HEAT-RELATED ILLNESS IN LOUISIANA:

Review of Emergency Department and Hospitalization Data from 2010-2020

March 2023

LOUISIANA DEPARTMENT OF HEALTH

AUTHORS:

This report was prepared by the Louisiana Department of Health (LDH) Office of Public Health's (OPH) Occupational Heat-Related Illness Prevention Program in collaboration with Louisiana State University Health New Orleans' School of Public Health, Louisiana State University's Department of Geology and Anthropology, and the Southern Climate Impacts Planning Program.

ACKNOWLEDGEMENTS:

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EXECUTIVE SUMMARY

This report summarizes heat-related illness data for Louisiana residents and workers from 2010 through 2020. Heat-related illness data include information about patients in Louisiana who were treated in the emergency department (ED) or hospitalized with a diagnosis indicating heat exposure. Two sets of analyses were conducted: 1) all cases, and 2) cases who were working when exposed to heat. This report contributes to public health's capacity to monitor and assess the burden of heat on Louisianans.

Understanding variations in heat-related ED and hospital visits can inform and target public education programs and policy and prevention efforts, such as heat alert protocols and action plans.

MAJOR FINDINGS

ALL CASES

- On average, there were 2,700 heat-related ED visits and 260 hospitalizations every year in Louisiana. About 75% of ED visits and hospitalizations occurred during the summer.
- Males accounted for 81% of ED visits and 87% of hospitalizations. The rate of ED visits for males was 4.5 times the female rate, and the male hospitalization rate was 7.8 times the female rate.
- Individuals ages 20 to 39 accounted for 40% of all heat-related ED visits and had the highest rates, followed by individuals 40 to 59 years old.
- Black residents had higher rates than white residents: 1.5 times the rate of ED visits, and 1.4 times the hospitalization rate.
- Parishes with the highest hospitalization rates were clustered in the Northern part of the state; parishes with elevated ED visits were located in every part of the state.

WORKERS

- On average, there were 320 work-related ED visits and 20 work-related hospitalizations for heat-related illness every year in Louisiana. Approximately 12% of the workers were not Louisiana residents.
- Male workers accounted for 90% of ED visits and 96% of hospitalizations. Workers ages 34 years and younger had the highest rates of ED visits; the rate for heat-related hospitalizations among workers varied minimally by age.
- Black workers had higher ED and hospitalization rates than white workers: 1.5 times the rate of ED visits and 2 times the hospitalization rate.
- Parishes with the highest rates of occupational heat-related illness were clustered in the northwest and central parts of the state.

OVERVIEW

Every year in Louisiana, about 10 people die and thousands more are treated in emergency departments or hospitalized due to heat. Heat exposure is intensifying as the frequency, severity, and duration of extreme heat events increases due to climate change. These changes are of concern in Louisiana because the state experiences some of the highest average summer temperatures in the nation. Louisiana's hot summers are compounded by high humidity which worsens the impact of heat by impairing the body's ability to cool by evaporation.

The human body maintains an internal temperature within a very narrow range. Heat-related illness can occur when someone is exposed to high temperatures and his or her body is unable to cool itself sufficiently through sweating. Heat-related illness (or hyperthermia) is a broad term for conditions directly related to an increase in body temperature. These conditions occur along a continuum of severity ranging from mild cramps, swelling and rashes to heat exhaustion and life-threatening heat stroke. Heat also has indirect health impacts: it can exacerbate chronic conditions such as respiratory, cardiovascular, and kidney disease, increase injuries and accidents, and strain mental health.

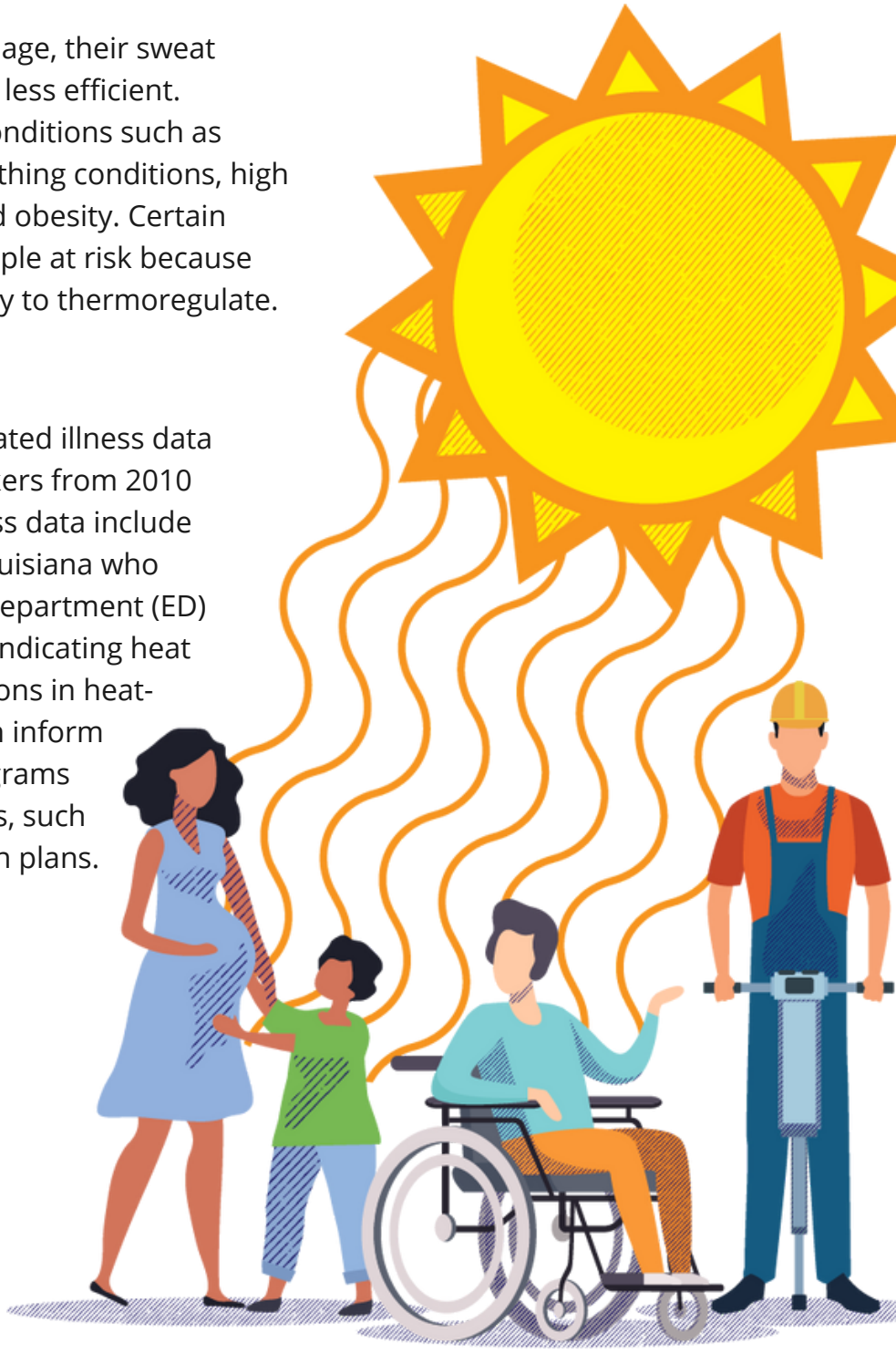
Progression of Heat-Related Illness

Illness	Symptoms
Heat Stroke	Confusion Altered mental status Slurred speech Loss of consciousness Seizures Very high body temperature Fatal if treatment delayed
Heat Exhaustion	Headache Nausea Dizziness Weakness Irritability
Heat Syncope	Fainting Dizziness/lightheadedness
Heat Cramps	Tightness or spasm of muscles
Heat Rash	Red clusters of pimples or small blisters

Anyone can develop heat-related illness, but some people are at greater risk.

- Workers in outdoor settings, and some indoor work settings without adequate climate-controlled environments.
- Infants and young children. They are sensitive to the effects of high temperatures and rely on others to control their environments.
- Pregnant women. They are under more bodily stress and are more likely to become dehydrated. Heat exposure can also contribute to premature birth, stillbirth, and lower infant birthweight.
- Older adults (65+). As people age, their sweat cooling mechanism becomes less efficient.
- People with chronic health conditions such as heart or kidney disease, breathing conditions, high blood pressure, diabetes, and obesity. Certain medications can also put people at risk because they interfere with their ability to thermoregulate.
- People who exercise outside.

This report summarizes heat-related illness data for Louisiana residents and workers from 2010 through 2020. Heat-related illness data include information about patients in Louisiana who were treated in the emergency department (ED) or hospitalized with a diagnosis indicating heat exposure. Understanding variations in heat-related ED and hospital visits can inform and target public education programs and policy and prevention efforts, such as heat alert protocols and action plans.



METHODS

DATA SOURCES

Data analyzed in this report are from ED and inpatient hospitalization billing records for all Louisiana hospitals, excluding Veterans Affairs and psychiatric hospitals. The Louisiana Hospital Association provided ED data, and LDH's Bureau of Health Informatics provided hospitalization data. ED and hospitalization data contain information regarding patient demographics (e.g., age, sex, race), treatment dates (e.g., date of admission, date of discharge), payment (e.g., primary payer, total costs), patient residence (e.g., parish, zip code), and all primary and secondary diagnoses classified according to the International Classification of Diseases, 9th Revision (ICD-9) or 10th Revision (ICD-10).

CASE SELECTION

Cases were selected for analysis if they were treated in the ED or hospitalized during 2010 through 2020 and had a primary or secondary diagnosis directly indicating heat exposure. Diagnoses include those for heat-related stroke, exhaustion, syncope, cramps, fatigue, and edema. (Appendix A: ICD codes Heat-Related Illness).

Cases who were working when they developed heat-related illness were flagged. Cases were considered work-related if workers' compensation paid the medical bill or the medical record contained a work-related diagnostic code (Appendix B: ICD codes Work-Relatedness).

RATE CALCULATIONS

Age-adjusted rates were calculated to determine differences by year, sex, age, race, and location (i.e., parish). Two sets of rate calculations were done: all cases followed by work-related cases. Non-Louisiana residents were included in annual case counts but were excluded from rate calculations because the denominators for rate calculations were Louisiana residents and workers.

Denominator data for rate calculations included the American Community Survey for Louisiana's total population and the U.S. Bureau of Labor Statistics' Current Population Survey for Louisiana's employed population. Rates for all cases were age-adjusted to the 2000 U.S. standard population, and worker rates were adjusted to the 2000 U.S. worker population. Age-adjustment removes the influence of differing age distributions among groups, allowing for a more accurate comparison of rates.

HEALTH DATA LIMITATIONS

This report only includes information about individuals who had a diagnosis of heat-related illness listed on their medical record. This approach does not reflect the total burden of heat. Heat-related illness is underdiagnosed and underreported, and ascertainment can vary by time and place. In addition, heat can exacerbate chronic conditions, contribute to injuries such as a fall or trip, and have other indirect health impacts.

This report also underestimates work-related cases. Many workers do not have workers' compensation, they have it but do not use it, or the healthcare provider does not record the case as work-related on the medical record.

There was a data gap from October to December 2020 when ED data were not obtained.

TEMPERATURE DATA

Temperature data sources include the Iowa Environmental Mesonet's Daily Summary Data and the Southern Climate Impacts Planning Program's Climate Trends tool.

The Daily Summary Data include daily observations from Louisiana's weather stations for maximum temperature (i.e., daytime highs), minimum temperature (i.e., overnight lows), and maximum apparent temperature (i.e., heat index). Temperature observation data were restricted to Louisiana's warm season: April through October. Apparent temperature (also known as the "feels like" temperature) includes both heat index and wind chill. Because the data were restricted to the warmer months, apparent temperature is considered heat index.

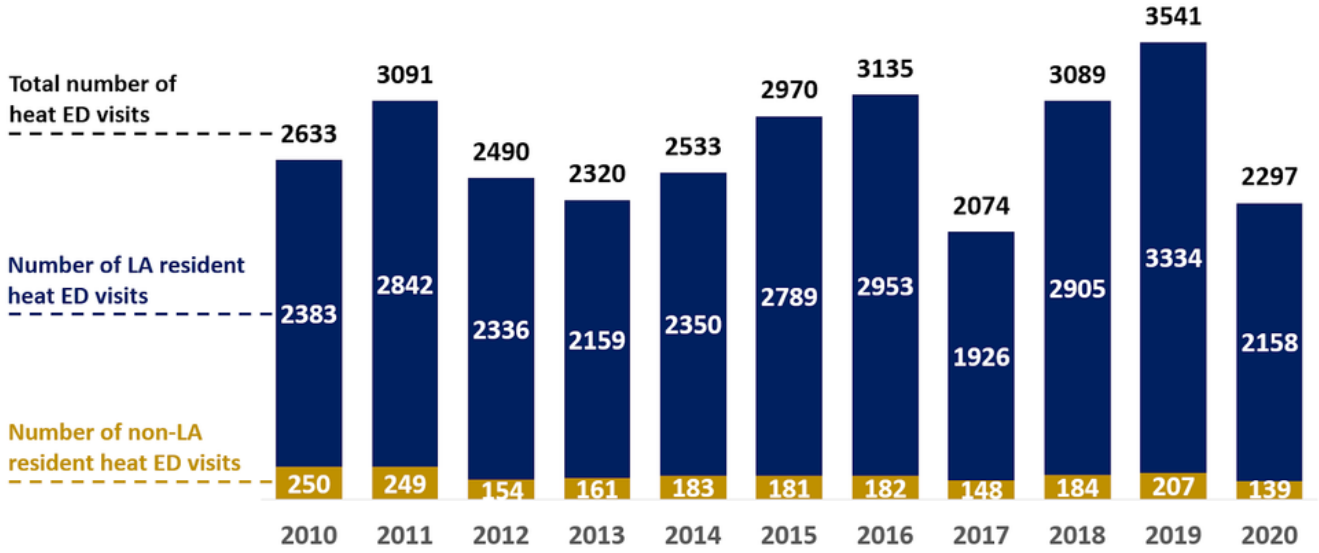
Average annual maximum and minimum temperatures and heat indices were calculated for the period 2010 through 2020 for Louisiana, and each of Louisiana's nine climate divisions. Parishes within each climate division share nearly homogenous characteristics regarding temperature, rainfall, and humidity. To facilitate review of data, Louisiana's nine climate divisions were combined into three Climate Divisions: North, Central, and South.

The Climate Trends Tool provides a comparative, annual analysis for average temperature at the state and climate division level. The tool uses long term averages calculated from the National Climatic Data Center's annual temperature datasets. Five-year moving averages were plotted in comparison to the long-term, historic average for the North, Central, and South climate divisions.

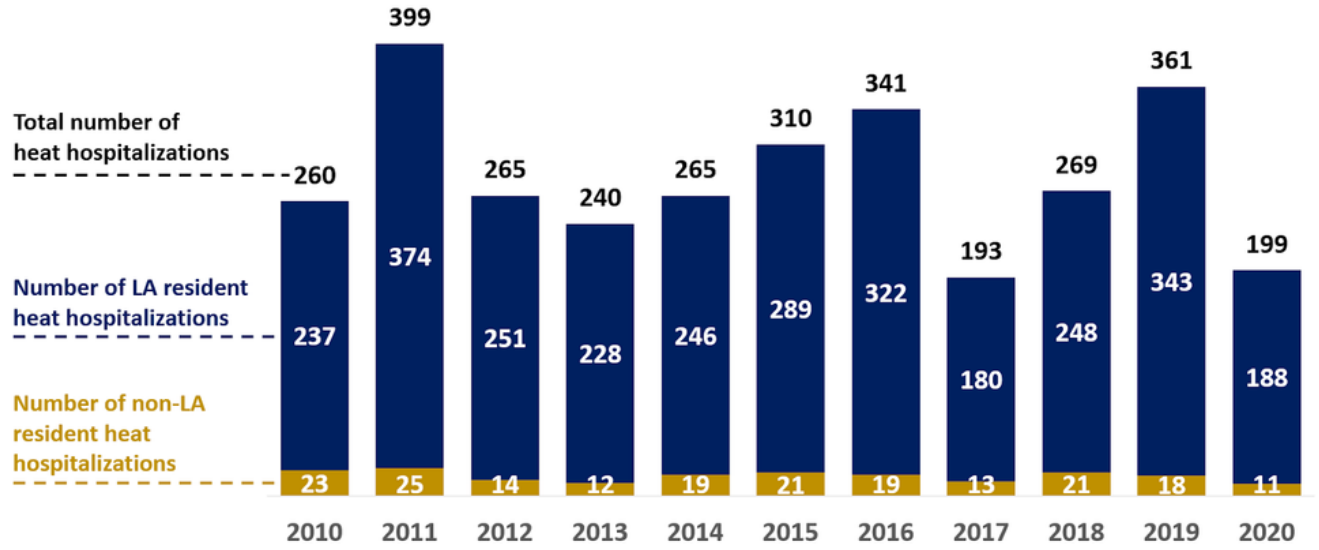
RESULTS

ANNUAL COUNTS AND RATES: ALL CASES

There was an annual average of 2,700 ED visits for heat-related illness.
Most of these ED visits were for Louisiana residents (93%). There were approximately 185 ED visits every year for non-Louisiana residents.



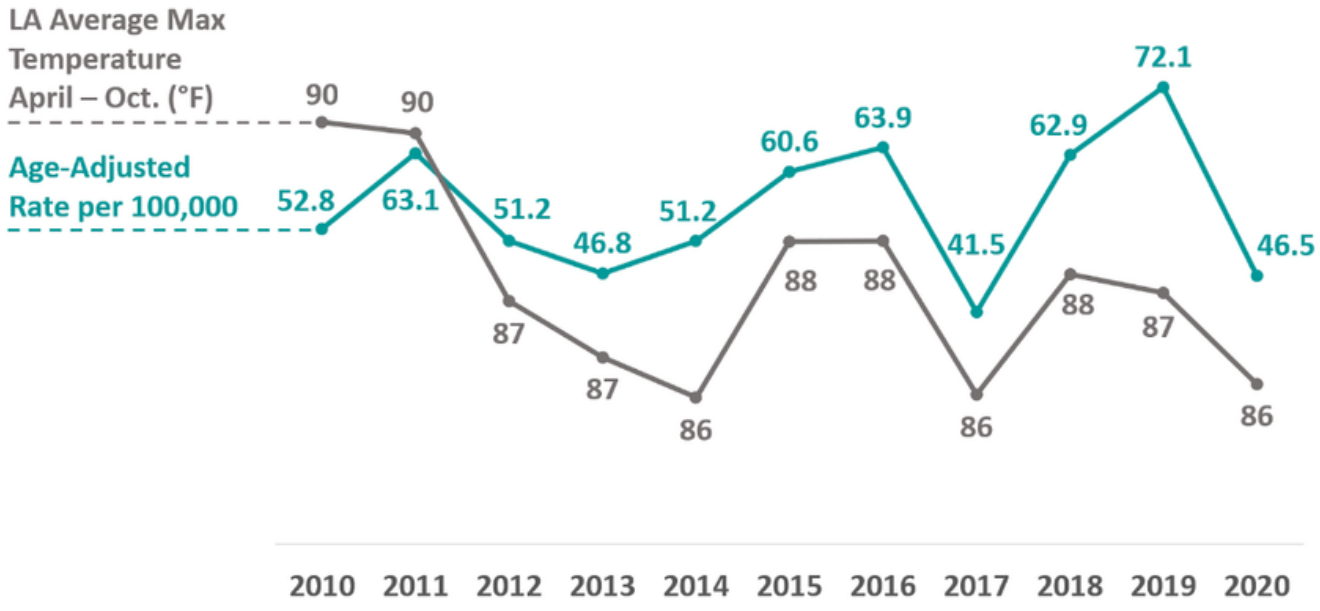
There was an annual average of 260 hospitalizations for heat-related illness.
Heat-related hospitalization stays ranged from 1 to 90 days with an average stay of 3 days. Most of the hospitalizations were for Louisiana residents (94%).



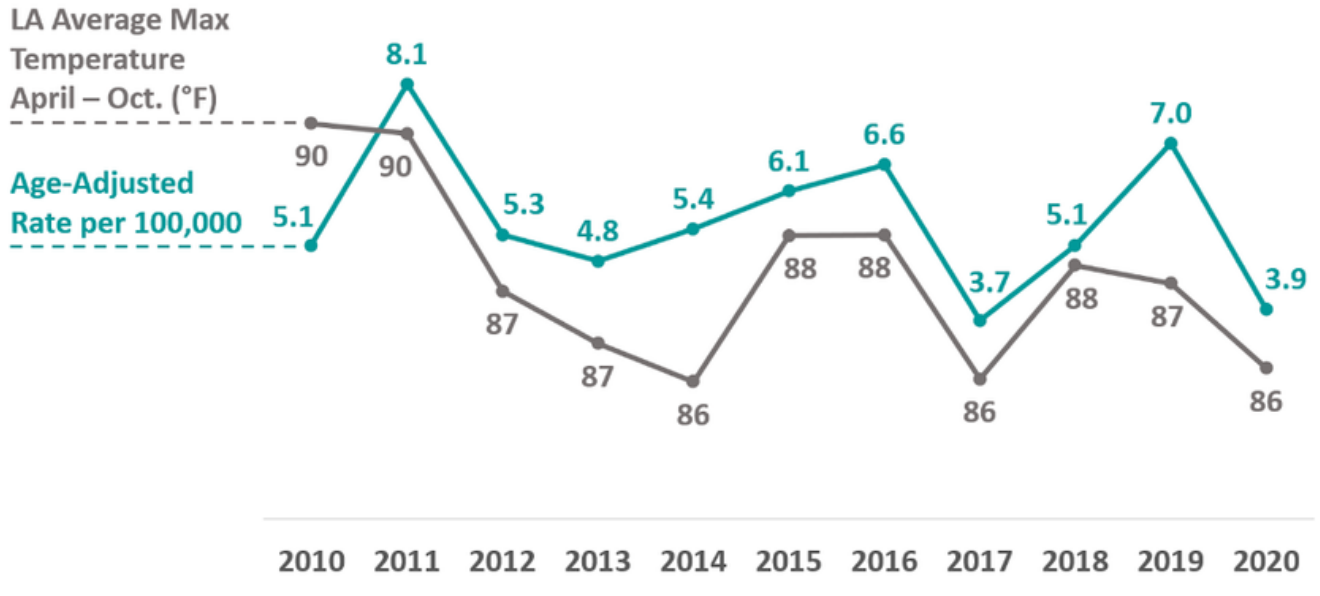
TEMPERATURE

Annual fluctuations in heat-related ED visits and hospitalizations generally corresponded to variations in temperature. The graphs below show the annual average maximum temperature, or daytime high temperature, for April through October and the age-adjusted rate of heat-related ED visits and hospitalizations for Louisiana residents.

ED visits increased as temperatures increased.

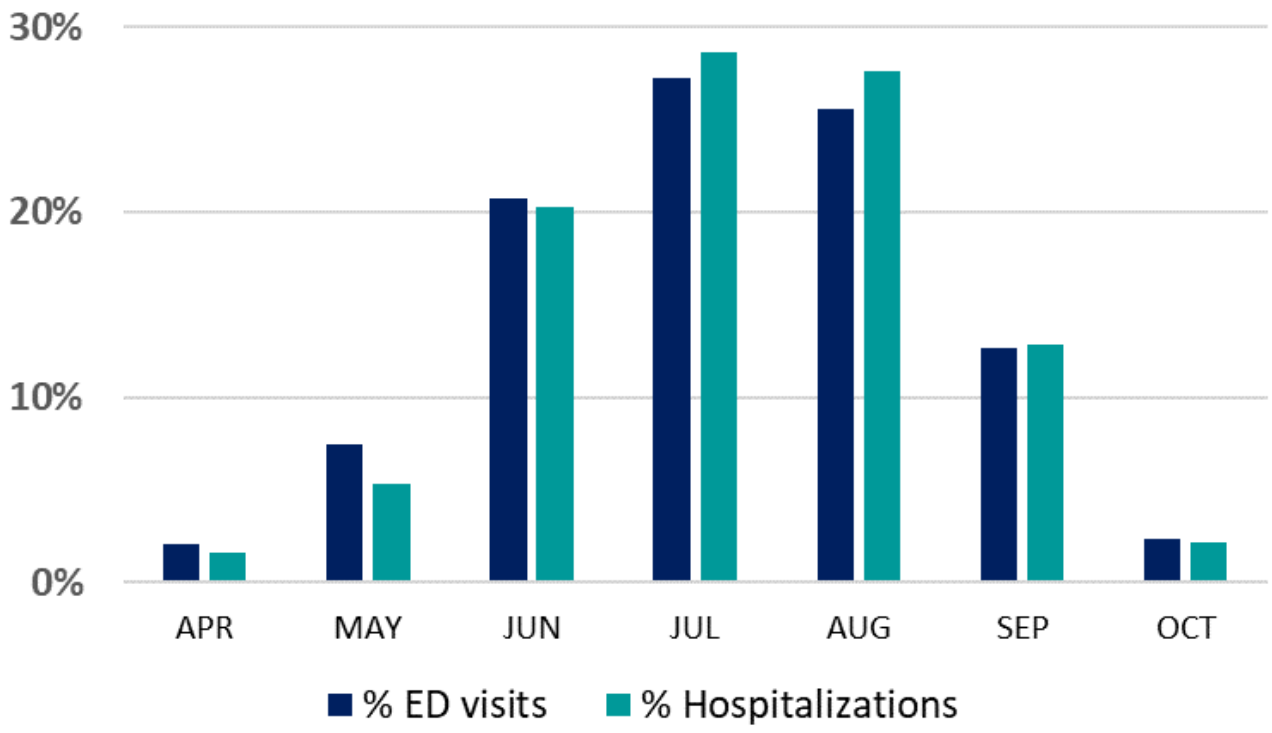


Hospitalizations increased as temperatures increased.



MONTH

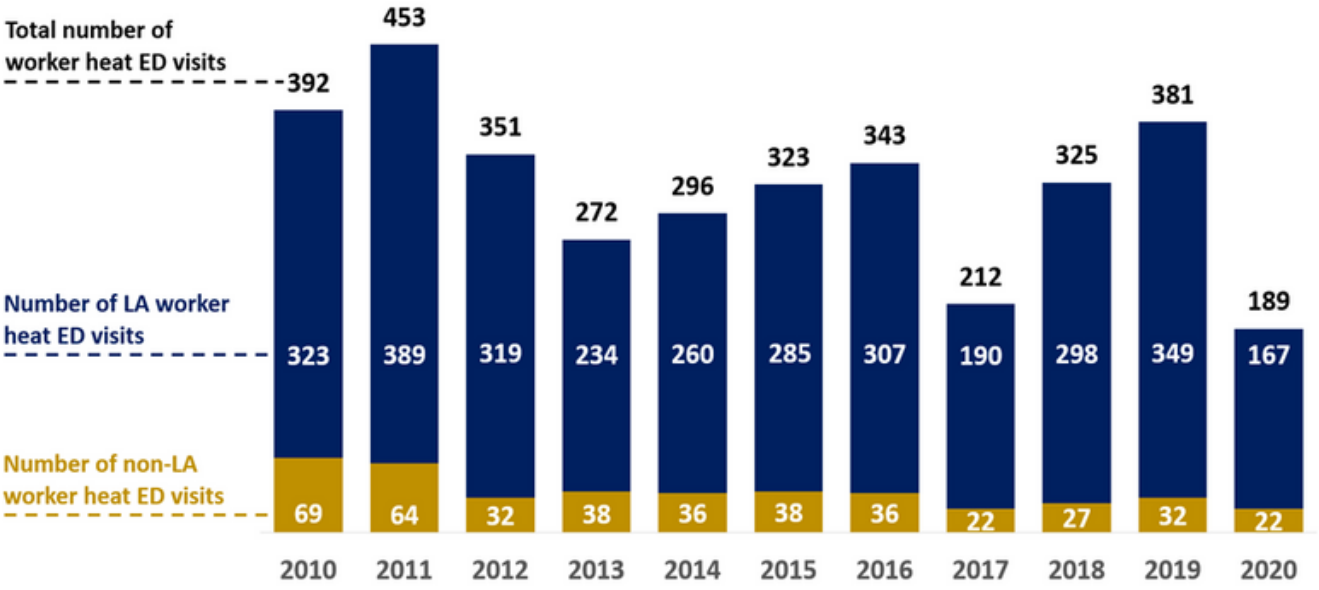
Most cases occurred during the summer months, peaking in July. Warm spring and fall temperatures contributed to almost one-quarter of all ED visits and hospitalizations. As the climate warms, more cases will occur in the fall and spring months.



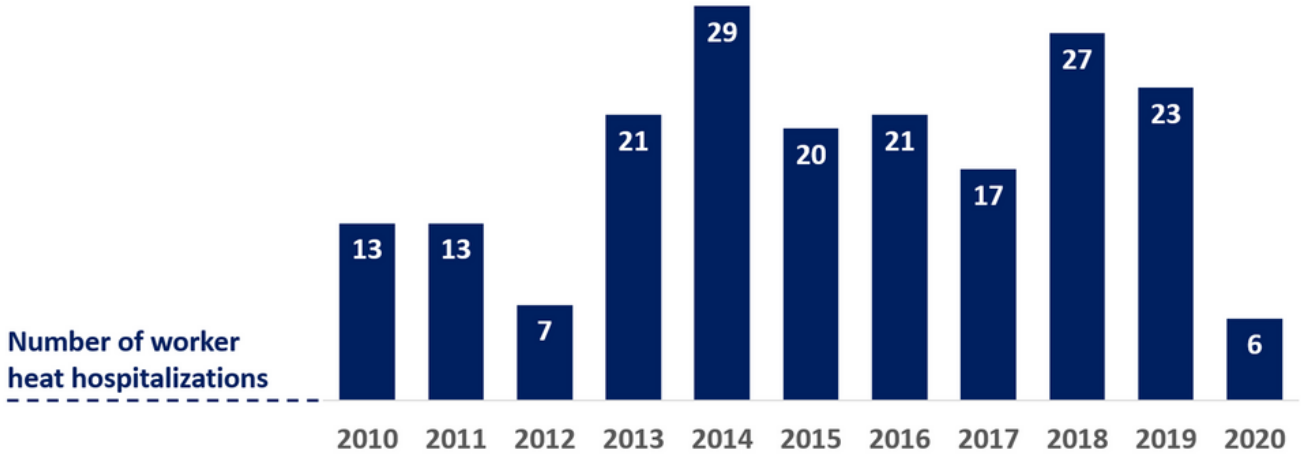
ANNUAL COUNTS AND RATES: WORKERS

Heat is a well-recognized occupational hazard and workers are one of the most at-risk populations because their exposure and responses are largely controlled by their job requirements and employer. About one-quarter of Louisiana's workforce is at risk of heat exposure due to outdoor and physically demanding work in industries such as agriculture, construction, landscaping, transportation, utilities, and some manufacturing. Indoor workers who work in inadequately climatized settings are also at risk.

There was an annual average of 320 work-related ED visits for heat-related illness. Approximately 12% of these visits were for workers who were not Louisiana residents.

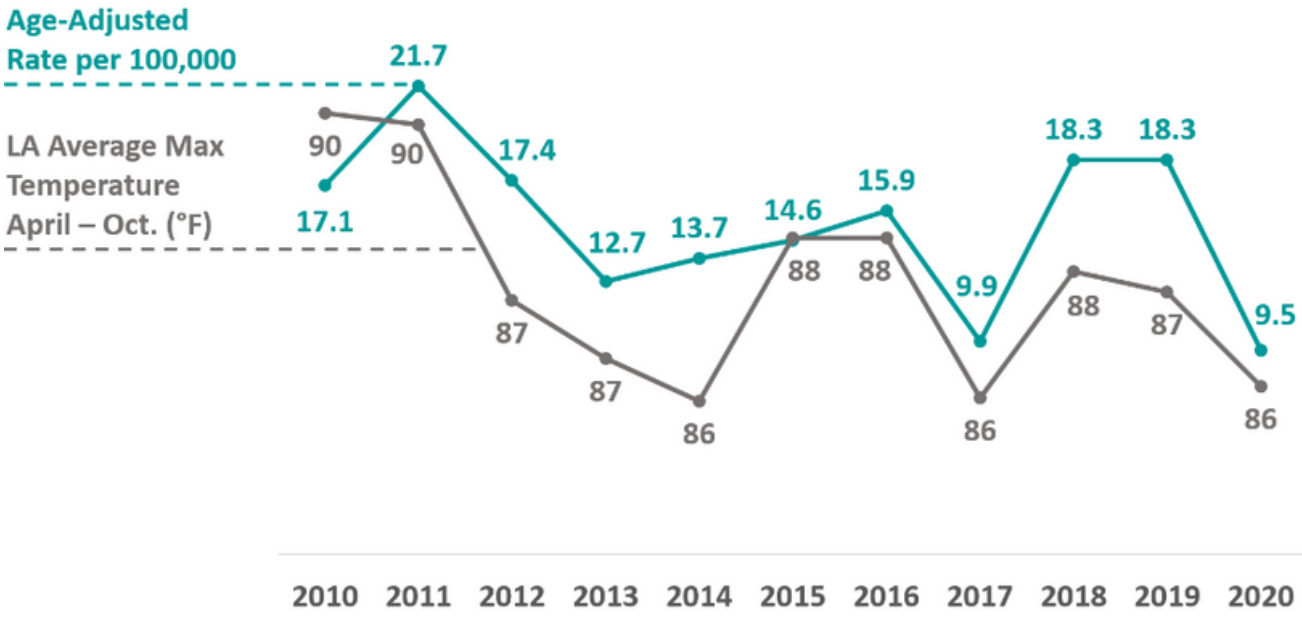


There was an annual average of 20 work-related hospitalizations for heat-related illness. About 11% of these workers were not Louisiana residents. Because of small numbers, the graph only displays total counts.

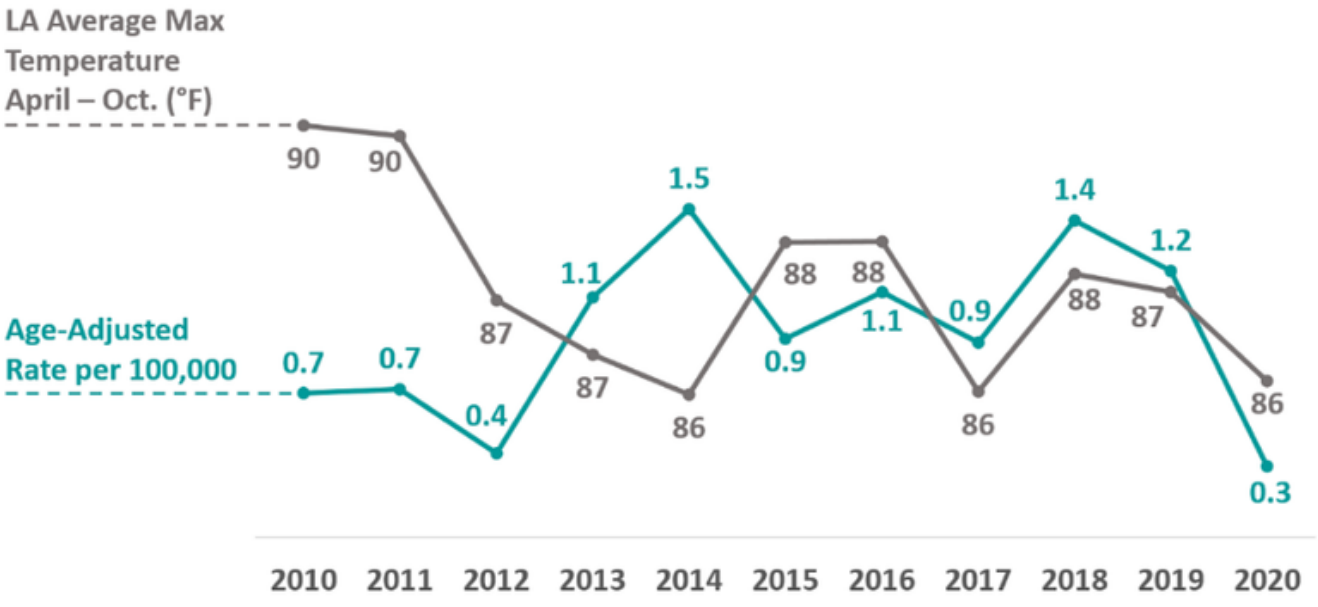


TEMPERATURE

The fluctuation in work-related ED visits corresponded with variations in temperature. The graph below shows the annual average maximum temperature, or daytime high temperature, for April through October and the age-adjusted rate of heat-related ED visits for Louisiana workers.



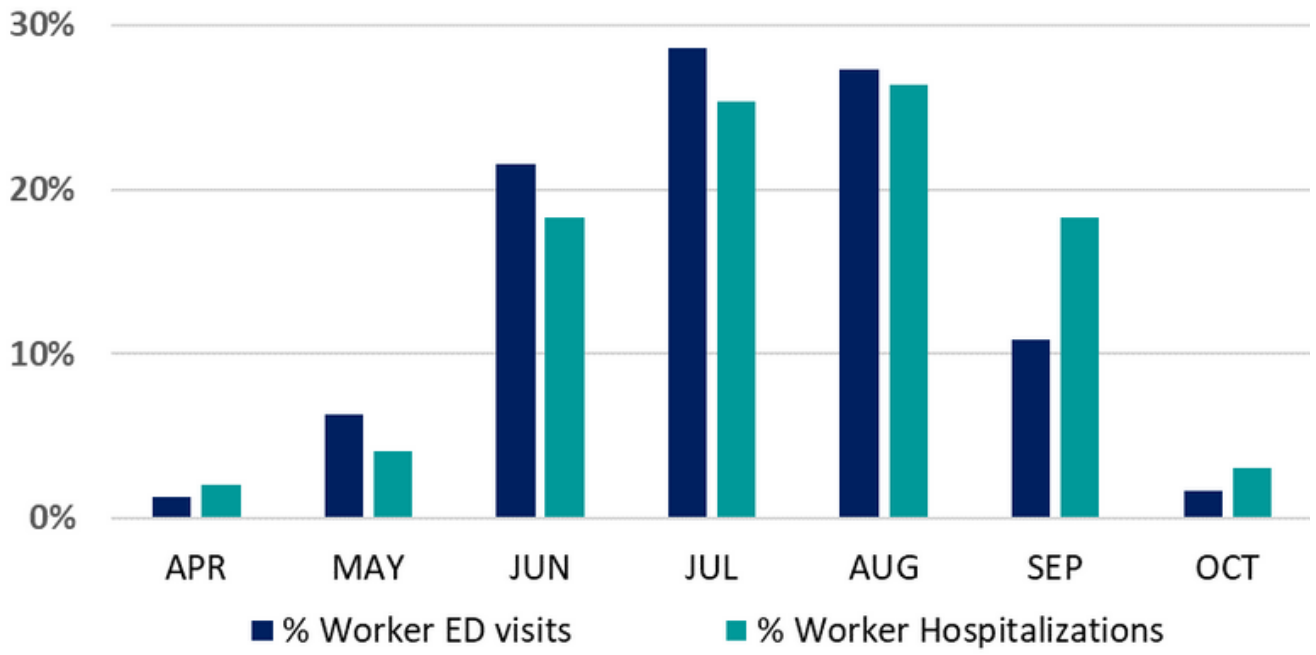
Work-related hospitalizations did not correspond to temperature as closely as ED visits.



MONTH

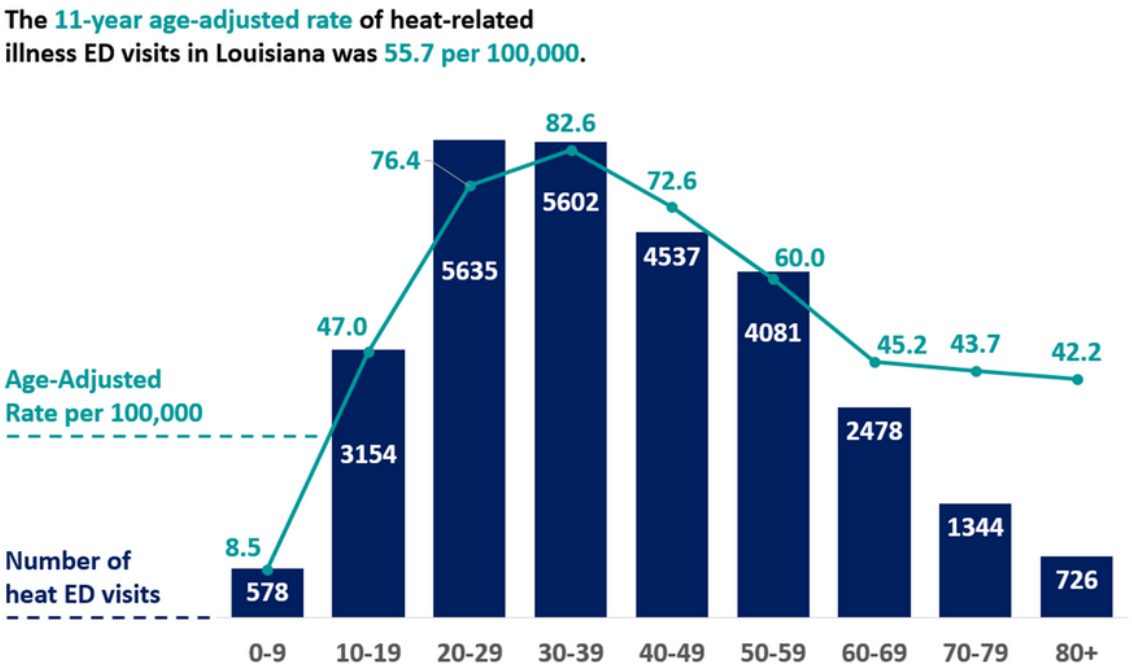
Most work-related cases occurred during the summer months: cases peaked in July for ED visits and August for hospitalizations.

Spring and fall accounted for 20% of ED visits and 27% of hospitalizations.

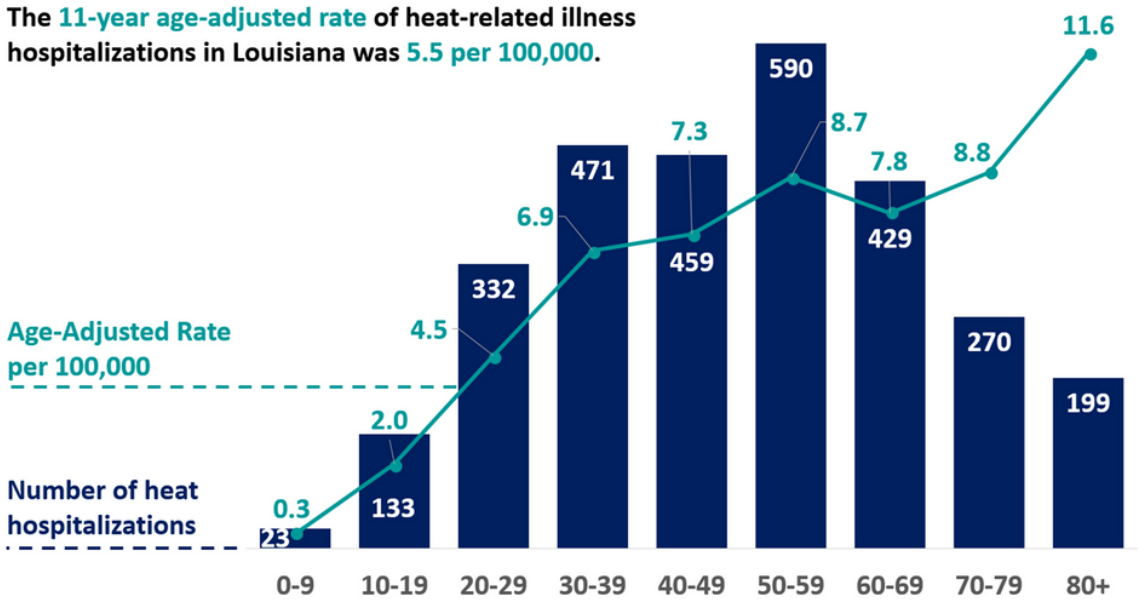


AGE: ALL CASES

Individuals 20 to 39 years old accounted for 40% of all heat-related ED visits and had the highest rates, followed by the 40 to 59 age group. The smallest number and rate were for children under 10 years of age.

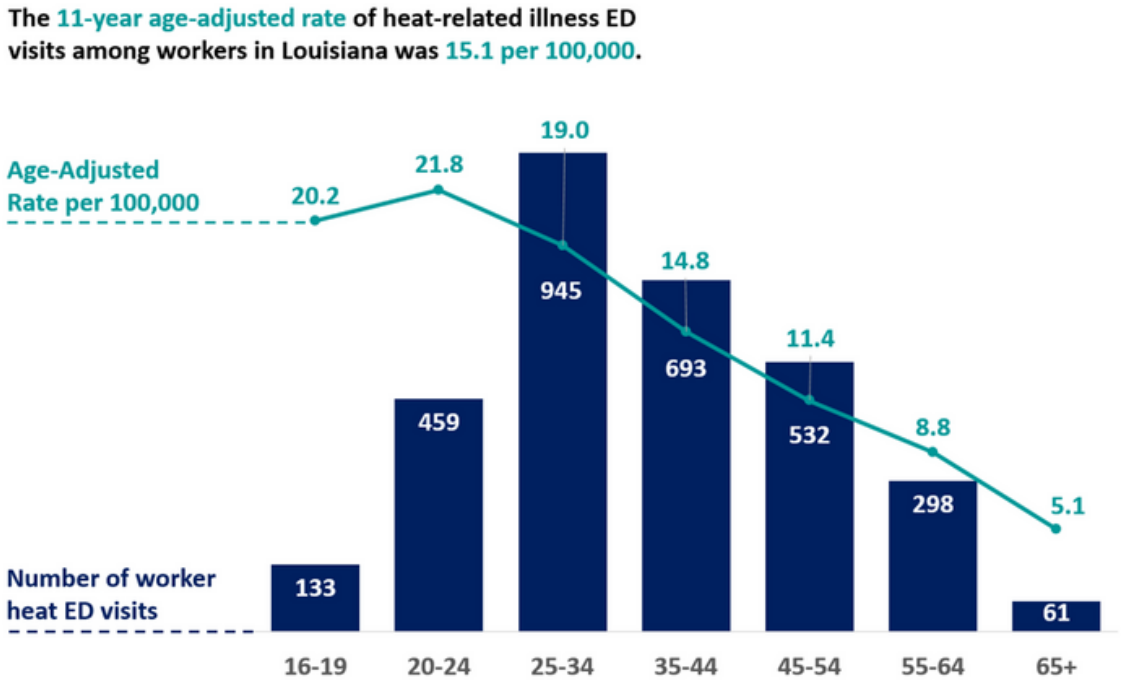


Hospitalizations for heat-related illness increased with age. The increased risk of heat for older adults is due to several factors including decrease in sweating and blood flow which limit the ability to cool, decrease in overall fitness, and increase in chronic health conditions such as diabetes and cardiovascular disease.

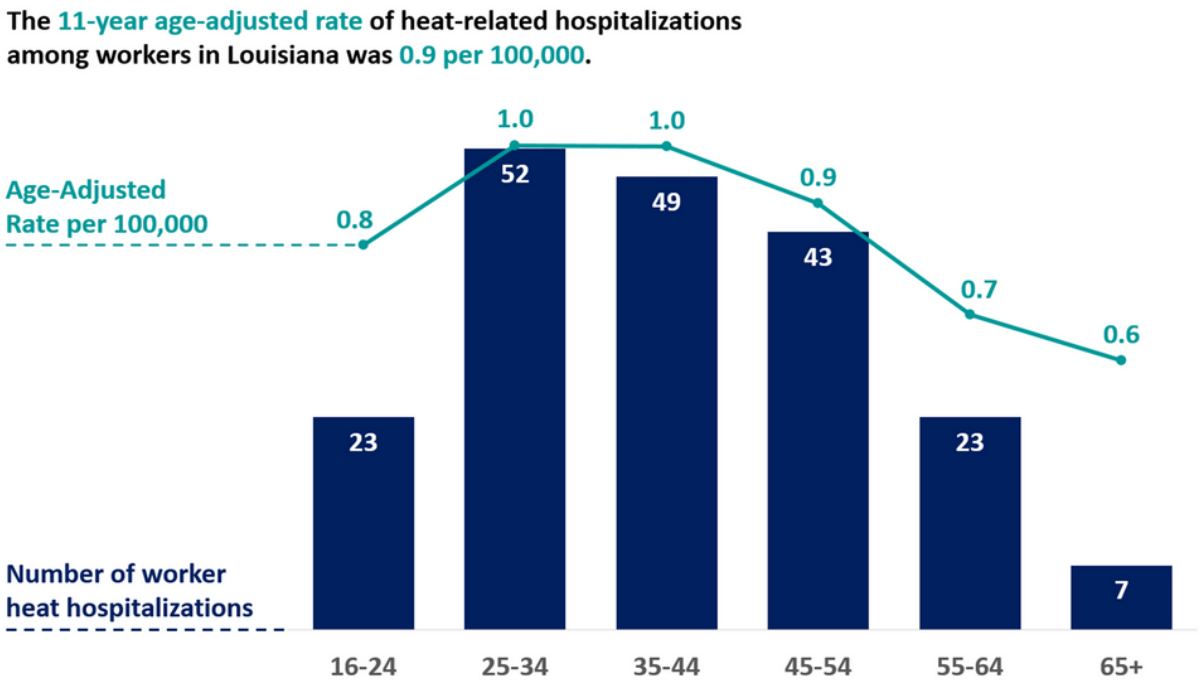


AGE: WORKERS

Workers ages 34 years and younger had the highest rates of ED visits for heat-related illness.

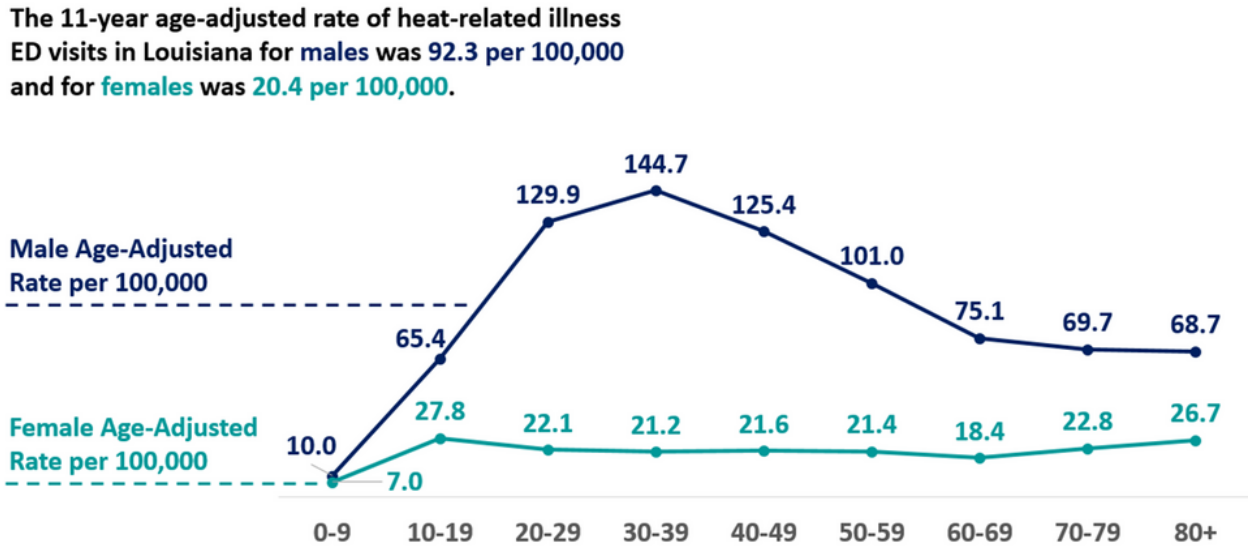


The rate for heat-related hospitalizations among workers varied minimally by age.

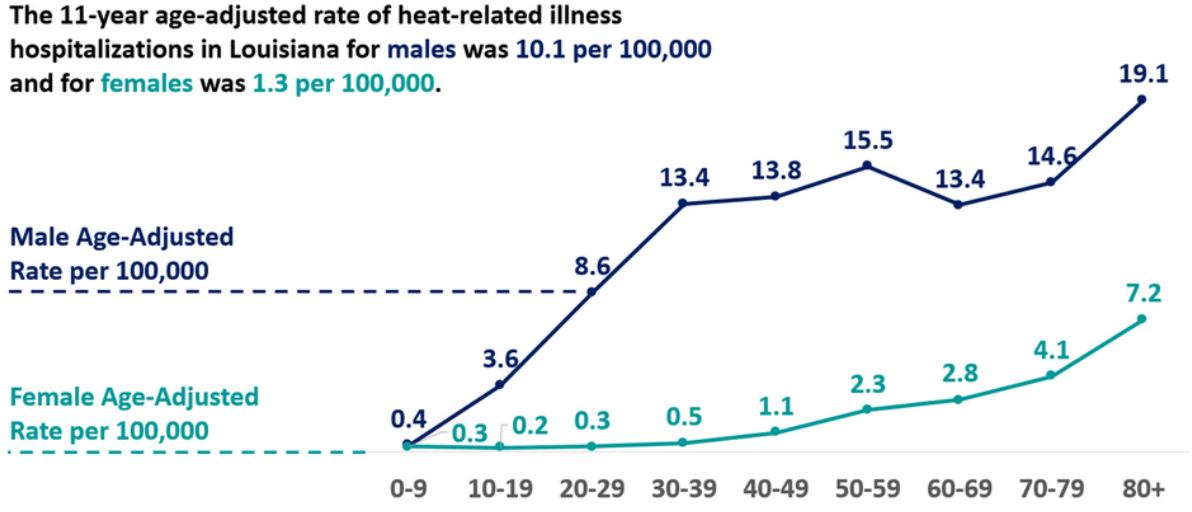


SEX: ALL CASES

Males accounted for 81% of ED visits and had an overall rate 4.5 times the female rate. The rate for males was greater than females for every age group. For ages 20 through 49, the male rate was 5.8 to 6.8 times the female rate. This difference in rates was less acute in younger and older age groups. Males have an increased risk of heat-related illness due to employment in outdoor occupations, involvement in physically demanding activities such as yard work and house repair including post-storm clean up, and participation in sports such as football and golf.



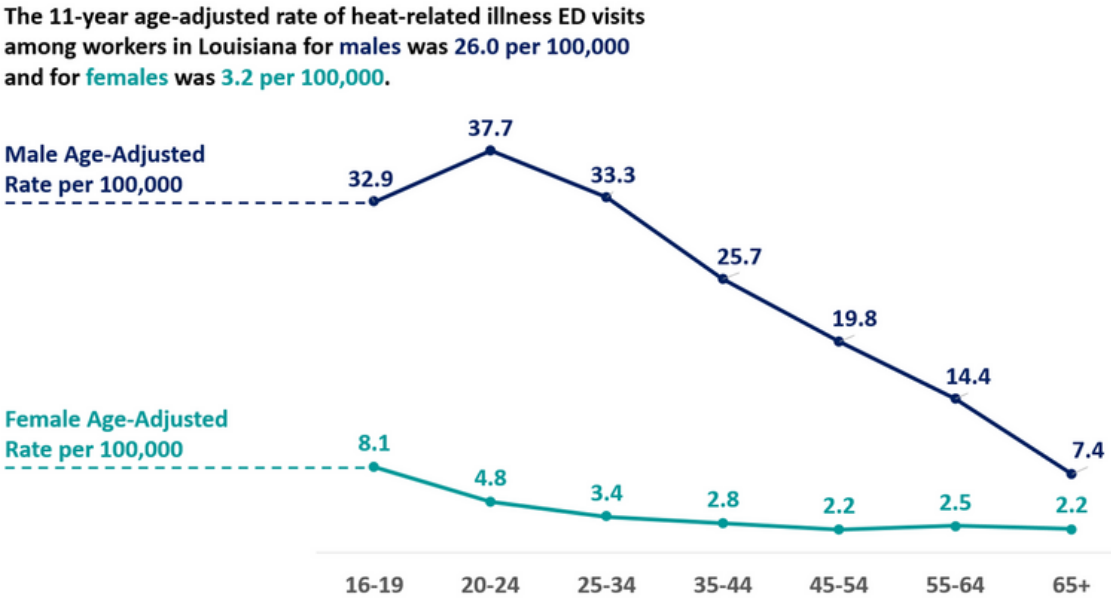
Males accounted for 87% of hospitalizations and had an overall rate 7.8 times the female rate. The heat-related hospitalization rate for males was greater than the female rate for every age group; the biggest difference was for ages 30 through 39 where males were hospitalized at a rate 26.8 times the female rate. For both males and females, the rate increased with increasing age.



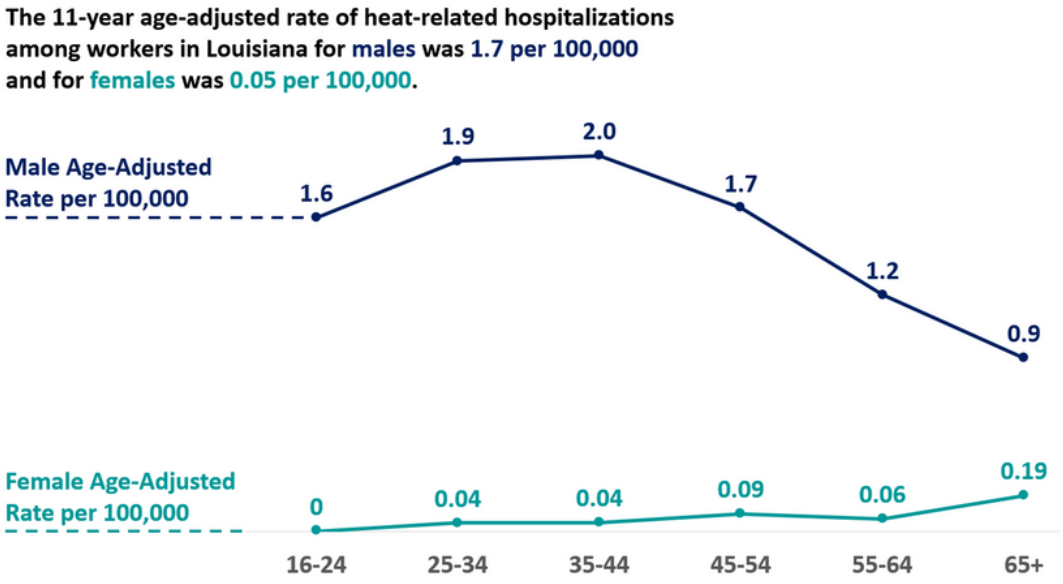
SEX: WORKERS

Differences in rates by sex highlight the difference in at-risk occupations: men are more likely to work in outdoor, physically demanding occupations.

90% of the work-related ED visits for heat-related illness were males. The male rate exceeded the female rate for every age group, and for both males and females the rate decreased with age.



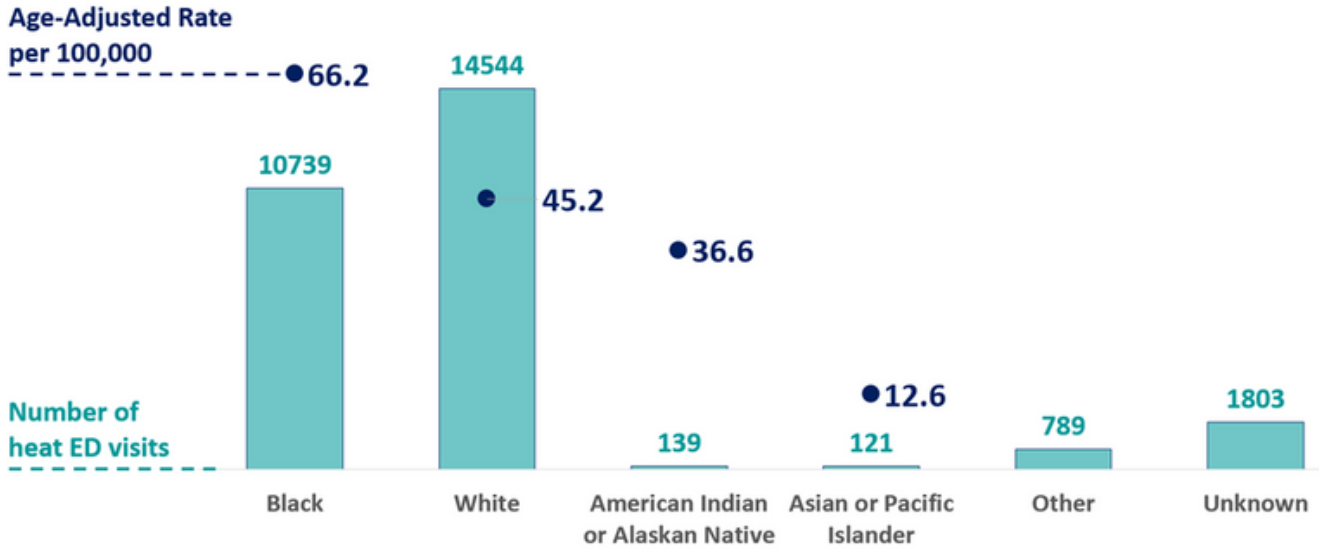
96% of the workers hospitalized for heat-related illness were males.



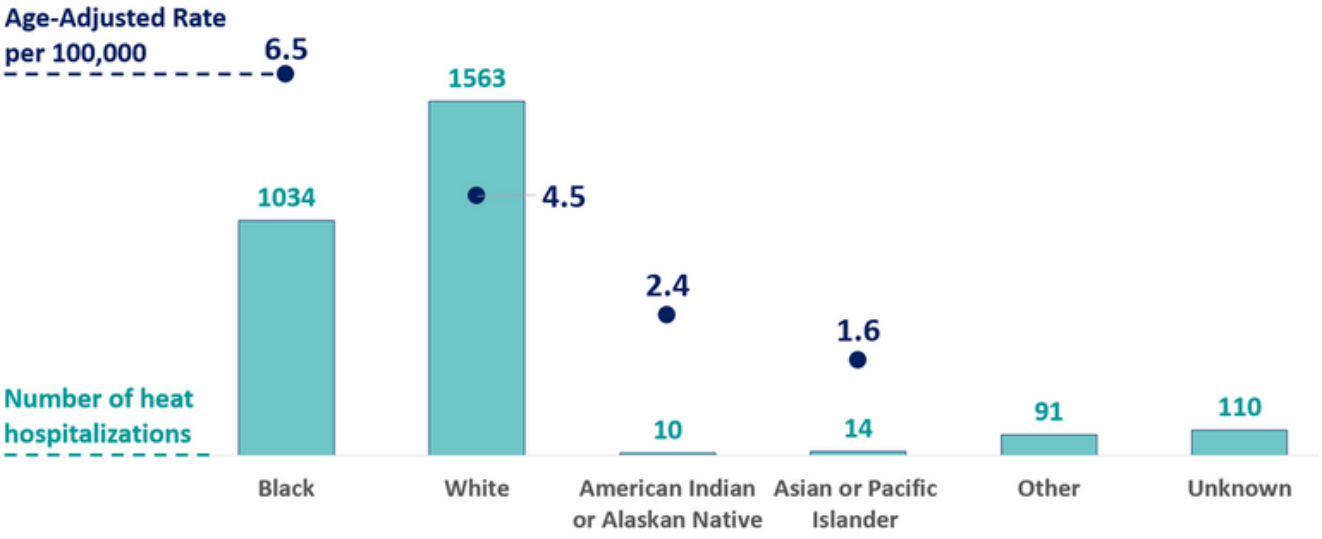
RACE: ALL CASES

Black residents had the highest rates of ED visits and hospitalizations for heat-related illness. Racial inequities in heat-related illness, and other health outcomes, are influenced by structural determinants of health including income, employment, and housing. Communities that experienced historical redlining experience hotter temperatures than neighboring areas due to factors like proximity to large roadways and industry and lack of tree cover. Neighborhoods with fewer trees have more sun exposure, resulting in higher temperatures.

Black residents' rate of ED visits was 1.5 times the rate for white residents.

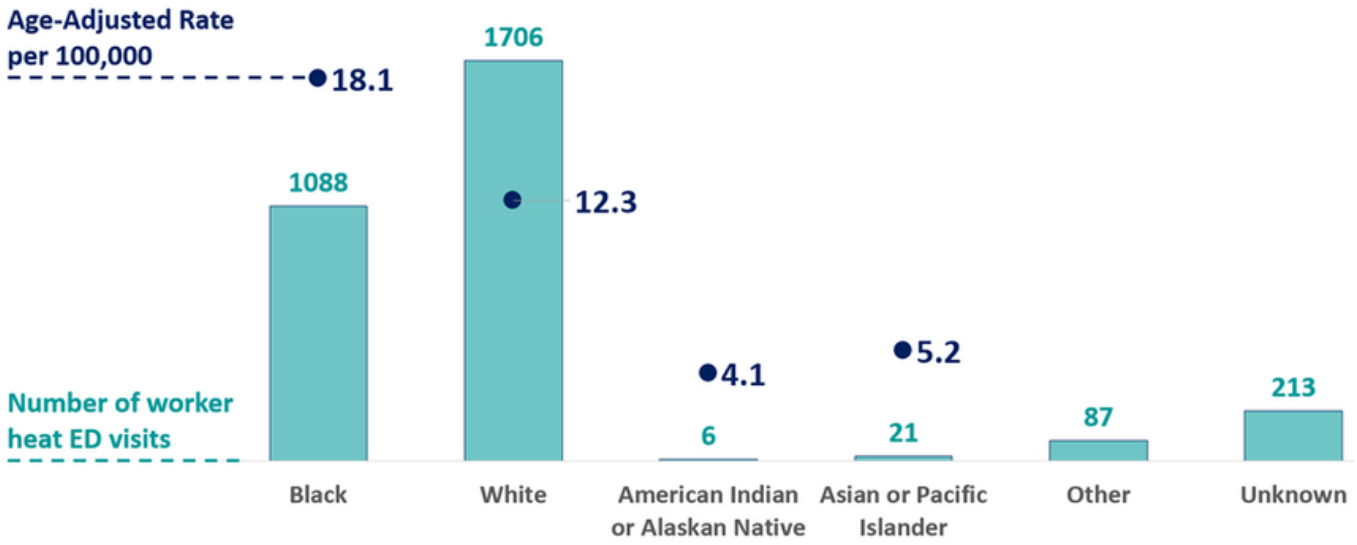


Black residents' rate of hospitalizations was 1.4 times the rate for white residents.

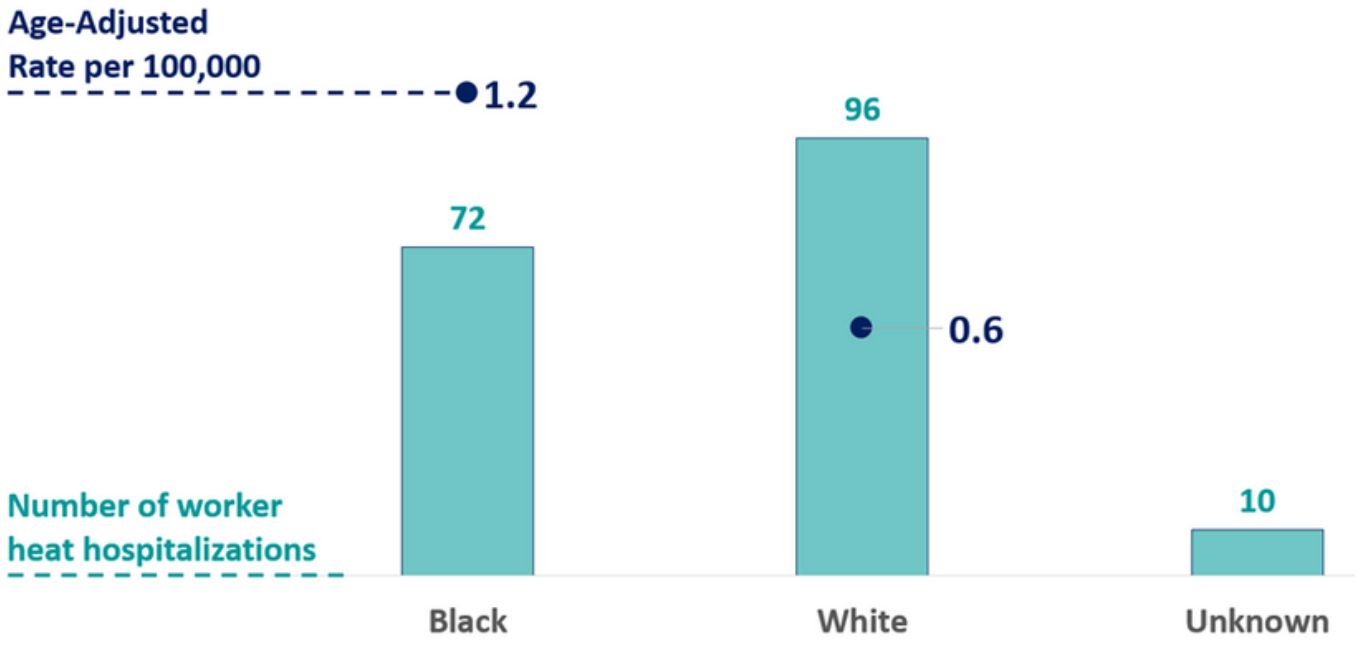


RACE: WORKERS

Black workers' rate of ED visits for heat-related illness was 1.5 times the rate for white workers.

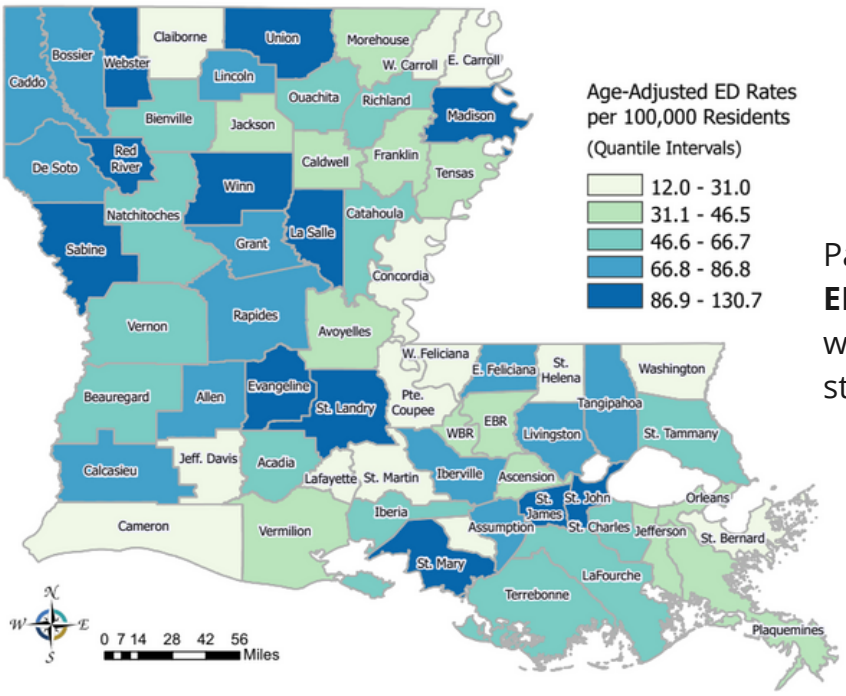


Black workers' rate of hospitalization for heat-related illness was double the rate for white workers.

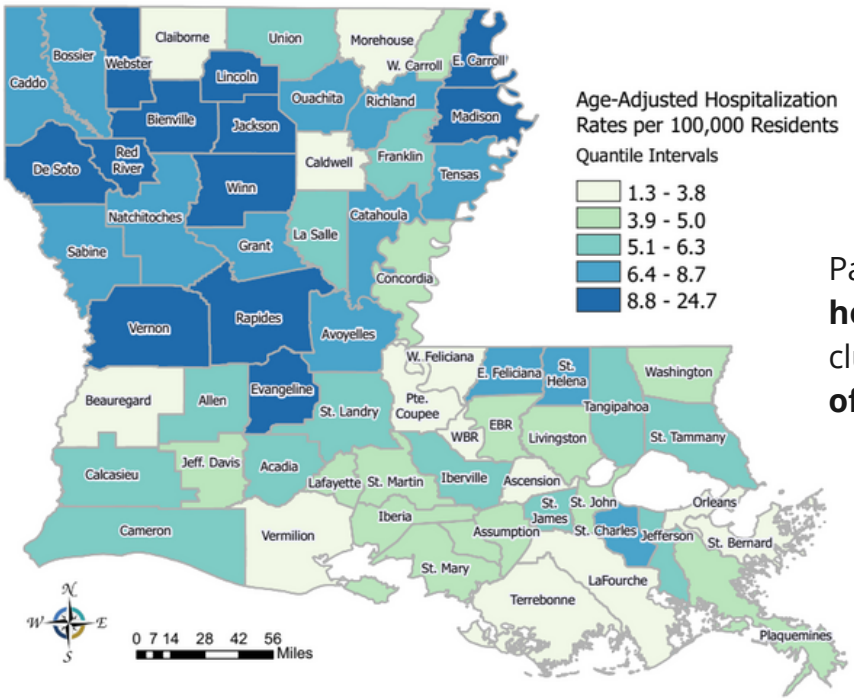


LOCATION: ALL CASES

Parish rates were calculated based on an individual's parish of residence.



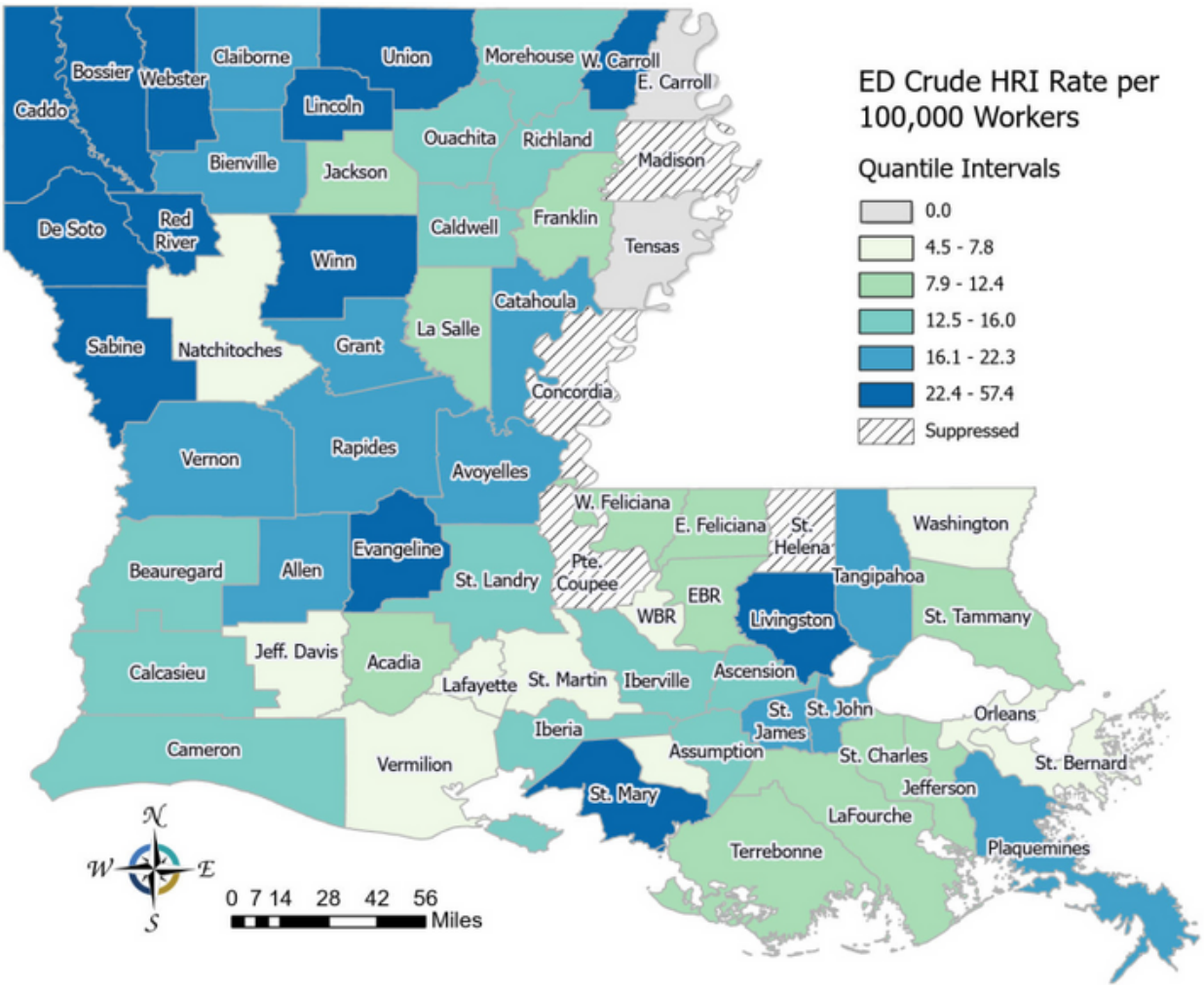
Parishes with **elevated rates of ED visits** for heat-related illness were distributed throughout the state.



Parishes with **elevated hospitalization rates** were clustered in the **Northern part of the state.**

LOCATION: WORKERS

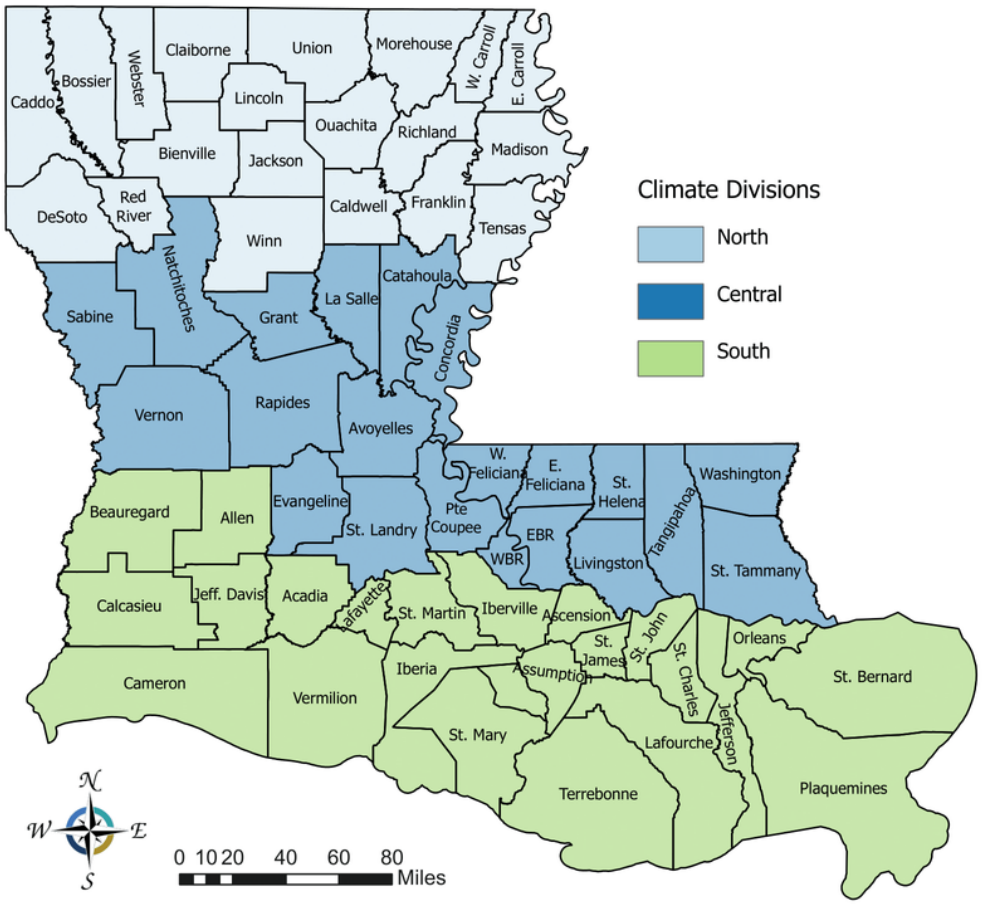
Parishes with high rates of occupational heat-related illness were clustered in the Northwest and Central parts of the state. Many of the parishes along the Northeastern part of the state had no cases, or too few cases to calculate a rate. Hospitalization data were not mapped due to small numbers.



TEMPERATURE

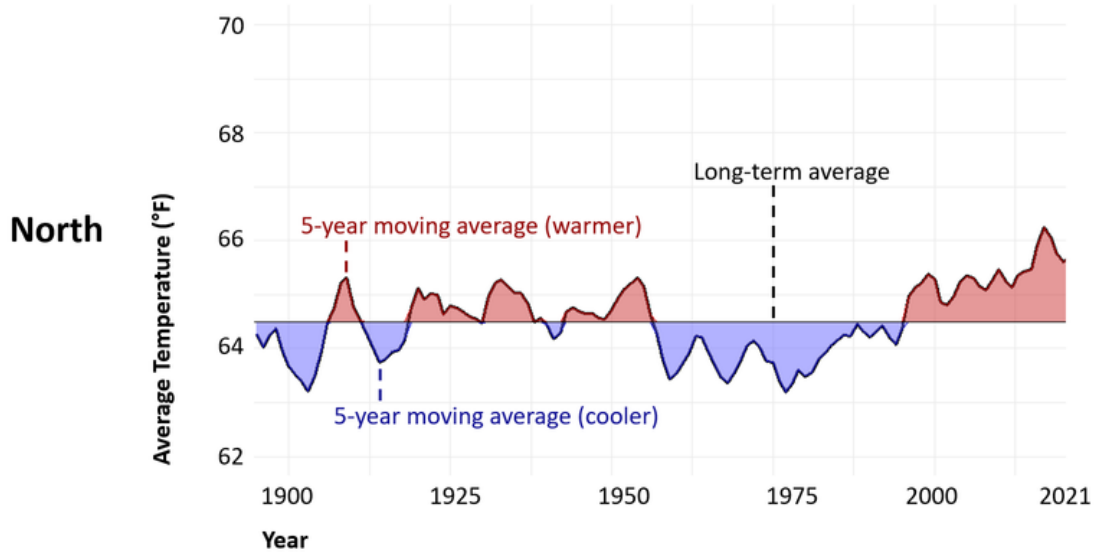
TEMPERATURE DATA: HISTORICAL

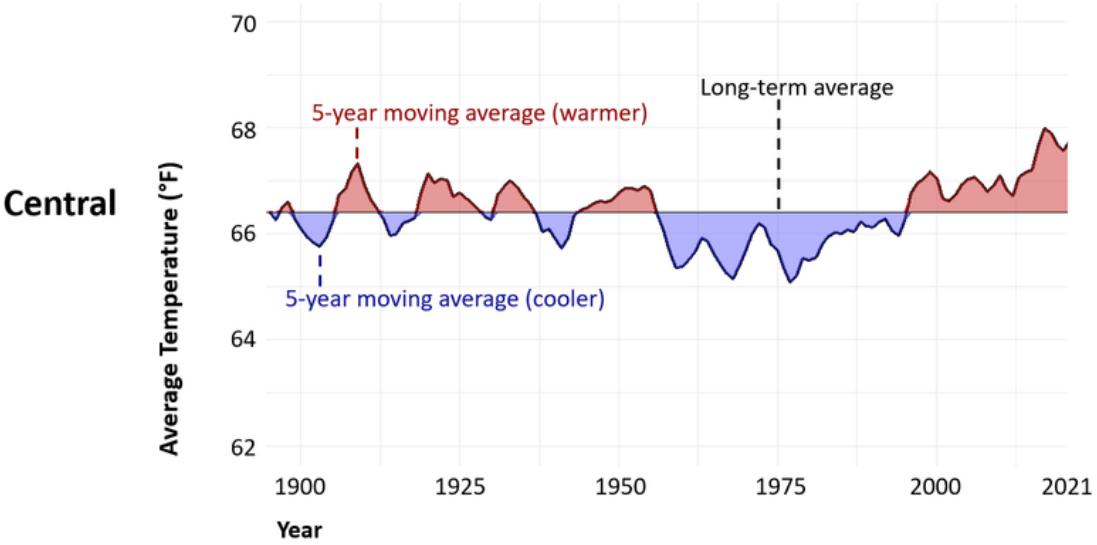
LOUISIANA PARISHES BY CLIMATE DIVISIONS

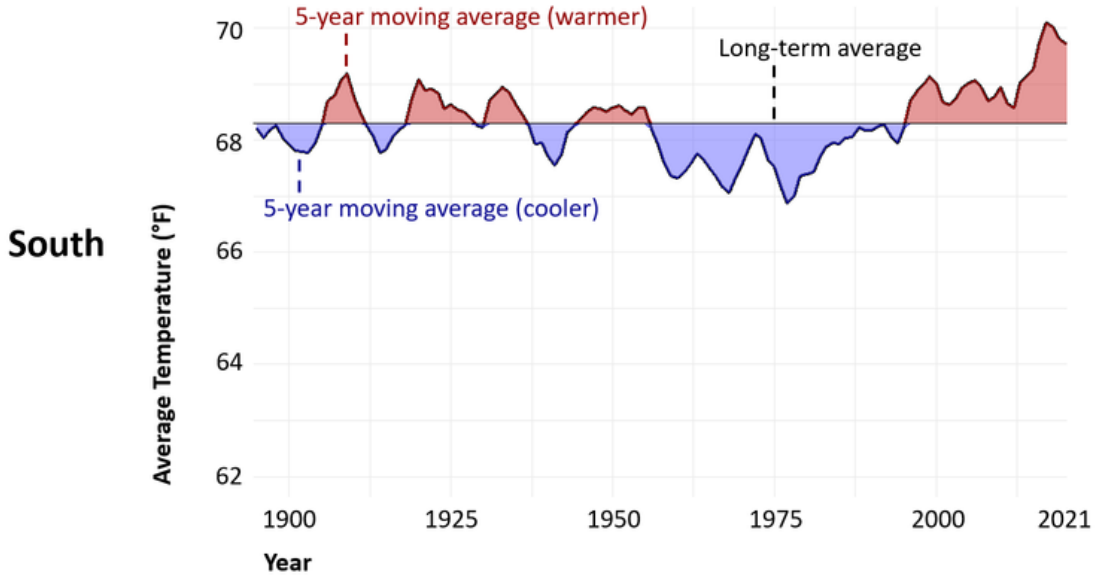


Temperature data from 1895 to 2021 are shown for the three climate divisions. Five-year moving averages of annual temperature data were plotted in comparison to the long-term average. Red indicates a warmer period than the long-term average, while blue represents a cooler period.

While there are annual fluctuations in the temperature, there is an overall warming trend for all three climate divisions. There is a greater rate of increase in average temperatures since the 1970s for all three climate divisions.


North
Average Temperature (°F)
70
68
66
64
62
Long-term average
5-year moving average (warmer)
5-year moving average (cooler)
1900
1925
1950
1975
2000
2021
Year

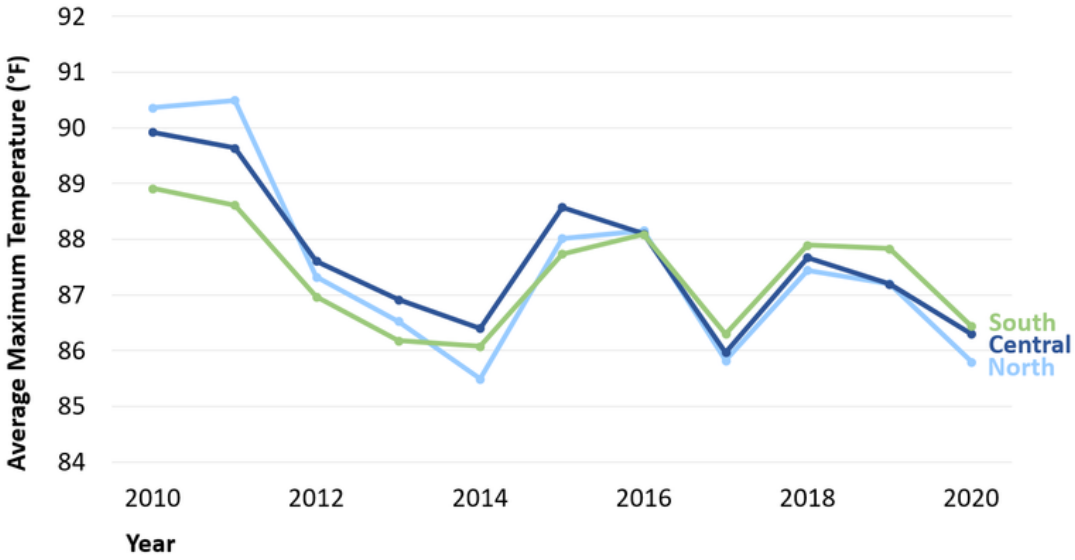

Central
Average Temperature (°F)
70
68
66
64
62
Long-term average
5-year moving average (warmer)
5-year moving average (cooler)
1900
1925
1950
1975
2000
2021
Year


South
Average Temperature (°F)
70
68
66
64
62
5-year moving average (warmer)
Long-term average
5-year moving average (cooler)
1900
1925
1950
1975
2000
2021
Year

TEMPERATURE DATA: 2010 TO 2020

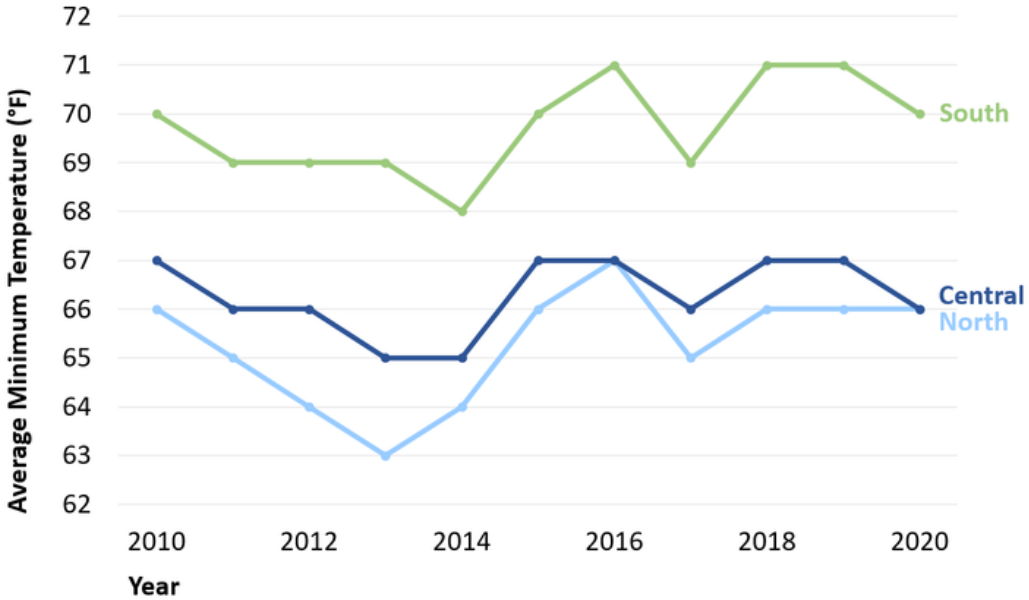
MAXIMUM TEMPERATURE

The average maximum temperature, or daytime temperature, is shown for each climate division. **All climate divisions experienced a similar trend: a warm period in 2010 and 2011 followed by colder than average temperatures in 2014.**



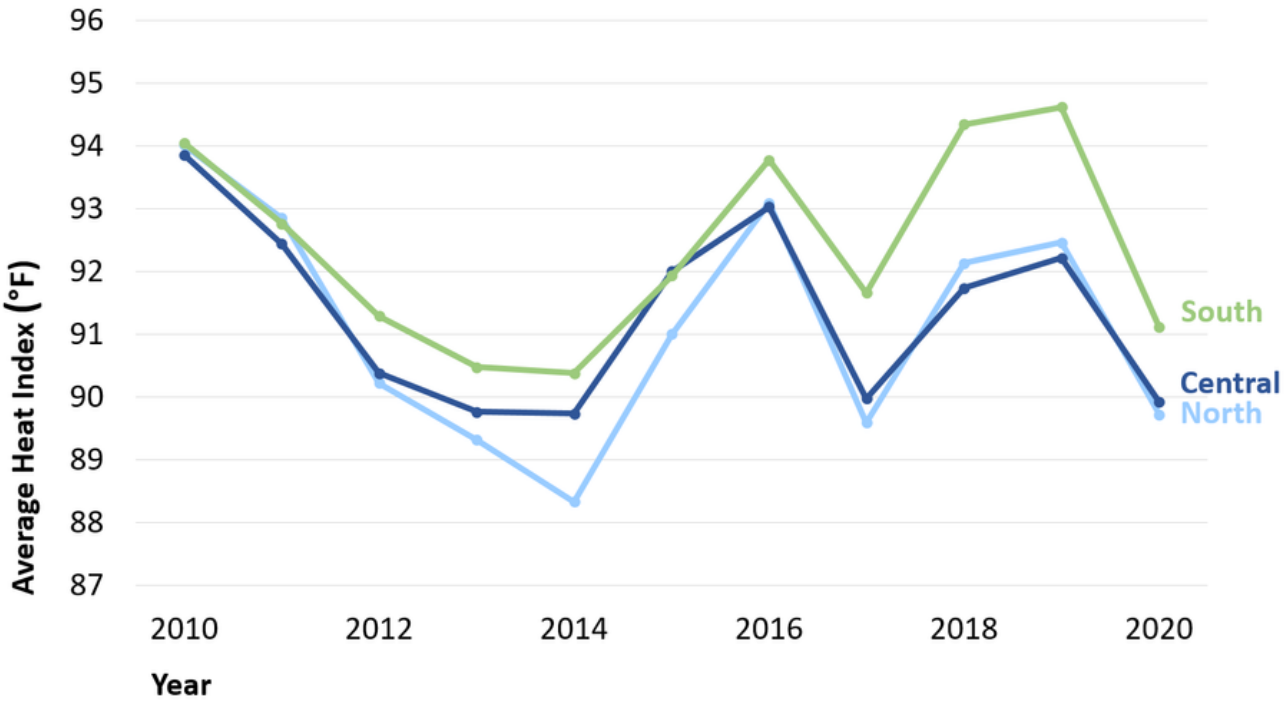
MINIMUM TEMPERATURE

Average minimum temperatures (or night-time temperatures) are highest in the South climate division. All climate divisions had an increase in their night-time temperatures. **Higher night-time temperatures can increase the risk of heat-related illness because prolonged periods of hot weather prevent people from cooling off from the day's heat.**



HEAT INDEX

Heat index is a measure of how hot it really feels when relative humidity is combined with air temperature. Heat indices range from high 80s°F to the mid-90s°F. **The South climate division had higher heat index values than other climate divisions** because its proximity to the Gulf of Mexico produces more humidity. The more humidity in the air, the more difficult it is to stay cool because there is less evaporation of sweat from skin.



NEXT STEPS

This report is the first detailed analysis of heat-related illness in Louisiana and is an important contribution to improving public health's capacity to monitor and assess the burden of heat on Louisianans. This report is part of a larger program strategy to a) improve the consistency, reliability, and timeliness of health data associated with heat exposure and b) promote data to inform climate resilient policies and practices. Our strategy also aims to highlight vulnerable populations, particularly working populations, who are most at risk of heat-related health impacts. Listed below is a brief description of additional projects. The timeline for these projects is 2023 through 2025.

- **Regional Heat-Health Profiles:** We are replicating this report at the regional level to facilitate use of the information at the local level.
- **Workers and heat:** We are analyzing work-related ED, hospitalization, and fatality data to identify high-risk occupations, demographics, and locations. The analyses will also evaluate injuries, such as fractures and lacerations, that occur when working in hot temperatures.
- **Syndromic surveillance of heat-related illness:** Syndromic surveillance uses daily data on chief complaint, admit and discharge diagnoses, clinical impressions and triage notes from ED records to detect emerging health issues and monitor community health in near-real time. We are creating weekly reports of ED visits for heat-related illness by region, age, race, and sex.
- **Heat vulnerability:** We are evaluating excess hospitalizations in New Orleans due to heat. Excess morbidity analysis captures all diagnoses which provides important information about how heat exacerbates chronic conditions.
- **Hurricane death certificate review:** We are reviewing death certificates of individuals who died during or shortly after Hurricanes Laura and Ida to assess the accuracy and consistency of recording heat fatalities and other disaster-related fatalities on death certificates.
- **Louisiana Fatality Assessment Control Evaluation Program (LA FACE):** We are partnering with the LA FACE program to assess occupational heat-related fatalities. LA FACE tracks all work-related fatalities occurring in Louisiana and conducts in-depth investigations of select fatalities.

APPENDICES

APPENDIX A: ICD CODES: HEAT-RELATED ILLNESS

International Classification of Diseases (ICD) Diagnostic and External Cause of Injury codes for Effects of Heat and Light	
Code	**Definition**
ICD 9th Revision	
992.0	Heat stroke
992.1	Heat syncope
992.2	Heat cramps
992.3	Heat exhaustion, anhidrotic
992.4	Heat exhaustion due to salt depletion
992.5	Heat exhaustion, unspecified
992.6	Heat fatigue
992.7	Heat edema
992.8	Other specified heat effects
992.9	Unspecified effects of heat and light
E900.0	Excessive heat due to weather conditions

ICD 10th Revision	
Code	**Definition**
T67.01XA	Heatstroke and sunstroke, initial encounter
T67.02XA	Exertional heatstroke, initial encounter
T67.1XXA	Heat syncope, initial encounter
T67.2XXA	Heat cramp, initial encounter
T67.3XXA	Heat exhaustion, anhydrotic, initial encounter
T67.4XXA	Heat exhaustion due to salt depletion, initial encounter
T67.5XXA	Heat exhaustion, unspecified, initial encounter
T67.6XXA	Heat fatigue, transient, initial encounter
T67.7XXA	Heat edema, initial encounter
T67.8XXA	Other effects of heat and light, initial encounter
T67.9XXA	Effect of heat and light, unspecified, initial encounter
X30.XXXA	Exposure to excessive natural heat, initial encounter
W92.XXXA	Exposure to excessive heat of man-made origin, initial encounter

APPENDIX B: ICD CODES: WORK-RELATEDNESS

International Classification of Diseases External cause of morbidity: work-relatedness	
Code	**Definition**
ICD 9th Revision	
E000.0	Civilian activity done for income
E000.1	Military activity
E800-E807	Railway accident among railway employee
E830-E838	Water transport accident among crew, dockers and stevedores
E840-E845	Air and space transport accidents among crew and ground crew
E846	Accidents involving powered vehicles used solely within the buildings and premises of industrial or commercial establishment
E849.1	Place of occurrence: farm building/land under cultivation
E849.2	Place of occurrence: mine or quarry
E849.3	Place of occurrence: industrial place and premises

ICD 10th Revision	
Y99.0	Civilian activity done for pay
Y99.1	Military activity
Y92.61	Building [any] under construction as the place of occurrence
Y92.62	Dock or shipyard as place of occurrence
Y92.63	Factory as place of occurrence
Y92.64	Mine or pit as the place of occurrence
Y92.65	Oil rig as the place of occurrence
Y92.69	Other specified industrial and construction area as the place of occurrence
Y92.71	Barn as the place of occurrence
Y92.72	Chicken coop as the place of occurrence
Y92.73	Farm field as the place of occurrence
Y92.74	Orchard as the place of occurrence
Y92.79	Other farm location as the place of occurrence
Z04.21[1]	Encounter for examination and observation following work accident
Z57.61[1]	Occupational exposure to extreme temperature
Z57.81[1]	Occupational exposure to other risk factors

[1] Z codes fall under the category of 'Factors influencing health status and contact with health services.