

Indicator Template
Content Area: Heart Attack
Indicator: Hospitalizations for Heart Attack

Environmental Public Health Tracking
August 2021

Type of EPHT Indicator	Health outcome
Measures	<ol style="list-style-type: none"> 1. Number of Hospitalizations for Heart Attack among Persons ≥ 35 Years of Age 2. Crude Rate of Hospitalizations for Heart Attack among Persons ≥ 35 Years of Age per 10,000 Population 3. Age-adjusted Rate of Hospitalizations for Heart Attack among Persons ≥ 35 Years of Age per 10,000 Population <p>Measures use the following combinations of geographic boundaries and temporal aggregation:</p> <ul style="list-style-type: none"> • Census tract, 5-year period • 5,000 Minimum Person Population Area, 3-year period • 20,000 Minimum Person Population Area, 1-year period • County, 1-year period • State, 1-year period
Derivation of Measure(s)	<p><i>Numerator:</i> Resident hospitalizations for Acute Myocardial Infarction (AMI), or Heart attack, using International Classification of Diseases, Ninth Revision, Clinical Modification code 410 (ICD-9-CM: 410) or International Classification of Diseases, Tenth Revision, Clinical Modification codes I21-I22 (ICD-10-CM: I21-I22) as the primary diagnosis codes</p> <p><i>Denominator:</i> Mid-year resident population aged 35 years and over</p> <p><i>Age-adjustment:</i> Age-adjustment by the direct method using Year 2000 U.S. Standard population</p>
Unit	<ol style="list-style-type: none"> 1. Age-adjusted rate per 10,000 population 2. Crude rate per 10,000 population 3. Number
Geographic Scope	US States and counties
Geographic Scale	Residents of jurisdiction – census tract, 5,000 minimum population area, 20,000 minimum population area, county, combined counties, and/or state
Time Period	Hospital admissions between January 1 to December 31, inclusive, for each year 2000 – most recent complete year available
Time Scale	Annual, 3-year period, or 5-year period
Rationale	Heart disease is the leading cause of death in the United States, causing almost 1 in 4 deaths. ¹ A heart attack is clinically referred to as a myocardial infarction or an acute myocardial infarction (MI or AMI; referred to hereafter as AMI). It

occurs when a section of the heart muscle dies or is damaged because of reduced blood supply.² The American Heart Association (AHA) estimated 805,000 new attacks and 200,000 recurrent attacks of acute myocardial infarction annually.³ According to the AHA 2020 Heart Disease and Stroke Statistics Report, prevalence of new and recurrent AMI for both men and women was 3.0% among Americans aged 20 years and older (approximately 7.0 million Americans).³

Heart disease is largely related to factors such as high blood pressure, smoking, diet, physical inactivity, and living and working conditions that lead to unhealthy behaviors.^{5,6} It is also the most common heart problem related to exposure to fine particles over a long period.^{7,8} In 2004, the AHA scientific statement on “Air Pollution and Cardiovascular Disease” concluded that exposure to particulate matter (PM) air pollution contributes to cardiovascular illness and death.⁷ Numerous epidemiologic studies report that air pollutants (PM_{2.5}, NO₂, and ozone) are associated with increased risk of cardiovascular death.^{7,8,9,10} The AHA also confirmed that PM_{2.5} exposure is deemed a modifiable factor that contributes to cardiovascular illness and death.⁸ Strategic examination and reduction of individuals' exposure to these air pollutants may result in a concurrent decrease in the number of deaths related to cardiovascular diseases.

In addition to air pollution, extreme temperatures-hot and cold spells-are also associated with excess ischemic heart disease and deaths from heart attack.¹¹ Exposure to cold increased the risk of heart attack, and exposure to heat and cold are both associated with increased risk of dying after a heart attack.^{11,12} With the frequency of extreme temperatures projected to escalate, better understanding of this relationship could help identify high-risk individuals and more effectively guide preventive actions.¹¹

CDC's Tracking Program developed sub-county geographies based on having a minimum population threshold of 5,000 and 20,000 persons. For data prior to 2020, these populations are based on population data of the 2010 Decennial Census. After the 2020 Decennial Census data are available, sub-county geographies will be aggregated based on the population of the Decennial Census for that decade, with health data reported during that decade using the corresponding geographies. The 5,000-person minimum population geographies are created by aggregating census tracts by block group population-weighted centroids until the minimum population threshold is achieved. The 20,000-person minimum population geographies are created by aggregating the 5,000-person minimum population geographies by census tract population-weighted centroids until the minimum population threshold is achieved. These two sets of geographies also contain areas of combined counties. Where possible, counties below the desired minimum population are combined with neighboring counties also below the desired minimum population until the minimum population threshold is achieved. Where not possible, these counties are left as independent counties. Census tracts with zero population are not included in

	<p>the described aggregations methods and remain as zero population census tracts. By using these geographies to display health data, the Tracking Program can provide statistically stable health information for smaller communities than standard county-level data can provide, while protecting the confidentiality of the residents of these geographies.¹³ For detailed information on the Tracking Program's aggregation methodology, please visit our GitHub repository.</p>
Use of the Measure	<p>These measures can be used to assess the burden of heart attack, monitor trends over time, identify high-risk groups, and enhance prevention, education, and evaluation efforts. The development of standardized measures and methods for AMI hospitalizations among residents in each state will inform multiple users at the national, state, and local levels.</p> <p>These measures will address the following surveillance functions:</p> <ul style="list-style-type: none"> • Examination of time trends in AMI hospitalizations. • Identification of seasonal trends. • Assessment of geographic differences in hospitalizations. • Evaluation of differences in AMI hospitalizations by age, gender, and race/ethnicity. • Determination of populations in need of targeted interventions. • Identification of possible environmental relationships warranting further investigation or environmental public health action, when AMI data are linked with environmental variables.
Limitations of the Measure	<ul style="list-style-type: none"> • On October 1, 2015 in the United States, the ICD-10-CM replaced the ICD-9-CM for coding of medical terminology and disease classification. As a direct result of this change, there are nearly five times as many diagnosis codes in ICD-10-CM than in ICD-9-CM, allowing for further expansion than was possible with ICD-9-CM. This coding change impacts information classifications for hospital discharge, emergency department, and outpatient records for administrative and financial transactions in all healthcare settings. Differences in counts and rates in years prior to 2015 (ICD-9-CM) compared with 2015 (ICD-9-CM and ICD-10-CM) and subsequent years (ICD-10-CM) could be a result of this coding change and not an actual difference in the number of events. • Although duplicate records and transfers from one hospital to another are excluded, the measures are based upon events, not individuals, because no unique identifier is always available. When multiple admissions are not identified, the true prevalence will be overestimated. • Hospitalization data for AMI does not include individuals who do not receive medical care or who are not hospitalized, including those who die in emergency rooms, in nursing homes, or at home without being admitted to a hospital, and those treated in outpatient settings.

	<ul style="list-style-type: none"> • Differences in rates by time or area may reflect differences or changes in diagnostic techniques and criteria and in the coding of AMI or in medical care access. • Differences in rates by area may be due to different socio-demographic characteristics and associated behaviors. • When comparing rates across geographic areas, a variety of non-environmental factors, such as access to medical care and diet, can impact the likelihood of persons hospitalized for AMI. • Reporting rates at the state and/or county level will not show the true disparities in AMI burden compared to a more local level (i.e., sub-county, neighborhood). • Reporting rates at the state and/or county level will not be geographically resolved enough to be linked with many types of environmental data. • When looking at small geographic levels (e.g., sub-county, ZIP code), users must take into consideration appropriate cell suppression rules imposed by the data providers or individual state programs. • Even at the county level, it can be expected that the measures generated will often be based upon numbers too small to report or present without violating state and federal privacy guidelines and regulations. Careful adherence to cell suppression rules in cross tabulations is necessary and methods to increase cell sizes by combining data across time (e.g., months, years) and geographic areas may be appropriate. • The Tracking Program's sub-county geographies are created using populations of United States Decennial Census. Measures towards the end of the decade may be less reliable as population shift occurs. • Limitations associated with the sub-county aggregation methodology are described in our GitHub repository.
Data Sources	<p><i>Numerator:</i> State inpatient hospitalization data (using admission date)</p> <p><i>Denominator:</i> U.S. Census Bureau population data</p>
Limitations of Data Sources	<ul style="list-style-type: none"> • Hospitalizations for AMI measures exclude transfers (i.e., a patient discharged from one facility and readmitted to a second facility on the same day) based on unique identifiers consisting of date of birth, ZIP code, gender, and encrypted social security number (where available). However, some transfers between hospitals for the same person for the same AMI event may remain in the data. Variations in the percentage of transfers or readmissions for the same AMI event may vary by geographic area and impact rates. • Although duplicate records are excluded, the measures are based upon events, not individuals, because no unique identifier is always available. When multiple admissions are not identified, the true prevalence will be overestimated.

	<ul style="list-style-type: none"> • Data on race and ethnicity are not routinely collected in all states. These data are not consistently recorded on medical records and when available are complicated further by non-standard definitions of race and ethnicity, the use of combined race/ethnicity, reporting of multiple race categories, and differences in self-report versus registrar reporting. • These data usually include only cases of state residents who were treated within the state. However, healthcare access is not restricted to these political boundaries. People discharged from the hospital for AMI in another state will typically not be counted in their own state or in the jurisdiction in which they were treated. Each state must individually obtain permission to access and, in some states, provide payment to obtain data about their state residents from another state. Currently, only a few states have access to, or agreements to obtain, their emergency department data from other states in which their residents may have received treatment. Without reciprocal reporting agreements with abutting states, statewide measures, and measures for geographic areas (e.g., counties) bordering other states may be underestimated because of healthcare utilization patterns. To the extent that patients are treated out of state and are not included the data, there is undercounting of the rate of residents with AMI hospitalizations. • Federal institutions, such as Veteran's Affairs, Indian Health Services, and prison facilities, are excluded from the data. • Practice patterns and payment mechanisms may affect diagnostic coding and decisions by healthcare providers to hospitalize patients. • Sometimes the mailing address of a patient (e.g., PO Box) is listed as the residence address of the patient. This may be different than the county or census tract of residence for the patient. • Patients may be exposed to environmental triggers in multiple locations, but geographic information is limited to residence. • Since the data capture hospital discharges (rather than admissions), patients admitted toward the end of the year and discharged the following year could be omitted from the admission year dataset. There is usually a two-year lag period before data are available from the data owner.
Related Indicators	<ul style="list-style-type: none"> • Annual PM2.5 Level • Ozone Days Above Regulatory Standard
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