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Hospital Stays Resulting from Excessive Heat and Cold Exposure Due to Weather Conditions in U.S. Community Hospitals, 2005

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Introduction

Hospitalizations due to excessive heat and cold from environmental, non-manmade sources, are the result of hyperthermia and hypothermia. Hyperthermia describes any condition that includes abnormally elevated body temperature levels. When an individual is unable to dispel heat efficiently, body temperature can rise to 106 degrees Fahrenheit as compared to a normal body temperature of 98.6 degrees Fahrenheit. Early symptoms, or heat exhaustion, include nausea, vomiting, fatigue, weakness, headache, muscle cramps and aches, and dizziness. Late symptoms, or heat stroke, include rapid pulse, difficulty breathing, strange behavior, hallucinations, confusion, agitation, disorientation, seizure, and coma.

Hypothermia describes any condition that includes abnormally lowered body temperature levels. When the body loses more heat than it is making, body temperatures can fall below 90 degrees Fahrenheit. Early symptoms include shivering, pale or blue-gray skin, apathy, poor judgment, mild unsteadiness in balance or walking, slurred speech, and numb hands and fingers. Late symptoms include difficulty performing tasks, stiff muscles, slow pulse, breathing that is shallow and slower, weakness or sleepiness, confusion, cold feel of the trunk of the body, and loss of consciousness. The groups that are most vulnerable to excessive heat and cold conditions are the elderly, children, and people with chronic conditions.¹

This Statistical Brief presents data from the Healthcare Cost and Utilization Project (HCUP) on the hospitalizations resulting from excessive heat and cold due to weather conditions in 2005. The demographic, utilization, and economic characteristics of individuals hospitalized for heat- and cold-related conditions are presented.

¹ National Oceanic and Atmospheric Administration (NOAA). *NOAA Watch*. Produced as a cooperative effort of NOAA's National Weather Service, the Federal Emergency Management Agency, and the American Red Cross. <http://www.noaa.gov/themes/heat.php> (Accessed June 8, 2008).

Highlights

- In 2005, there were about 12,700 hospitalizations that were related to excessive heat or cold due to weather conditions. About 6,200 hospitalizations were heat-related stays and an estimated 6,500 hospitalizations were cold-related stays with a combined national cost of over \$120 million.
- The majority of individuals hospitalized for excessive weather-related heat or cold exposure were first seen in the emergency department (ED) and subsequently admitted to the hospital (81.6 percent for heat-related stays and 77.6 percent for cold-related stays) which is significantly higher than the 42.5 percent of hospitalizations that begin in the ED for all other stays.
- In the poorest communities hospitalizations resulting from excessive heat or cold due to weather were about 2 to 2.5 times more common than in the wealthiest communities.
- About 5.6 percent of all hospital stays were uninsured, but a much larger portion of stays related to excessive weather temperature exposure were uninsured: 16.9 percent of heat-related and 12.8 percent of cold-related stays.
- While there were less than 2 stays per 100,000 population in large metropolitan areas, in rural areas there were about 3 to 4 stays per 100,000 population for cold- and heat-related stays, respectively.

Despite the relatively low number of hospitalizations due to excessive heat and cold exposure, the data reveal interesting and important patterns. All differences between estimates noted in the text are statistically significant at the 0.05 level or better.

Findings

General findings

In 2005, there were an estimated 12,700 hospitalizations that were caused by excessive exposure to heat or cold due to weather conditions. About 6,200 hospitalizations were heat-related stays and an estimated 6,500 hospitalizations were cold-related stays with a combined national hospital cost of over \$120 million. The average cost of stays related to cold exposure was more than twice that of those related to heat exposure: \$12,500 per cold-related stay compared to \$6,200 per heat-related stay. The average cost of all other hospital stays was about \$8,100 per stay. The main driver of the increased cost associated with cold-related stays appeared to be the length of time the patient remained in the hospital. The average length of stay for cold-related hospitalizations was 6.7 days which was more than twice as long as the average length of heat-related stays (3.2 days). When the patient's time in the hospital was accounted for, the cost per day was identical for heat and cold related stays at \$1,900 which was comparable to the per day cost of all other hospital stays.

Patients hospitalized for heat- and cold-related stays were older than the average hospital patient (age 47 years): those hospitalized for excessive heat exposure averaged about 54 years, while those hospitalized for cold-related stays averaged about 59 years. The majority of these hospitalizations began in the emergency department (ED) and subsequently resulted in admission to the hospital (81.6 percent for the heat-related stays and 77.6 percent for the cold-related stays)—a much higher percentage than the 42.5 percent of hospitalizations that began in the ED for all other stays. The percentage of patients who died at the hospital for heat-related stays was 2.9 percent (about 180 patients) which was close to the estimated 2.1 percent of in-hospital deaths among non-related stays. In contrast, the percentage of people who died at the hospital for cold-related exposure was significantly higher at 10.5 percent (about 685 patients).

Rates of hospital stays resulting from excessive heat and cold, by gender, age, and region

Hospitalization rates resulting from excessive exposure to heat and cold due to weather conditions were low compared to all other hospital stays, but still reveal important patterns. Hospitalization rates for both heat- and cold-related stays increased significantly with age and were higher in males. Rates of heat- and cold-related hospitalizations were about 15 times greater in the oldest age group (65+) compared to the youngest age group, 0–17 year olds (about .5 per 100,000 population compared to 6.0 to 7.6 per 100,000 population). Among men, the hospitalization rate for heat-related stays was about 3 times greater than the rate for women and about 1.4 times greater for cold-related stays compared to women.

Regional patterns of hospitalizations due to excessive heat and cold were consistent with the expected climate in each region. Heat-related stays were far more common in the South than in any of the other region (3.1 stays related to heat per 100,000 population in the South compared to 1.4 to 1.7 stays in the remaining regions). In contrast, cold-related stays were much more frequent in the Northeast compared to the other regions (3.7 stays per 100,000 population in the Northeast compared to 1.6 to 2.2 stays in the other regions).

Hospital stays resulting from excessive heat and cold, by median community income

The rate of hospital stays resulting from excessive exposure to heat and cold due to weather was inversely related to wealth: as community-level income increased, the rate of hospitalizations decreased (figure 1). This pattern was seen in all hospital stays as well. In the poorest communities hospitalizations resulting from exposure to heat and cold were about 2 to 2.5 times more common than in the wealthiest communities. Hospitalization rates for heat-related and cold-related stays were similar within each income level.

Hospital stays related to excessive heat and cold, by payer

Government payers, Medicare and Medicaid, were billed for the majority of hospital stays related to excessive exposure to heat or cold due to weather conditions. Collectively, these two payers were responsible for about half of heat-related and nearly 70 percent of cold-related stays compared to about

57 percent of all hospital stays. Relative to its share of all hospital stays (37.2 percent), Medicare—the insurance program for the elderly and disabled—was disproportionately billed for nearly half of stays related to excessive cold, but a comparable portion of heat-related stays (37.6 percent). In contrast, Medicaid—the insurance program for low-income individuals—was billed for about 20 percent of all hospital stays which was similar to its share of cold-related stays (20.4 percent), but was billed for disproportionately less heat-related stays (9.8 percent).

For both heat-related and cold-related hospitalizations, private insurance was billed for significantly less stays compared to its share of all hospital stays (27.4 percent and 14.9 percent of heat- and cold-related stays, respectively, compared to 34.9 percent of all hospital stays). While about 5.6 percent of all hospital stays were uninsured, a much larger portion of stays related to excessive temperatures were uninsured: 16.9 percent of heat-related and 12.8 percent of cold-related stays.

Hospital stays related to excessive heat and cold, by patient location

Hospital stays related to excessive heat and cold were more common in non-metropolitan locations (i.e., rural areas) compared to metropolitan and micropolitan areas (figure 3). While there were less than 2 stays per 100,000 population in large metropolitan areas, in rural areas there were about 3 to 4 stays per 100,000 population for cold- and heat-related stays, respectively. More patients may be hospitalized in rural areas because of relatively poorer access to outpatient health care services compared to those patients residing in metropolitan locations. This pattern was similar to that seen in all hospital stays for which the overall rate of hospital admissions in rural areas was greater than in metropolitan locations.

Most common reasons for being admitted to the hospital related to excessive exposure to heat and cold due to weather conditions

Patients hospitalized for excessive heat or cold exposure present to the hospital for a specific condition (identified by the principal diagnosis code) with notation in their hospital discharge record that the hospitalization was a result of a weather-related event. More than half of patients hospitalized for exposure to excessive heat were admitted for heat exhaustion and heat/sun strokes. Other reasons for heat-related hospitalizations included fluid and electrolyte disorders (7.6 percent of stays), renal failure (6.4 percent of stays), fainting (3.4 percent of stays) and atherosclerosis (2.1 percent of stays).

Among patients hospitalized for cold-related stays, about a third of patients were hospitalized principally for hypothermia and frostbite. Other reasons for hospitalizations included septicemia (6.8 percent of stays), complicated diabetes (6.4 percent of stays), pneumonia (2.7 percent of stays), and fluid and electrolyte disorders (2.6 percent of stays).

Data Source

The estimates in this Statistical Brief are based upon data from the HCUP 2005 Nationwide Inpatient Sample (NIS).

1) Denominator data for the population rates were derived from 2005 Claritas Population Data.

Definitions

Diagnoses, Procedures, ICD-9-CM, and Clinical Classifications Software (CCS)

The principal diagnosis is that condition established after study to be chiefly responsible for the patient's admission to the hospital. All-listed procedures include all procedures performed during the hospital stay.

ICD-9-CM is the International Classification of Diseases, Ninth Revision, Clinical Modification, which assigns numeric codes to diagnoses. There are about 12,000 ICD-9-CM diagnosis codes.

CCS categorizes ICD-9-CM diagnoses and procedures into clinically meaningful categories.² This "clinical grouper" makes it easier to quickly understand patterns of diagnoses and procedures.

² HCUP CCS. Healthcare Cost and Utilization Project (HCUP). August 2006. U.S. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp

Case Definition

External cause of injury codes (E codes) were used to identify heat- and cold weather-related stays. E codes are a type of ICD-9-CM diagnosis code that explain the reasons for hospitalizations.

Heat-related stays: E code 900.0 (Excessive heat due to weather conditions)

E code 900.9 (Excessive heat of unspecified origin)

Cold-related stays: E code 901.0 (Excessive cold due to weather conditions)

E code 901.9 (Excessive cold of unspecified origin)

Types of hospitals included in HCUP

HCUP is based on data from community hospitals, defined as short-term, non-Federal, general and other hospitals, excluding hospital units of other institutions (e.g., prisons). HCUP data include OB-GYN, ENT, orthopedic, cancer, pediatric, public, and academic medical hospitals. They exclude long-term care, rehabilitation, psychiatric, and alcoholism and chemical dependency hospitals, but these types of discharges are included if they are from community hospitals.

Unit of analysis

The unit of analysis is the hospital discharge (i.e., the hospital stay), not a person or patient. This means that a person who is admitted to the hospital multiple times in one year will be counted each time as a separate "discharge" from the hospital.

Costs and charges

Total hospital charges were converted to costs using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare and Medicaid Services (CMS).³ Costs will tend to reflect the actual costs of production, while charges represent what the hospital billed for the case. For each hospital, a hospital-wide cost-to-charge ratio is used because detailed charges are not available across all HCUP States. Hospital charges reflect the amount the hospital charged for the entire hospital stay and does not include professional (physician) fees. For the purposes of this Statistical Brief, costs are reported to the nearest hundreds.

Payer

Payer is the expected primary payer for the hospital stay. To make coding uniform across all HCUP data sources, payer combines detailed categories into more general groups:

- Medicare includes fee-for-service and managed care Medicare patients.
- Medicaid includes fee-for-service and managed care Medicaid patients. Patients covered by the State Children's Health Insurance Program (SCHIP) may be included here. Because most state data do not identify SCHIP patients specifically, it is not possible to present this information separately.
- Private insurance includes Blue Cross, commercial carriers, and private HMOs and PPOs.
- Other includes Worker's Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs.
- Uninsured includes an insurance status of "self-pay" and "no charge."

When more than one payer is listed for a hospital discharge, the first-listed payer is used.

Admission source

Admission source indicates where the patient was located prior to admission to the hospital. Emergency admission indicates the patient was admitted to the hospital through the emergency department.

³ HCUP Cost-to-Charge Ratio Files (CCR). Healthcare Cost and Utilization Project (HCUP). 2001–2003. U.S. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp.

Median community-level income

Median community-level income is the median household income of the patient's ZIP Code of residence. The income value is missing for homeless and foreign patients.

About HCUP

HCUP is a family of powerful health care databases, software tools, and products for advancing research. Sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP includes the largest all-payer encounter-level collection of longitudinal health care data (inpatient, ambulatory surgery, and emergency department) in the United States, beginning in 1988. HCUP is a Federal-State-Industry Partnership that brings together the data collection efforts of many organizations—such as State data organizations, hospital associations, private data organizations, and the Federal government—to create a national information resource.

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Arizona Department of Health Services
Arkansas Department of Health & Human Services
California Office of Statewide Health Planning & Development
Colorado Hospital Association
Connecticut Integrated Health Information (Chime, Inc.)
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Health Care Cost Containment Council and Department of Public Health
Indiana Hospital & Health Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Maryland Health Services Cost Review Commission
Massachusetts Division of Health Care Finance and Policy
Michigan Health & Hospital Association
Minnesota Hospital Association
Missouri Hospital Industry Data Institute
Nebraska Hospital Association
Nevada Division of Health Care Financing and Policy, Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health & Senior Services
New York State Department of Health
North Carolina Department of Health and Human Services
Ohio Hospital Association
Oklahoma Health Care Information Center for Health Statistics
Oregon Association of Hospitals and Health Systems
Rhode Island Department of Health
South Carolina State Budget & Control Board
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Health Care Authority
Wisconsin Department of Health & Family Services

About the NIS

The HCUP Nationwide Inpatient Sample (NIS) is a nationwide database of hospital inpatient stays. The NIS is nationally representative of all community hospitals (i.e., short-term, non-Federal, non-rehabilitation hospitals). The NIS is a sample of hospitals and includes all patients from each hospital, regardless of payer. It is drawn from a sampling frame that contains hospitals comprising about 90 percent of all discharges in the United States. The vast size of the NIS allows the study of topics at both the national and regional levels for specific subgroups of patients. In addition, NIS data are standardized across years to facilitate ease of use.

About HCUPnet

HCUPnet is an online query system that offers instant access to the largest set of all-payer health care databases that are publicly available. HCUPnet has an easy step-by-step query system, allowing for tables and graphs to be generated on national and regional statistics, as well as trends for community hospitals in the U.S. HCUPnet generates statistics using data from HCUP's Nationwide Inpatient Sample (NIS), the Kids' Inpatient Database (KID), the State Inpatient Databases (SID) and the State Emergency Department Databases (SEDD).

For More Information

For more information about HCUP, visit www.hcup-us.ahrq.gov.

For additional HCUP statistics, visit HCUPnet, our interactive query system, at www.hcup.ahrq.gov.

For information on other hospitalizations in the U.S., download *HCUP Facts and Figures: Statistics on Hospital-based Care in the United States in 2005*, located at <http://www.hcup-us.ahrq.gov/reports.jsp>.

For a detailed description of HCUP, more information on the design of the NIS, and methods to calculate estimates, please refer to the following publications:

Steiner, C., Elixhauser, A., Schnaier, J. The Healthcare Cost and Utilization Project: An Overview. *Effective Clinical Practice* 5(3):143–51, 2002.

Design of the HCUP Nationwide Inpatient Sample, 2005. Online. June 13, 2007. U.S. Agency for Healthcare Research and Quality.

http://www.hcup-us.ahrq.gov/db/nation/nis/reports/NIS_2005_Design_Report.pdf

Houchens, R., Elixhauser, A. *Final Report on Calculating Nationwide Inpatient Sample (NIS) Variances, 2001*. HCUP Methods Series Report #2003-2. Online. June 2005 (revised June 6, 2005). U.S. Agency for Healthcare Research and Quality.

<http://www.hcup-us.ahrq.gov/reports/CalculatingNISVariances200106092005.pdf>

Houchens RL, Elixhauser A. *Using the HCUP Nationwide Inpatient Sample to Estimate Trends. (Updated for 1988-2004)*. HCUP Methods Series Report #2006-05 Online. August 18, 2006. U.S. Agency for Healthcare Research and Quality.

http://www.hcup-us.ahrq.gov/reports/2006_05_NISTrendsReport_1988-2004.pdf

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AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of health care in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please e-mail us at hcp@ahrq.gov or send a letter to the address below:

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Rockville, MD 20850

Table 1. Overview of hospital stays resulting from exposure to excessive heat and cold due to weather conditions, 2005

	Heat-related stays*	Cold-related stays*	Stays not related to heat or cold
Number of stays	6,200	6,500	39.1 million
Mean length of stay	3.2	6.7	4.6
Aggregate costs	\$38.7 million	\$81.5 million	\$315.8 billion
Cost per stay	\$6,200	\$12,500	\$8,100
Cost per day	\$1,900	\$1,900	\$1,800
Mean age	54 years	59 years	47 years
Percent admitted from the ED	81.6	77.6	42.5
Percent died at the hospital	2.9	10.5	2.1
<i>Rates per 100,000 population</i>			
<i>Age</i>			
0-17 years	0.4	0.5	9,568.3
18-44 years	1.6	1.3	8,855.9
45-64 years	2.6	2.7	11,883.4
65+ years	6.0	7.6	36,342.8
<i>Gender</i>			
Females	1.1	1.8	10,656.6
Males	3.2	2.6	15,737.9
<i>Region</i>			
Northeast	1.7	3.7	14,154.9
Midwest	1.4	2.2	13,687.7
South	3.1	1.6	14,018.9
West	1.4	1.9	10,888.8

*Excessive heat and cold exposure due to weather conditions were identified by all-listed ICD-9-CM external cause of injury codes (E codes).

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample (NIS), 2005.

Table 2. Top 5 most common reasons for hospital stays related to excessive heat exposure due to weather conditions, 2005

Rank	Principal CCS diagnosis	Number of stays for this condition (percentage of all weather-related heat stays)
1	Other injuries and conditions due to external causes*	3,633 (58.6)
	Heat exhaustion	2,050
	Heat stroke and sun stroke	1,159
	Heat collapse	232
2	Fluid and electrolyte disorders	484 (7.8)
3	Acute and unspecified renal failure	394 (6.4)
4	Syncope (fainting)	212 (3.4)
5	Peripheral and visceral atherosclerosis (hardening of the arteries)	131 (2.1)

*This CCS category includes a mix of several diagnoses. The diagnoses that appear most often in heat-related stays are noted.

Note: Excessive exposure to heat due to weather conditions were identified by all-listed ICD-9-CM external cause of injury codes (E codes).

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample (NIS), 2005.

Table 3. Top 5 most common reasons for hospital stays related to excessive cold exposure due to weather conditions, 2005

Rank	Principal CCS diagnosis	Number of stays for this condition (percentage of all weather-related cold stays)
1	Other injuries and conditions due to external causes*	2,218 (34.0)
	Hypothermia	1,351
	Frostbite	757
2	Septicemia (except in labor)	445 (6.8)
3	Diabetes mellitus with complications	420 (6.4)
4	Pneumonia (except that caused by tuberculosis and sexually transmitted diseases)	179 (2.7)
5	Fluid and electrolyte disorders	172 (2.6)

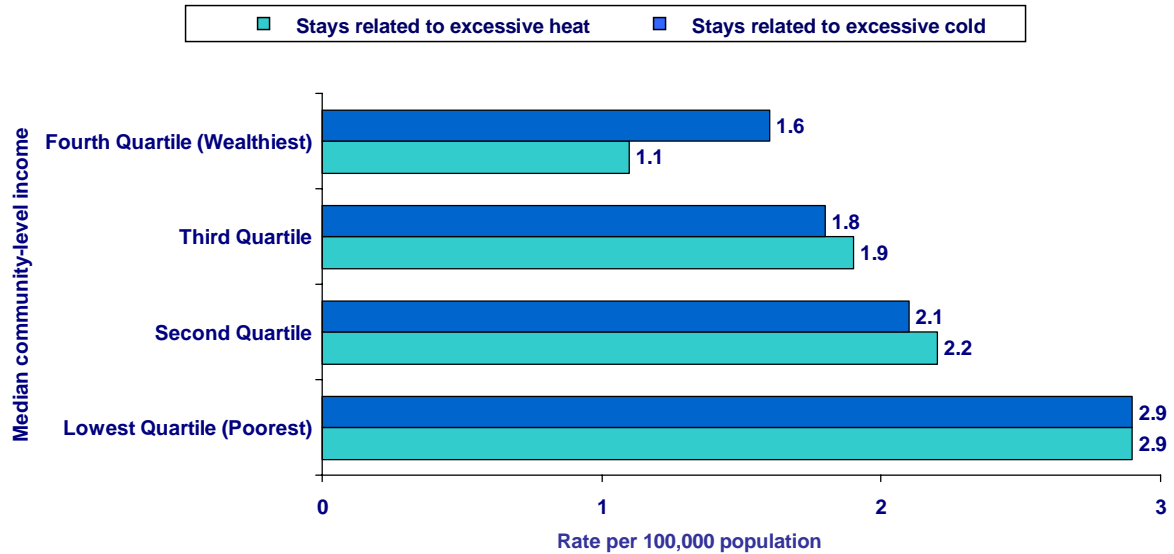
*This CCS category includes a mix of several diagnoses. The diagnoses that appear most often in cold-related stays are noted.

Note: Excessive exposure to cold due to weather conditions were identified by all-listed ICD-9-CM external cause of injury codes (E codes).

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample (NIS), 2005.



Figure 1. Rate of hospital stays resulting from exposure to excessive heat or cold due to weather conditions were more common in poor communities, 2005*



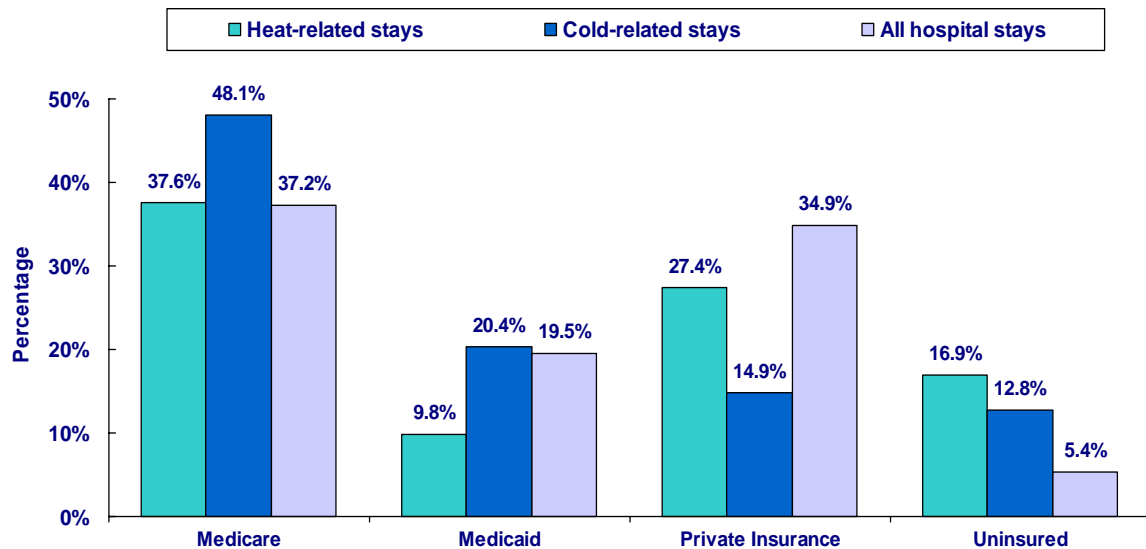
*Based on all-listed ICD-9-CM external cause of injury codes (E codes).

Note: The denominator for the rates was derived from 2005 Clarita's Population Data.

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2005.



Figure 2. Disproportionately more hospital stays caused by excessive heat or cold exposure due to weather conditions were uninsured compared to all hospital stays, 2005*

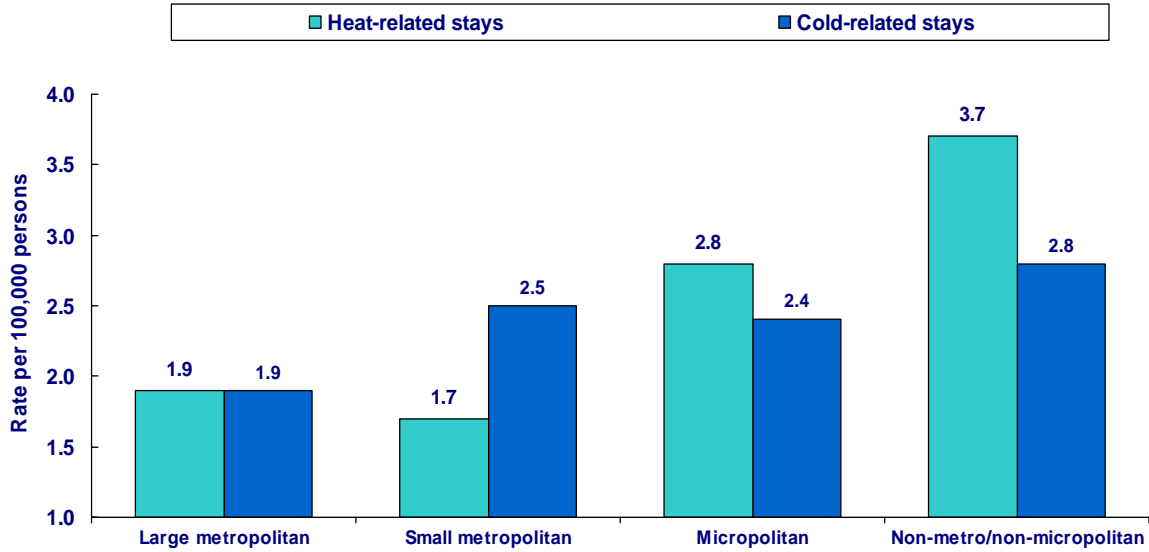


*Based on all-listed ICD-9-CM external cause of injury codes (E codes).

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2005.



Figure 3. Rate of hospital stays caused by exposure to excessive heat or cold due to weather conditions were greater in rural areas compared to metropolitan areas, 2005*



*Based on all-listed ICD-9-CM external cause of injury codes (E codes).

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 2005.