

## New Mexico Heat Stress Surveillance 2008-2010

Over the last 50 years (1960-2010), maximum daily temperatures in New Mexico increased. State land weather station data analysis using time series models reveal that high temperatures increased 0.08° F each year during this period, for a total increase of 4° F.

This trend of increasing temperature is likely to continue, based on projections of the future climate of New Mexico derived from global and regional climate models data with the assumption that global anthropogenic emissions of greenhouse gases will continue to increase<sup>1-4</sup>. Specifically, these climate models project the following substantial changes in New Mexico's climate over the next fifty to one hundred years<sup>3, 5-7</sup>: a) average air temperature will become substantially warmer by 6-12°F (3.3-6.7°C), b) there will be more episodes of extreme heat, heat waves and fewer episodes of extreme cold.

As temperatures increase, the public health concern is heat-related illness<sup>8, 9</sup>. Any individual, regardless of age, sex, or health status may develop heat-related illness if engaged in intense physical activity and/or exposed to environmental heat, even in the dry environmental conditions of New Mexico. Physiologic mechanisms maintain core body temperature in the narrow optimum range around 37° C (98.6° F).<sup>9</sup> The normal physiologic response to rising core body temperature is to sweat and circulate blood closer to the skin's surface to increase the cooling. When heat exposure exceeds the physiologic capacity to cool and the core body temperature continues to rise, a range of heat-related adverse health effects can result.

Although some of these signs and symptoms, such as heat-related cramps, syncope, and edema are relatively minor and readily treatable, they should be used as warning signs to immediately remove the affected individual from the exposure. Other conditions such as heat exhaustion may progress to heat stroke, the most serious form of heat-related disease, which if untreated

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can result in death or permanent neurological impairment.

The New Mexico Environmental Public Health Tracking Network (NMEPHTN) develops, monitors and analyzes indicators of heat stress to help document changes in morbidity and mortality over place and time due to heat, monitor vulnerable areas and New Mexico communities, and to inform and evaluate the results of local climate-adaptation strategies and perhaps, extreme heat warning systems, once those become implemented. One of the heat stress morbidity indicators that is tracked are emergency department (ED) visits for heat stress. This report provides results from a regional analysis of ED visits for heat stress among residents who were seen at acute care non-federal hospital facilities during 2008-2010.

### Methods

NMEPHTN defines heat stress as a constellation of explicit effects of hot weather on the body, including heat stroke and sunstroke (hyperthermia), heat syncope or collapse, heat exhaustion, heat cramps, heat fatigue, heat edema, and other unspecified clinical effects attributed to excessive heat exposure. Cases of heat stress are classified as any diagnosis included in the range of the International Classification of Diseases, 9th edition, Clinical Modification (ICD-9-CM) 992.0-992.9 or cause of injury code in the range E900.0 or E900.9. However, cases with a code of E900.1 (man-made source of heat) anywhere in the patient medical record are excluded.

ED visit data for heat stress were collected for 2008-2010 by the NMDOH's Epidemiology and Response Division (ERD) from individual non-federal licensed

facilities in the state in response to a letter requesting provision of the data annually. In New Mexico, ED visit reporting to the ERD is required under 7.4.3.10 of the New Mexico Administrative Code (NMAC) for notifiable diseases or conditions, as of 04/30/2009.

Three morbidity measures of ED visits as heat stress indicators are being tracked: the number, crude rate per 100,000 population, and age-adjusted rate of visits for heat stress per 100,000 population. Population estimates were provided by the Bureau of Business and Economic Research at the University of New Mexico. Age-adjusted rates were calculated using the direct method for age-adjustment to the U.S. 2000 standard population. Analysis of fewer than 25 cases used the indirect method of age adjustment.

These measures were analyzed by New Mexico health regions, as defined in July 2012, to identify New Mexico geographic regions' vulnerabilities. In order to link temperature to health outcomes, these geographic regions were also characterized by the daily estimates of maximum temperature for summer months (May-September).

## Results

Thirty-six acute care non-federal hospital facilities in New Mexico reported data to NMDOH for the years 2008-2010. During this period there were 526 heat-stress ED visits among New Mexico residents. Overall, June and July were the months with the highest burden of heat stress visits. By health region, the Southeast and Southwest had the highest rate of ED visits (Table, Figure). There were low rates of ED visits across health regions from October through April.

The 30-year (1971-2000) 95<sup>th</sup> percentile daily maximum temperature was highest for the Southeast and Southwest (105<sup>o</sup> F and 103<sup>o</sup> F, respectively). The 95<sup>th</sup> percentile daily maximum temperature for the Northwest and Metro was 98<sup>o</sup> and for the Northeast was 99<sup>o</sup> F.

Analysis of the age-adjusted rates of ED visits for heat stress during the hottest months (i.e., May-September) suggests that New Mexico males may be more likely to be treated in EDs for heat stress than females. This sex difference is statistically significant only among residents of the Southeastern Region as compared to other regions of New Mexico.

Statistically significant differences between age groups do not occur between regions, but do occur within the Southeastern Region. Middle age residents (15-44 and 45-64 age groups) in the Southeast had a higher rate of ED heat stress during May-September 2008-2010 than those under age 15 in the same region, for example (Table).

## Discussion

Analyses indicate that in New Mexico, the highest burden of ED heat stress rates occurs: a) at temperatures at or above the 30-year 95<sup>th</sup> percentile thresholds predominately in the months of June and July and b) especially, in the health regions with the highest maximum daily temperatures (Southeast and Southwest). While there is a statistically significant difference in the ED rates between males and females in the Southeast, it is not clear why this might occur in this region and not others. There is no consistent pattern between heat stress and age group across regions.

**Table. Crude Rate of Emergency Department Visits for Heat Stress per 100,000 Population by Age-groups and New Mexico Health Region, May-September 2008-2010**

2012 New Mexico Health Region	Crude Rate per 100,000 population and 95% Confidence Intervals (LL-UL)				
	0-14	15-44	45-64	65+	Total (All Ages)
Northwest	3.6 (0.7 - 6.5) <sup>†</sup>	7.2 (4.0 - 10.3)	6.0 (2.3 - 9.8) <sup>†</sup>	5.6 (0.1 - 11.0) <sup>†</sup>	5.9 (4.0 - 7.7)
Northeast	5.0 (1.6 - 8.6) <sup>†</sup>	9.3 (5.9 - 12.7)	6.6 (3.6 - 9.6)	8.2 (3.4 - 13.1) <sup>†</sup>	7.5 (5.7 - 9.4)
Metro	5.0 (3.1 - 8.2)	6.7 (5.2 - 8.3)	4.8 (3.2 - 6.4)	5.3 (2.8 - 7.8)	5.7 (4.8 - 6.6)
Southeast	5.7 (2.4 - 9.1) <sup>†</sup>	14.8 (10.6 - 18.9)	15.3 (10.0-20.6)	13.9 (7.1-20.7)	12.8 (10.4 - 15.2)
Southwest	5.6 (2.6-8.7)	11.0 (7.8-14.1)	6.7 (3.6-9.8)	14.3 (8.5-20.1)	9.3 (7.5-11.1)
New Mexico	5.0 (3.8 - 6.3)	9.0 (7.8 - 10.2)	6.9 (5.6 - 8.2)	8.9 (6.8 -10.9)	7.6 (6.9 - 8.3)

<sup>†</sup> This count or rate is statistically unstable (RSE >0.30), and may fluctuate widely across time periods due to random variation (chance).

Because heat stroke, even if treated, can result in up to 17% of heat stroke survivors suffering permanent neurologic damage and death rates as high as 33%,<sup>8,10</sup> measures should be taken to prevent heat-related illness, especially among vulnerable populations<sup>11</sup>. These populations may include individuals with pre-existing chronic diseases or conditions such as cardiovascular disease, diabetes, obesity, which make individuals more susceptible to the effects of heat than healthy individuals<sup>12</sup>.

Medical providers should anticipate heat stress encounters at or above these thresholds, most likely during the months of May-September. Should temperature trends continue, there is likely to be an increase in ED visits.

There are a number of caveats to this analysis. First, due to incomplete e-coding, there may be an underestimation of ED visits due to heat stress. Second, data were submitted by individual hospital EDs which have varied systems, databases, and capacities to extract data and file formats that are produced.

### Recommendations

Given the results of these analyses, residents of the Southeast and Southwest regions of the state may not be fully aware of the high risk of heat stress, especially in June and July; therefore, increased education and outreach efforts are warranted among residents of those communities. Additionally, adaptation strategies (such as cooling centers) and extreme heat warning systems sensitive to regional characteristics (e.g. wind and humidity) may need to be developed and implemented to prevent morbidity. Finally, the NMDOH should continue to explore the variables, that when combined, are more predictive of heat events than temperature alone. These variables may include wind, humidity, and local geography (streams, lakes, etc.).

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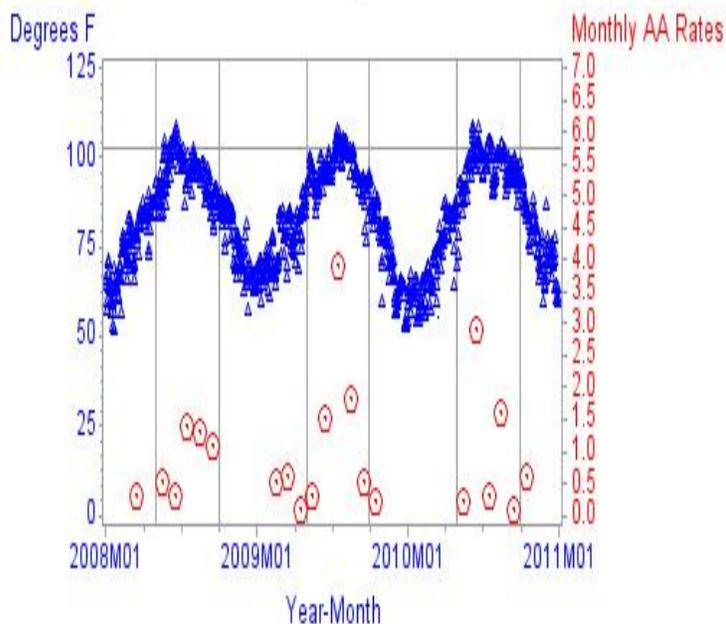
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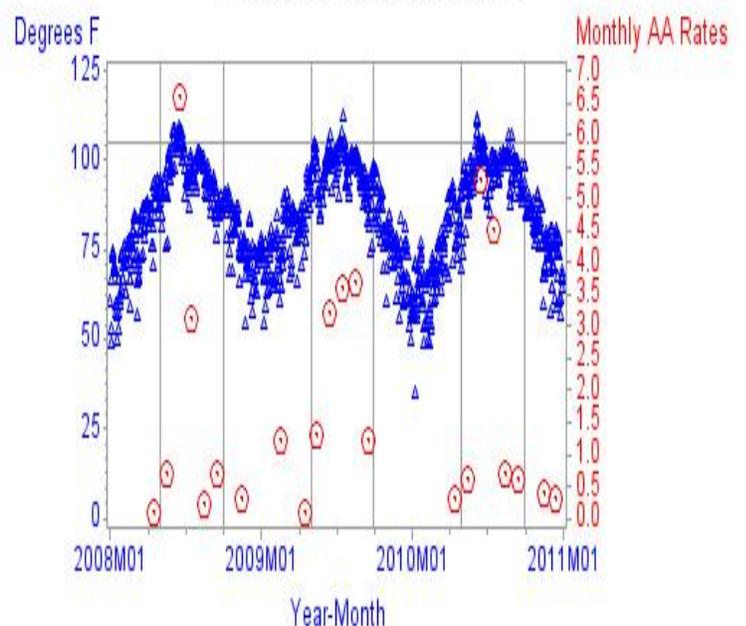
**Figure. Daily Maximum Surface Temperatures and Monthly Age-Adjusted (AA) Heat Stress Emergency Department Visit Rates per 100,000 Population for Southern New Mexico Health Regions, 2008-2010**

**Monthly Age-Adjusted Heat Stress ED Visit Rates, 2008-2010  
and Daily Maximum Temperature  
Southwest Region New Mexico**



Horizontal reference line is at 103 F, 30 year 95th percentile heat event threshold.  
Vertical reference lines mark May-September periods each year.

**Monthly Age-Adjusted Heat Stress ED Visit Rates, 2008-2010  
and Daily Maximum Temperature  
Southeast Region New Mexico**



Horizontal reference line is at 105 F, 30 year 95th percentile heat event threshold.  
Vertical reference lines mark May-September periods each year.