

TOPIC AREA: Respiratory Disease
INDICATOR: ASTHMA HOSPITAL ADMISSIONS

MEASURES	Annual number of hospital admissions with a primary discharge diagnosis of asthma (ICD-9-CM 493) Average number of hospital admissions due to asthma per day, by month Minimum and maximum daily numbers Annual rate of hospital admissions Annual age-adjusted rate of hospitalization
DEMOGRAPHIC UNIT	Annual total population estimate for the calendar year. Data can be obtained from U.S. Bureau of the Census. Other measures can include: 1) age categories such as 0-4, 5-14, 15-34, 35-64 and 65+; 2) sex; 3) race; 4) ethnicity; 5) out of state hospitalizations; 6) primary insurer/payer; 7) E-codes; 8) suspected causes such as adverse drug reactions or Environmental Tobacco Smoke (ETS); 9) length of stay; 10) CPT codes for severity; 11) co-morbidities such as diagnosis for Chronic Obstructive Pulmonary Disease (COPD), pneumonia, bronchitis and influenza; and 12)V-codes.
GEOGRAPHIC UNIT	State, County, Zip Code, Census Tract
TEMPORAL UNIT	Year, Quarter/Season, Month, Day
SIGNIFICANCE AND BACKGROUND	As a chronic disease asthma adversely impacts millions of Americans and consumes billions of dollars in health care costs. Available annual statistics for 2002-2004 included 20.5 million people who reported having asthma, more than 574,000 asthma hospitalizations and at least 4,200 asthma deaths¹. Asthma prevalence is consistently higher in children². Race, income and geography are also predictive of poor asthma outcomes³. Based on a review of available scientific evidence the Institute of Medicine concluded that allergens from cats, cockroaches and house dust mites caused asthma exacerbations, as did exposure to ETS in preschool aged children⁴. In 2005 the California Air Resources Board also concluded that ETS caused asthma exacerbations in children and adults. It estimated that each year exposure to ETS was statistically predictive of 202,300 excess childhood asthma episodes. There are large direct (\$14.7 billion) and indirect (\$5.0 billion) annual costs associated with asthma⁵. Environment Attributable Fractions of 1988-1994 costs for asthma were estimated at 39.2% for children <6 years and 44.4% for 6-16 year olds, and more than \$400 million for each age group⁶. Associations between air pollution exposures and asthma have been repeatedly demonstrated. The association between ambient air particulate matter (PM) concentrations and asthma, including increased hospital admissions, is well documented⁷⁻⁸. Modeling results demonstrate 5-20% increases in respiratory-related hospital admissions per 50µg/m³ of PM₁₀ and 5-15% per 25µg/m³ of PM_{2.5} or PM_{10-2.5}, with the largest effect on asthma admissions⁹. In the Eastern United States summer ozone pollution has been shown to be associated with more than 50,000 hospital admissions per year for asthma and other respiratory conditions. United States and Canadian studies found warm season ozone-associated increases in respiratory hospital admissions ranged from 2-30% per 20 ppb (24 hours), 30 ppb (8-hours) or 40 ppb (1-hour)¹⁰.
RATIONALE	Most acute asthma incidents, including hospitalizations, are preventable if asthma is properly managed according to established medical guidelines, which include reducing exposures to environmental triggers¹¹. Asthma hospitalization data can be used to evaluate environmental impacts, if there are enough observations to permit the analysis of temporal and geographic trends. The use of physician-diagnosed asthma is not subject to recall bias. In contrast to the chronic disease asthma hospitalization indicator, this asthma hospitalization indicator captures all hospital admissions without regard to patients hospitalized. Asthma hospitalization data, but not patient admission data, is readily available to most state health departments. Even without personal patient identifiers, hospital admission data with day of admission and residential location in a county or zip code can reveal trends over time and space¹². These multi-dimensional trends in asthma hospital admissions may reflect the contribution of environmental hazards. This information may be of use in designing, implementing and evaluating interventions such as the use of air quality alerts and establishing lower limits for

	environmental tobacco smoke in the home.
LIMITATIONS OF THE MEASURE	Only persons experiencing severe asthma events are hospitalized. Therefore, asthma hospitalizations only measure one piece of the larger asthma burden picture. Under ideal conditions asthma hospitalizations should be evaluated using multiple datasets: asthma mortality, emergency department visits, urgent care visits and asthma prevalence. Care must be taken in comparing between states and attributing environmental causes to asthma hospitalizations, because a variety of non-environmental factors can affect asthma control and impact the likelihood of persons hospitalized for asthma. These factors can include medical practices related to prescribed medications, medical compliance, health care availability and co-morbidities. Additionally, this asthma hospitalization indicator should be interpreted with caution when it is used to evaluate programs aimed at reducing the asthma burden. Factors to consider should include the sensitivity of this measure to detect environmental changes, consistency in healthcare access, clinical practice guidelines, and availability and efficacy of dispensed medications. Finally, this measure only includes state residents who were admitted to hospitals in their own state. State inpatient hospitalization datasets do not include all hospitalized populations. State inpatient hospitalization data exclude hospital admissions in Veterans Administration, Indian Health Service and institutionalized (prison) populations. Hospital access and admission/discharge patterns differ from state to state. Inter-state differences in medical practice patterns and payment mechanisms may also affect diagnostic coding and health care provider decisions. Patients could be exposed to environmental triggers in multiple locations, but hospital discharge data only codes residential location at time of admission. It is possible that residents of one state may be hospitalized in a neighboring state and not captured in hospital data for the state where the exposure occurred.
RECOMMENDATIONS/USES	This indicator can be used to evaluate asthma hospitalization prevalence in geographic areas and changes over time. Associations with environmental factors such as ozone, PM, ETS may be possible if good quality data are available and results are judiciously used. Another use can be to select areas with high asthma hospitalization prevalence for environmental public health intervention programs.
RELATED MEASURES	<i>Healthy People 2010</i>, Chronic Disease Indicators Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (asthma prevalence data, asthma history module, call-back survey) Environmental Protection Agency's air quality data for particulate matter and ozone
NOTES AND REFERENCES	1. <i>Asthma Prevalence, Health Care Use and Mortality</i>, 2002. CDC/NCHS web site. 2. Britton JR, Lewis SA, Epidemiology of childhood asthma. In: MA Gienbycz and BJ O'Connor (Eds.), <i>Asthma: Epidemiology, Anti-Inflammatory Therapy and Future Trends</i>. Switzerland: Birkhäuser Verlag, 2000, pp. 25-56. 3. Gold DR, Wright R, Population disparities in asthma. <i>Annu. Rev. Public Health</i> 2005; 26: 89-113. 4. Committee on the Assessment of Asthma and Indoor Air. <i>Clearing the Air: Asthma and Indoor Air Exposure</i>. Washington, DC: National Academy Press, 2000. 5. American Lung Association, <i>Trends in Asthma Morbidity and Mortality</i>, November 2007. 6. Landrigan PJ, Schechter CB, Lipton JM, Fahs MC, Schwartz J. Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer and developmental disabilities. <i>Environ Health Perspect.</i> 2002; 111:A721-8. 7. Jörres RA, Magnussen H. Atmospheric pollutants. In PJ Barnes, IW Rodger and NC Thomson (Eds.), <i>Asthma: Basic Mechanisms and Clinical Management</i> (3rd Ed.). London: Academic Press, 1998, pp. 589-596. 8. Trasande L, Thurston GD, The role of air pollution in asthma and other pediatric morbidities. <i>J Allergy Clin Immunol</i> 2005; 115: 689-99. 9. U.S. EPA. <i>Air Quality Criteria for Particulate Matter</i> (Volumes I & II). U.S. Environmental Protection Agency, Washington, DC,

	EPA/600/P-99/002aF-bF, 2004. 10. U.S. EPA. <i>Air Quality Criteria for Ozone and Related Photochemical Oxidants</i> (Volumes I-III). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-05/004aF-cF, 2006. 11. National Institutes of Health. <i>Guidelines for the Diagnosis and Management of Asthma</i>. Expert Panel Report (1997) and update on selected topics, 2002. 12. Oyana TJ, Rogerson P, Lwebuga-Makasa JS, Geographic clustering of adult asthma hospitalization and residential exposure to pollution at a United States-Canada border crossing. <i>Am J Public Health</i> 2004; 94: 1250-7.
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How-To GUIDE – SEHIC ASTHMA INDICATOR # C1:

ASTHMA HOSPITAL ADMISSIONS

NOTE: Many states are funded by the Centers for Disease Control and Prevention's (CDC's) National Asthma Control Program to conduct surveillance of asthma hospitalizations. These programs may be collecting similar asthma hospitalization data, such as frequencies and rates for your state. To find the name and contact information for your State Asthma Contact, go to:

<http://www.cdc.gov/asthma/contacts/default.htm>.

1. Annual Number of Hospital Admissions Due to Asthma

- From the statewide hospital discharge file (from State Health Department, Hospital Association, etc.) obtain the number of hospital admissions that meet these criteria (do not include emergency department data):
 - Principal (Primary) discharge diagnosis of 493 (ICD-9-CM).
 - State of residence='your state'.
- Exclude admissions of:
 - Out-of-state residents or state residence is unknown
 - Out-of-state hospitalizations
 - Transfers from another hospital, health care facility or skilled nursing home. (Only initial hospital admissions should be used. For example, if the multi-state coding scheme proposed by the Healthcare Cost and Utilization Project (HCUP) is used with "asource=2", this selection will exclude transfers from other hospitals.
- Use data that has not been de-duplicated. Without personal identifiers, this data source represents hospitalization data and not patient data. A patient could have multiple hospitalizations during a calendar year. Some have referred to hospitalization data as inpatient hospital events that are "not de-duplicated", to represent differences between patient transactions versus re-admissions.
- Use admission date during calendar year, not fiscal year.
- Because the data source for this indicator is a hospital discharge file, the year of the file refers to the year of discharge. Note that some late December admissions may be missed if patients were discharged in the following year.

NOTE: In some jurisdictions, the state health department (or other state agency) owns and maintains the State's hospital discharge data; in others, these data are owned and managed by another entity, such as a nonprofit organization or hospital association. In the latter case, health departments are encouraged to work with their local hospital discharge data stewards to obtain the data. States may also contact the National Association of Health Data Organizations (NAHDO) for assistance in working with these data and/or their local affiliate. Contact information for NAHDO and its affiliates is available on the Internet at: <http://www.nahdo.org/memberlist.aspx>.

2. Average number of hospital admissions due to asthma per day, by month

- Obtain the number of hospital admissions produced using the guidelines in 1 above.
- Using a variable in your hospital discharge file that documents the "month of hospital admission" produce a table that stratifies the number of hospital admissions

by the month of admission. (If no hospital admission month variable is present, utilize the date of hospital admission to derive the month.)

- Divide each month's number of admissions by the number of days in that month to get the "Average Number of Hospital Admissions per Day, by Month". This step corrects for the differing number of days per month.

3. Minimum and Maximum Daily Numbers

- Using the "date of hospital admission" variable in the hospital discharge file, generate the admission frequencies for each day of the year.
- Select the smallest and largest numbers.

4. Annual rate of hospital admissions per 10,000 residents (Crude)

a) To obtain the denominator for the rate:

- Go to the U.S. Census Population Estimates website:
<http://www.census.gov/popest/states/> (Note: If your state requires use of a specific census file, please use the data required by your state to obtain the denominator during inter-census years.)
- From the menu on the left, select "*state estimates by demographic characteristics.*"
- From the drop down menu on the right ("popular tables"), select "*Age and Sex by State: April 1, 2000 to July 1, 2006.*" Click the "go" icon.
- Download the table for your state for the appropriate year, using your choice of the formats available (Excel, CSV)
- Obtain the state population total from the table that includes "both sexes". The population estimate should correspond with the year for which you wish to calculate the hospitalization rate.

b) To calculate annual hospital admission rate per 10,000 residents:

- Divide the numerator (number of visits obtained in 1 above) by the denominator (total state population obtained in 4a above)
- Multiply this result by 10,000.
- This gives you the "**Annual crude rate of asthma hospital admissions per 10,000 residents**".

5. Annual age-adjusted rate of hospital admissions per 10,000 residents (Age-Adjusted)

a) To obtain the numerator for the rate:

- Obtain the number of hospitalizations by five-year age categories as documented in Table 1 below utilizing the criteria outlined in 1 ("Annual number of hospitalizations due to asthma"). Note that you will need to obtain the number of hospitalizations for individuals 15-17 year olds and 18-19 year olds rather than a "15-19" year olds.
- Enter the number of asthma hospitalizations by age category into Column B of Table 1. Column A is for Age Groups.

b) To obtain the denominator for the rate:

- Use previously obtained results from 4a.
- Population for 15-17:

- a) Subtract the population for persons “18 years and over” from the total population. This gives you the # of persons under 18 years of age.
- b) Sum the age categories representing “Under 5 years,” “5-9 years,” and “10-14 years.” This gives you the # of persons under 15 years of age.
- c) Subtract 1b (persons <15 years) from 1a (persons <18 years). This gives you the population for 15-17 year olds.

2. Population for 18-19:

- a) Subtract the # obtained in 1c (directly above) from the 15-19 year olds as provided in the US Census population estimate table. This will give you the population 18-19 year olds.

c) To calculate the rate:

- Use Table 1 below: A pre-coded Table 1 spreadsheet is also provided for these calculations. Column A is for Age Groups.
- Columns B and C should already been entered utilizing information obtained in 4a and 4b.
- Calculate the age specific hospitalization rate by obtaining the value of Column B / Column C and placing this value in Column D.
- Column E is the weight of the US 2000 Standard population by age category. These values were derived from Table 1 in: <http://www.cdc.gov/nchs/data/statnt/statnt20.pdf>
- To calculate the “**Annual age-adjusted rate of hospital admissions**” multiply the values in Column D by those in Column E” and place this value in Column F. Sum the values in Column F and multiply by 10,000. This is your “Annual age-adjusted hospitalization rate per 10,000 residents.”

Table 1: Calculation Table for Annual State Age-adjusted Hospital Admission Rate/10,000 residents						
	Column A	Column B	Column C	Column D	Column E	Column F
Row #	Age Group	State Resident Hospitalizations, for year “X”				
		# State of Hosp for Year “X”	State Pop for year “X”	Hosp / Pop	US 2000 Std Pop Weight	Adjusted Hosp Rate
7	Under 5			B7/C7	0.069135	D7*E7
8	5-9			B8/C8	0.072532	D8*E8
9	10-14			B9/C9	0.073032	D9*E9
10	15-17			B10/C10	0.043035	D10*E10
11	18-19			B11/C11	0.029133	D11*E11
12	20-24			B12/C12	0.066478	D12*E12
13	25-29			B13/C13	0.06453	D13*E13
14	30-34			B14/C14	0.071044	D14*E14
15	35-39			B15/C15	0.080762	D15*E15
16	40-44			B16/C16	0.081851	D16*E16
17	45-49			B17/C17	0.072118	D17*E17
18	50-54			B18/C18	0.062716	D18*E18
19	55-59			B19/C19	0.048454	D19*E19
20	60-64			B20/C20	0.038793	D20*E20
21	65-69			B21/C21	0.034264	D21*E21
22	70-74			B22/C22	0.031773	D22*E22
23	75-79			B23/C23	0.027	D23*E23
24	80-84			B24/C24	0.017842	D24*E24
25	85+			B25/C25	0.015508	D25*E25
	Total					[Σ(F7:F25)] *10,000

*Please note that an Excel spreadsheet has been provided for your use. This spreadsheet will auto-calculate the age-adjusted hospitalization rate. The user enters state population data for each age category, followed by the number of state asthma hospitalizations. This is done for each age category.