STATE ENVIRONMENTAL HEALTH INDICATORS COLLABORATIVE (SEHIC)  
CLIMATE AND HEALTH INDICATORS

Category: Health Outcome Indicators  
Indicator: Allergic Disease

MEASURE DESCRIPTION

| Measure: | Allergic disease related hospital admissions (number, rate)  
Allergic disease related emergency discharges (number, rate) |
| Time scale: | Calendar year |
| Measurement units: | Annual, seasonally |
| Geographic scale: | County, State, & Multi-state |

Background and significance: Over the past century, the overall global surface temperature has increased by 0.7–1.4°F\(^1\). Continuing climate change is expected to have an impact on the occurrence of extreme temperature days and weather patterns, which can affect allergic disease. Higher temperatures in heat waves accelerate chemical reactions that lead to ozone and secondary particle formation. Higher temperatures and elevated carbon dioxide concentrations also lead to increased emissions of volatile organic compounds (VOCs) by vegetation, which serve as ozone precursors\(^2\). Air pollution plays a significant and complex role in the etiology of allergic disease, as well as on the effect aeroallergens have on these diseases\(^3\). Furthermore, it has been hypothesized that climate change will play a role in aeroallergen (pollens, molds, and indoor proteins) concentrations\(^6\), and weather patterns influence movement and dispersion of air pollutants. Changes in climate will likely affect aeroallergen production\(^7,8\), the timing and length of pollen season\(^9\), and distributions of pollen producing species\(^10\). Each of these will influence human exposure, sensitization, and exacerbation of illness.

Allergies and asthma collectively cost over $30 billion annually in the U.S., and 54.5% of people in the U.S. test positive for an allergic response to one or more allergen\(^4\). Allergic diseases primarily associated with aeroallergens include allergic rhinitis (hay fever; 477, J30.1), asthma (493, J45), atopic dermatitis (eczema; 691.8, L20), allergic urticaria (hives; 708.0, L50.0), and allergic conjunctivitis (372.14, H10.1)\(^4,11\). Children’s health is particularly susceptible to environmental pollution, including air pollution, and infant mortality is still a major contributor to childhood mortality\(^12\). Asthma, affected by both air pollution and aeroallergens, is the predominant chronic disease of childhood. It affects approximately 4.8 million US residents, and is the chief cause of school absenteeism and child hospitalization\(^13\). Furthermore, 15-20% of children worldwide suffer from atopic dermatitis, and this figure is increasing\(^13\). Children and adults who live in urban areas are at an increased risk from pollen-induced respiratory allergy\(^14\), air pollution\(^21\), and exposure to a higher heat index\(^21\).

There are relatively few studies that investigate linkages between climate change and allergic disease health outcomes\(^15,16,17,18\). The potential confounding and effect modification caused by temperature interacting with air pollutants, aeroallergens,
and health outcomes is also a complex issue, with varying results depending on pollutant, geography, climate, and sensitization that can not be overlooked\textsuperscript{19,20,14}. This health outcome indicator will attempt to track allergic disease. The indicator will be particularly useful to study trends that may occur with changing climate.

| Rationale: | A hypersensitive reaction of the immune system to a normally harmless environmental substance is an allergy. An aeroallergen is any of various airborne substances, like pollen or spores that can cause an allergic response. Aeroallergens are expected to increase and change distribution with climate change\textsuperscript{7,8,9,10}, thus effecting allergic disease. Allergic diseases primarily associated with aeroallergens include allergic rhinitis (hay fever; 477, J30.1), asthma (493, J45), atopic dermatitis (eczema; 691.8, L20), allergic urticaria (hives; 708.0, L50.0), and allergic conjunctivitis (372.14, H10.1)\textsuperscript{4,11} and can be tracked or monitored along with pollen and other major allergens. The economic impacts of allergic disease, and the quality of life impacts for those affected, are already significant. Climate change-induced amplification of this trend would be of great consequence. It is important to understand as much as possible about these complex relationships to improve health outcomes. This indicator will be useful in tracking trends in allergic disease that can be linked to other climate related indicators. Measurements may have different meanings during the winter versus the summer seasons. By measuring at this seasonal time scale, we will be able to investigate these within year temporal effects for each indicator. |
| Limitations of measure: | In addition to various aeroallergens, many important non-climate factors such as ambient air pollutants, environmental conditions at home, land use patterns, and host species abundance etc., can play a role in allergic health outcomes. Therefore these factors should be considered and controlled in the indicator analysis. Some allergic diseases may also be related to climate factors, or have an indirect, complicated, or unknown relationship to climate change. A challenge would be to fully understand the mechanism in which climate change affects aeroallergen concentration and distribution and then allergic diseases. |
| Data source: | Vital Records, Hospital Admission Records, Emergency Discharge Data |
| Limitations of data source: | Some states will not have emergency discharge data; this will likely lead to under-ascertainment of data for mild cases. Furthermore, hospitalization data are typically released annually, after a data preparation period, which can take one to two years. This will delay the calculation of these indicators. To minimize confusion, it is important to note that data sources use different codes (ICD-9 or ICD-10) depending on the state, and that, within a state, data sources may use different codes as well. |
| Related datasets: | National Allergy Bureau, NCDC/NOAA North American Pollen Database, Census data from U.S. Bureau of the Censuses, historic average temperature data, and AQS air quality data for particulate matter and ozone, NCDC/NOAA daily weather conditions (temperature, humidity, etc.) |
| Additional data elements: | Month of year, season, age, gender, race, and ethnicity |
References:


3 D’Amato, G et al. 2001. The role of outdoor air pollution and climatic changes on the rising trends in respiratory allergy. Respiratory Medicine, 95(7):6066-11.

4 Reid, Colleen and Janet Gamble. 2009. Aeroallergens, Allergic Disease, and Climate Change: Impacts and Adaptation. EcoHealth. Epub before print DOI:10.1007/s10393-009-0261-x


I. Hospitalizations due to Allergic Disease

1. Calculate Number of Hospitalizations due to Allergic Disease
   a. From the statewide hospital discharge file (from State Health Department, Hospital Association, etc.) obtain the number of hospitalizations that meet these criteria (do not include emergency department data):
      • Principal (primary) discharge diagnosis of 493, 477, 691.8, 708.0 or 372.14 (ICD-9-CM) or J45, J30.1, L20, L50.0 or H10.1 (ICD-10-CM).
      • State of residence = ‘your state’
      • Use data that are not de-duplicated (do not exclude for deaths, readmissions)
      • Use admission date during calendar year, not fiscal year. Retain the day of admission.
      • Exclude admissions of:
        o Out-of-state residents and unknown residence
        o Out-of-state hospitalizations
        o Transfers from another hospital (using the source of admission code in the hospital discharge dataset, eg. If HCUP format, exclude source=2).
   b. Obtain the number of hospitalization for the following disease groups by stratifying data:
      • Allergic Diseases
        o Asthma (493 or J45)
        o Allergic rhinitis (hay fever) (477 or J30.1)
        o Atopic dermatitis (eczema) (691.8 or L20)
        o Allergic urticaria (hives) (708.0 or L50.0)
        o Allergic conjunctivitis (372.14 or H10.1)

2. Calculate Rate of Hospitalizations due to Allergic Disease
   a. Stratify into the correct geographic scale by using the county or ZIP fields from the hospitalization records
   b. Use the Census 2000 aggregated block population that fits within the boundary of your chosen area as the denominator to calculate the rate

II. Emergency Department Visits due to Allergic

1. Calculate Number of Emergency Discharges due to Allergic Disease
   a. From the statewide emergency discharge file (from State Health Department, etc.) obtain the number of emergency discharges that meet these criteria:
      • Principal (primary) discharge diagnosis of 493, 477, 691.8, 708.0 or 372.14 (ICD-9-CM) or J45, J30.1, L20, L50.0 or H10.1 (ICD-10-CM).
      • State of residence = ‘your state’
      • Use data that are not de-duplicated (do not exclude for deaths, readmissions)
      • Use date during calendar year, not fiscal year. Retain the day of visit.
• Exclude discharges of:
  o Out-of-state residents and unknown residence
  o Out-of-state hospitalizations
b. Obtain the number of hospitalization for the following disease groups by stratifying data:
• Allergic Diseases
  o Asthma (493 or J45)
  o Allergic rhinitis (hay fever) (477 or J30.1)
  o Atopic dermatitis (eczema) (691.8 or L20)
  o Allergic urticaria (hives) (708.0 or L50.0)
  o Allergic conjunctivitis (372.14 or H10.1)

2. **Calculate Rate of Hospitalizations due to Allergic Disease**
a. Stratify into the correct geographic scale by using the county or ZIP fields from the hospitalization records
b. Use the Census 2000 aggregated block population that fits within the boundary of your chosen area as the denominator to calculate the rate

**Notes:**

If counts in any year are less than 5, than please report data in 5 year intervals.

Data should be reported as state level data rather than county level data if appropriate.