographic Variables (Unadjusted)**  
**50 States + DC, 2006 BRFSS, N= 345,593**

	Percent	95% CI		Percent	95% CI
Total	8.2	8.0-8.4	Education		
Gender			College grad	7.0	6.7-7.3
Males	6.0	5.7-6.3	Some college	8.8	8.4-9.2
Females	10.3	10.0-10.6	High School grad	8.2	7.8-8.6
P value	<0.0001		<High School	10.3	9.6-11.0
Age (years)			P value	<0.0001	
18-24	9.3	8.4-10.3	Married		
25-34	7.5	7.1-8.0	Yes	7.1	6.9-7.3
35-44	7.9	7.5-8.4	No	9.9	9.5-10.3
45-54	8.3	7.9-8.7	P Value	<0.0001	
55-64	9.0	8.6-9.4	Weight status (BMI)		
65+	7.6	7.3-8.0	Not overwt (BMI <25.0)	6.9	6.5-7.2
P value	<0.0001		Overwt (BMI 25-29.9)	7.3	6.9-7.6
Race/ethnicity			Obese (BMI 30.0-39.9)	10.4	9.9-10.8
White	8.4	8.2-8.7	Ext. Obesity (BMI 40+)	20.2	18.7-21.7
Black	9.7	9.0-10.5	P value	<0.0001	
Hispanic	5.7	5.1-6.3	Smoking status		
Other	9.0	8.1-9.9	Non-smoker	7.8	7.5-8.0
P value	<0.0001		Current smoker	10.0	9.5-10.5
Income			P value	<0.0001	
Unknown*	8.0	7.5-8.6			
>\$75K	6.6	6.2-7.1	*This category represents 48,268 persons who did not report their household income and was included to avoid eliminating this large number of respondents from the logistic regression analysis		
\$50-75K	7.5	7.0-8.0			
\$25-50K	7.5	7.2-7.9			
<\$25k	11.2	10.7-11.7			
P value	<0.0001				

**Table B.**  
**Results of Logistic Regression;**  
**Outcome is current asthma among adults**  
**2006 BRFSS n=321,626, 50 States + DC**

Measure	Odds Ratio	P value	95% Confidence Interval	
			lower	upper
Gender (Men is referent)				
Women	1.79	<0.001	1.68	1.91
Age (65+ is referent)				
55-64 yrs	1.26	<0.001	1.17	1.37
45-54 yrs	1.22	<0.001	1.13	1.33
35-44 yrs	1.23	<0.001	1.13	1.35
25-34 yrs	1.19	<0.001	1.08	1.31
18-24 yrs	1.44	<0.001	1.27	1.63
Race (white is referent)				
Black	0.90	0.026	0.81	0.99
Hispanic	0.55	<0.001	0.49	0.62
Other	1.09	0.153	0.97	1.23
Marital status (not married is referent)				
Married	0.81	<0.001	0.76	0.87
Income (>\$75K is referent)				
\$50-75K	1.04	0.443	0.94	1.16
\$25-50K	1.02	0.752	0.91	1.13
<\$25K	1.46	<0.001	1.29	1.66
Unknown income	1.09	0.216	0.95	1.24
Education (college grad is referent)				
Some college	1.07	0.065	1.00	1.15
High School	0.98	0.700	0.90	1.08
< High School	1.31	<0.001	1.17	1.46
Weight (not overweight is referent)				
BMI 25-29.9	1.24	<0.001	1.16	1.34
BMI 30-39.9	1.75	<0.001	1.63	1.89
BMI 40+	3.27	<0.001	2.92	3.66
Smoking status (nonsmoker is referent)				
Current smoker	1.21	<0.001	1.13	1.31
Region (rest of US is referent)				
NE states	1.26	<0.001	1.18	1.34

## References

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- <sup>i</sup> New England Asthma Regional Council. Asthma in New England Part I. Adults. Dorchester, MA May 2003.
- <sup>ii</sup> New England Asthma Regional Council. Asthma in New England Part II. Children. Dorchester, MA January 2004.
- <sup>iii</sup> New England Asthma Regional Council. The Burden of Asthma in New England. Dorchester, MA March 2006.
- <sup>iv</sup> Sandel, M & Adams M, unpublished results from the National Survey of Children's Health 2003.
- <sup>v</sup> Jeanne Moorman, CDC Asthma Teleconference of 6/8/2204 as reported by Betsy Wasilevich, Asthma Initiative of Michigan, CDC Grantee Meeting, 2/16/2005.
- <sup>vi</sup> Protocol for defining asthma control in the asthma call-back survey data, based on the NAEPP Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, was developed by Betsy Wasilevich, PhD, MPH, Sarah Lyon-Callo, MA, MS, and Ann Rafferty, PhD, Michigan Department of Community Health.
- <sup>vii</sup> [www.cdc.gov/mmwr/preview/mmwrhtml/rr5707a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5707a1.htm), accessed September 22, 2008.
- <sup>viii</sup> IOM (Institute of Medicine). 2000. Clearing the Air: Asthma and Indoor Air Exposures. Washington, DC: National Academy Press.
- <sup>ix</sup> <http://www.healthypeople.gov/> accessed September 16, 2008.