



Heat Morbidity Surveillance Using Hospital Discharge Data

2013 Data

Maricopa County Department of Public Health

Division of Disease Control

Office of Epidemiology

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Table of Contents

Background.....	3
<i>Heat Morbidity Surveillance</i>	3
<i>Hospital Discharge Data</i>	3
Methodology.....	3
Results.....	4
<i>Introduction</i>	4
Graph 1. Multi-year Total Heat Related Illness, Maricopa County, 2008-2013.....	4
Graph 2. Heat Related Illness by Month, Maricopa County, 2013.....	6
Graph 3. Heat Related Illness by Age Group and Visit Type, Maricopa County, 2013.....	6
<i>Demographics</i>	8
Graph 4. Heat Related Illness by Gender, Maricopa County, 2013.....	8
Graph 5. Rate of Heat Related Illness by Gender, Maricopa County, 2013.....	7
Graph 6. Rate of Heat Related Illness by Age Group, Maricopa County, 2013.....	9
Graph 7. Heat Related Illness by Age Group and Gender, Maricopa County, 2013.....	11
Graph 8. Heat Related Illness by Race/Ethnicity, Maricopa County, 2013.....	11
Graph 9. Rate of Heat Related Illness by Race/Ethnicity, Maricopa County, 2013.....	11
Graph 10. Heat Related Illness by Activity Type,, Maricopa County, 2013.....	12
<i>Trends</i>	13
Graph 11. Heat Related Illness by Place of Injury, Maricopa County, 2013.....	13
Graph 12. Heat Related Illness by Visit Type, Maricopa County, 2013.....	14
Graph 13. Heat Related Illness by Inpatient Length of Stay, Maricopa County, 2013.....	14
Graph 14. Heat Related Illness by Discharge Status, Maricopa County, 2013.....	15
Graph 15. Heat Related Illness by Insurance Type, Maricopa County, 2013.....	15
Graph 16. Insurance Type by Age Group, Maricopa County, 2013.....	16
Graph 17. Insurance Type by Race, Maricopa County, 2013.....	17
Limitations.....	17
Conclusions and Next Steps.....	18
APPENDIX.....	19
<i>2013 Tables</i>	19
Table 1. Heat Related Illness by Month and Visit Type, Maricopa County, 2013.....	20
Table 2. Heat Related Illness by Age Group and Month, Maricopa County, 2013.....	21
Table 3. Heat Related Illness by Gender and Visit Type, Maricopa County, 2013.....	21
Table 4. Heated Related Illness by Age, Gender, and Visit Type, Maricopa County, 2013.....	21
Table 5. Heat Related Illness by Age Group and Visit Type, Maricopa County, 2013.....	22
Table 6. Heat Related Illness by Race/Ethnicity and Visit Type, Maricopa County, 2013.....	22
Table 7. Heat Related Illness by Activity Type and Visit Type, Maricopa County, 2013.....	23
Table 8. Heat Related Illness by Source of Admission and Visit Type, Maricopa County, 2013.....	24
Table 9. Heat Related Illness by Length of Stay, Maricopa County, 2013.....	24
Table 10. Heat Related Illness by Discharge Status and Visit Type, Maricopa County, 2013.....	25

Background

Throughout the year, Maricopa County experiences extremely hot temperatures that can have a negative impact on the health of its residents and visitors. Due to the extreme temperatures, the Maricopa County Department of Public Health (MCDPH) Office of Epidemiology has been using surveillance practices to track climatological data and heat-associated deaths in the county to gain a better understanding of the full impact.

Beginning in 2012, the Office of Epidemiology expanded these efforts to include heat-related illness (HRI) surveillance which will assist in improving the Department's response to the chronic environmental heat experienced in Maricopa County. Additionally, by expanding the heat surveillance system, opportunities to learn more about the effects of heat in Maricopa County and ways to best use heat surveillance will become more evident.

Methodology

Hospital discharge data (HDD) contains emergency department (ED) and inpatient (IP) hospital visits for all non-federal (Veteran's Affairs, Indian Health Service) hospitals in Maricopa County. Heat related illness visits were identified using selected International Classification of Diseases-9th Revision (ICD-9) codes. Selection of ICD-9 codes was made using a combination of literature review searches of other heat morbidity surveillance systems along with the definition provided by the Council of State and Territorial Epidemiologists (CSTE) for hospitalizations due to heat. Selected visits were then put into four categories according to the following criteria:

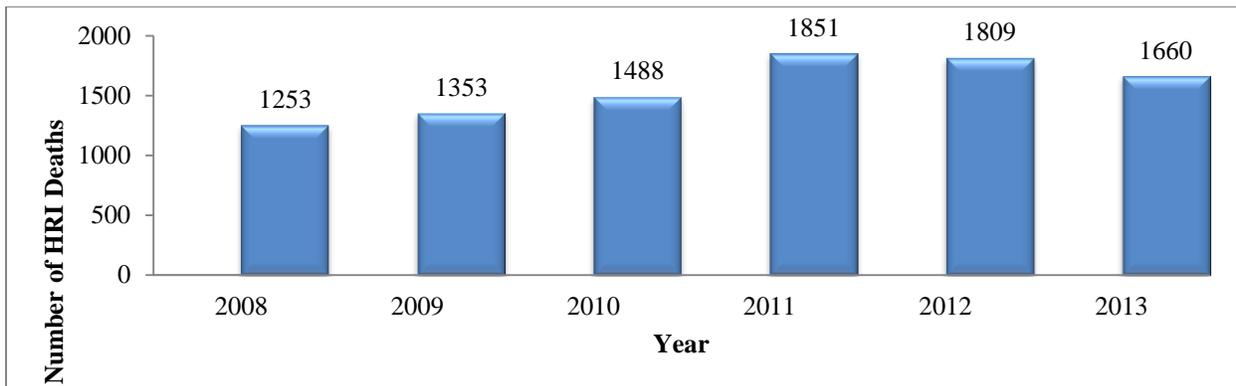
- **Heat Related Illness:** the presence of one or more of the inclusion ICD-9 codes listed in any of the diagnosis or injury variables in the HDD.
 - The SAS program scans a record to see if it contains a code for a primary diagnosis (DX) of heat. If it does, the record is coded as having a primary DX heat. If not, the program will then scan the record to see if any of the 24 secondary codes are heat related. If yes, then the person is coded as having a secondary diagnosis of heat related illness. If not, the program then checks the 6 injury codes to see if the record was coded as having a heat related injury and if yes, the person is coded as having a heat related illness. If no, the record is coded as not having any type of heat related illness and is dropped from analysis.
- **Primary DX Heat:** Cases where the primary reason for hospitalization or emergency department (ED) visit is heat related.
- **Secondary DX Heat:** Cases where heat is listed as one of the up to 24 secondary causes for hospitalization or ED visit.
- **Heat Injury:** Heat is mentioned as the cause of injury for the hospitalized person. There are up to 6 injury diagnoses per record in addition to the primary diagnosis.

Results

All results represent occurrences of heat related illness in Maricopa County hospitals (n=1,660); many of these individuals are non-residents of Maricopa County. However, rates were calculated using Maricopa County residents only and exclude any out of jurisdiction cases or cases with unknown county of residence.

Introduction

Graph 1. Total number of heat related illnesses by year (n=9,414), Maricopa County, 2008-2013



The number of heat related illnesses increased steadily from 2008-2013, with the highest percentage of heat related illnesses occurring in 2011 (20%).

Table 1. Total Number of In-Patient visits and Emergency Department Visits by Year, Maricopa County, 2008-2013

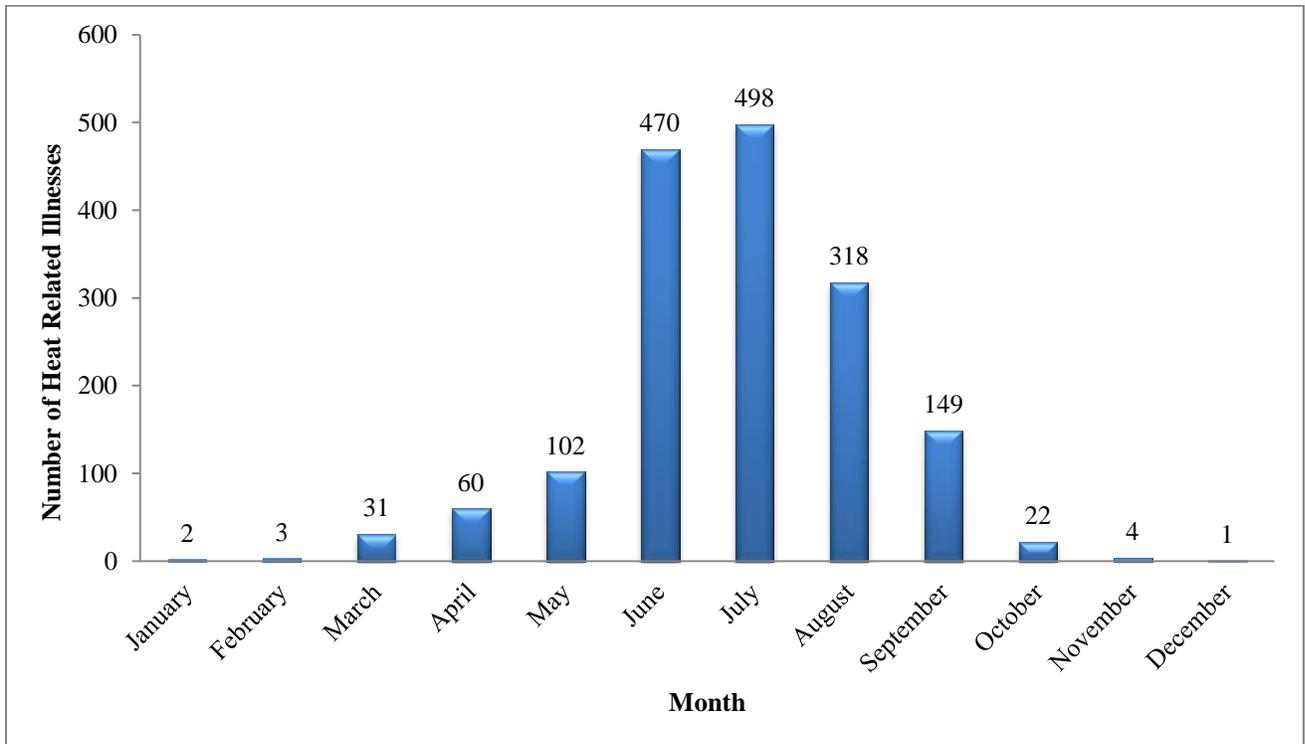
Year	In-Patient (n=2,071)	Emergency Department (n=7,343)	Total Visits
2008	238 (19%)	1,015 (81%)	1,253
2009	320 (24%)	1,033 (76%)	1,353
2010	352 (24%)	1,136 (76%)	1,488
2011	402 (22%)	1,449 (78%)	1,851
2012	393 (22%)	1,416 (78%)	1,809
2013	366 (22%)	1,294 (78%)	1,660

The percentage of in-patient visits slightly increased from 2008 to 2009, remains steady for 2009 to 2010, then slightly decreases, then remains steady for 2011 through 2013. The percentage of emergency

Heat Morbidity Surveillance

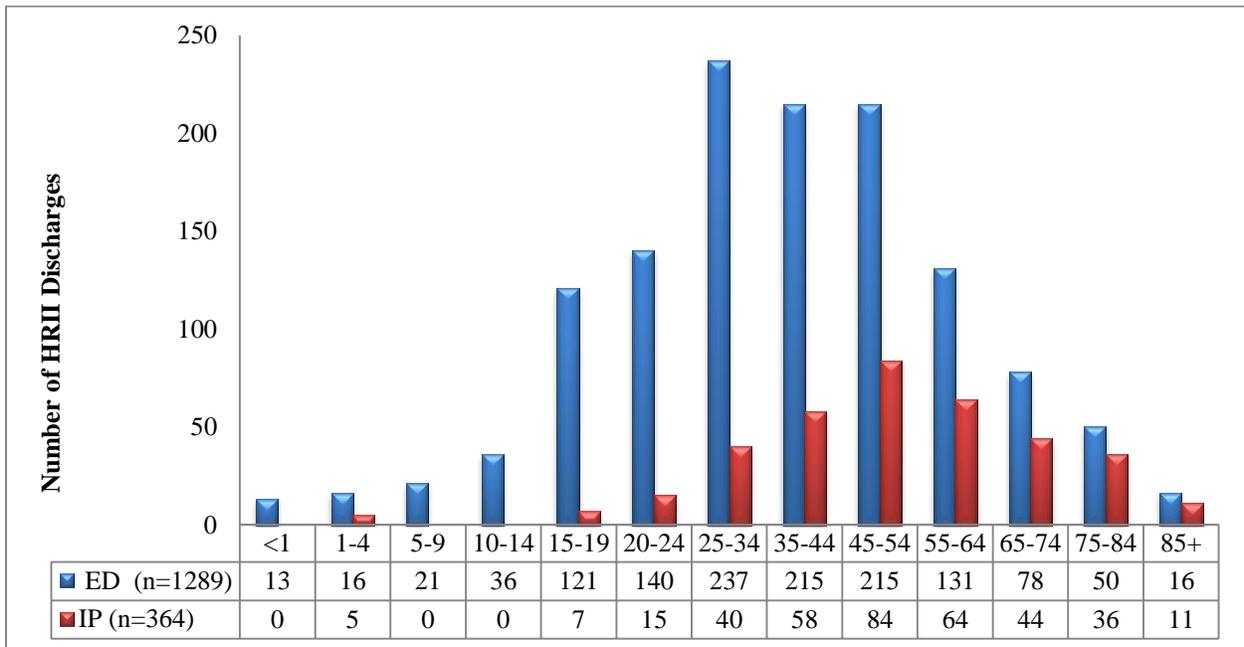
department visits slightly decreased from 2008 to 2009, and remained steady from 2009 to 2010. From 2010 to 2011 the percentage slightly increased, and then remained steady until 2013.

Graph 2. Heat related illness by month (n=1,660), Maricopa County, 2013



The number of heat related illnesses dramatically increased June through August, with the month of July experiencing the highest percent of heat related illnesses (30%).

Graph 3. Heat related illness by age group and visit type (n=1,653)*, Maricopa County, 2013

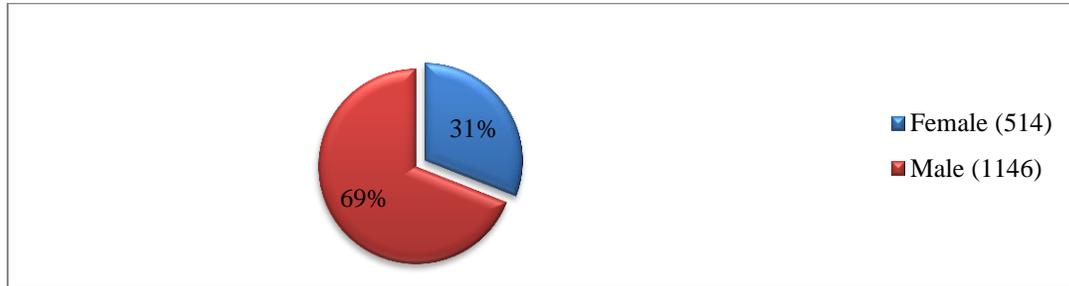


*Missing/unknown values were excluded from the total n value

Emergency department (ED) visits for heat related illness were consistently higher than in-patient (IP) visits, and account for 78% of total visits. Additionally, ED visits for heat related illnesses were consistently higher than IP visits, particularly, amongst those ages 25-34 (51%).

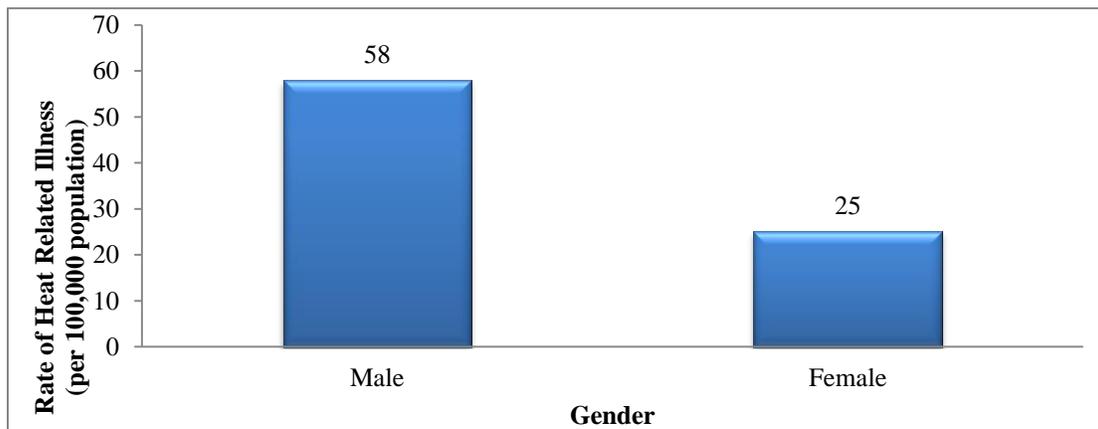
Demographics

Graph 4. Heat related illness by gender (n=1,660), Maricopa County, 2013



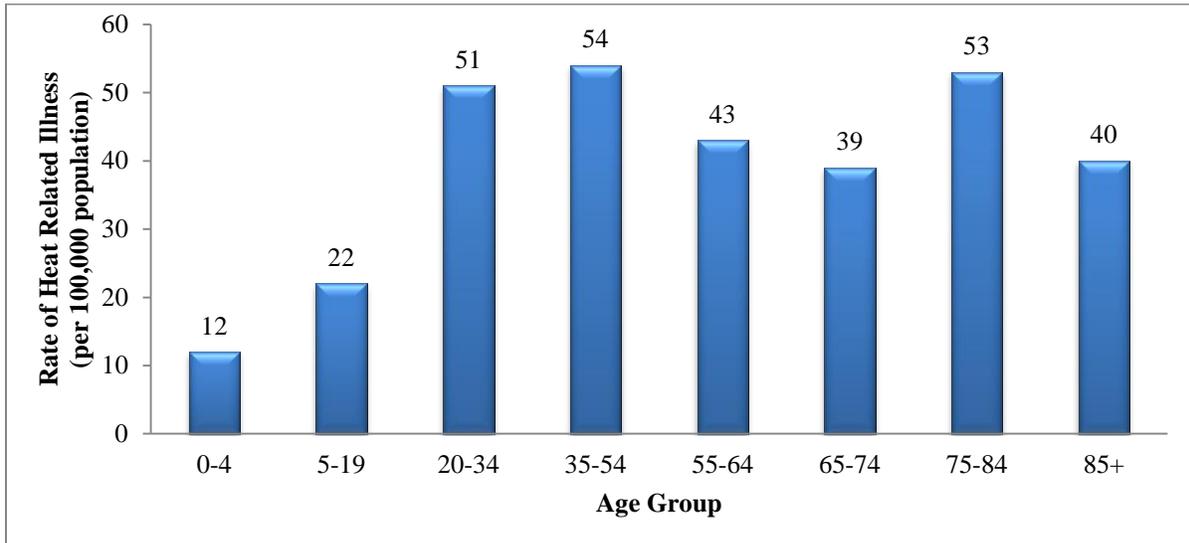
In 2013, heat related illnesses affected males more than females (69% vs. 31%).

Graph 5. Rate of heat related illness by gender (n=1,660), Maricopa County, 2013



In 2013, the rate of heat related illness was consistently higher in males (58.0) than females (25). This is consistent with the number of heat related illness shown in Graph 4.

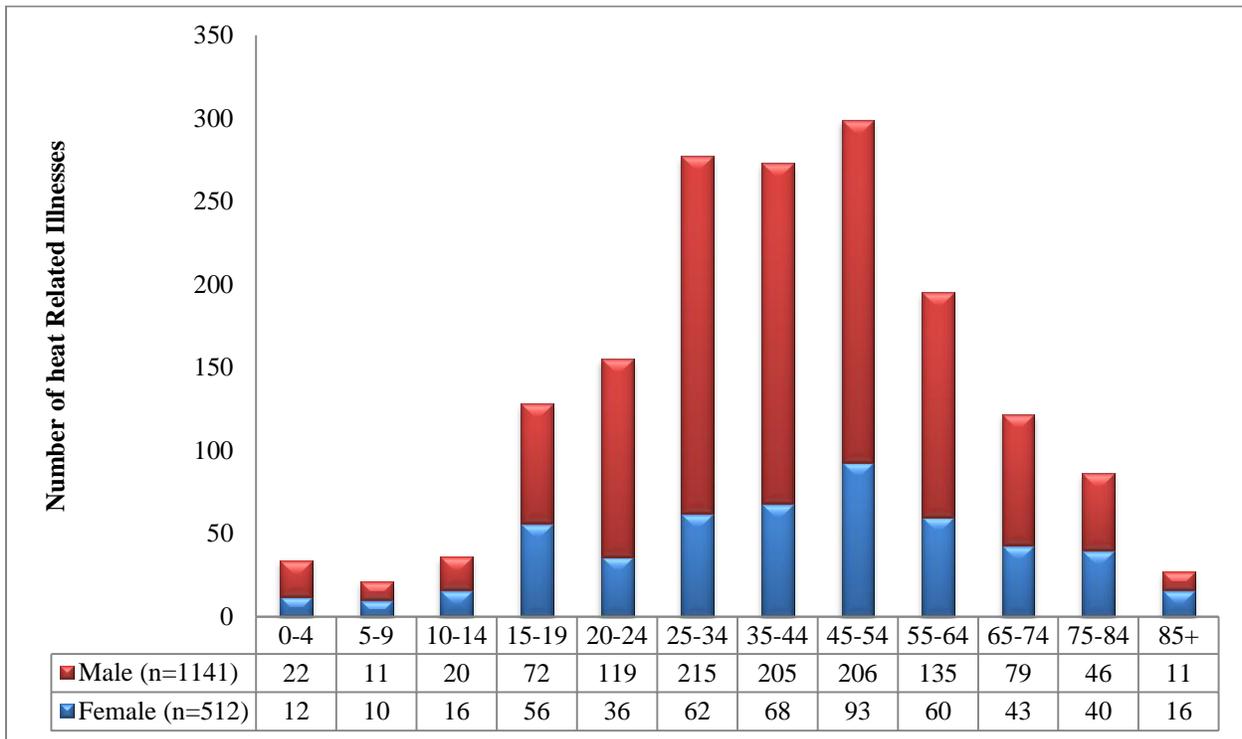
Graph 6. Rate of heat related illness by age group (n=1,653)*, Maricopa County, 2013



*Missing/unknown values were excluded from the total n value

In 2013, the rate of heat related illness was consistently higher between the ages of 20-64, with the rates being the highest amongst those ages 35-54.

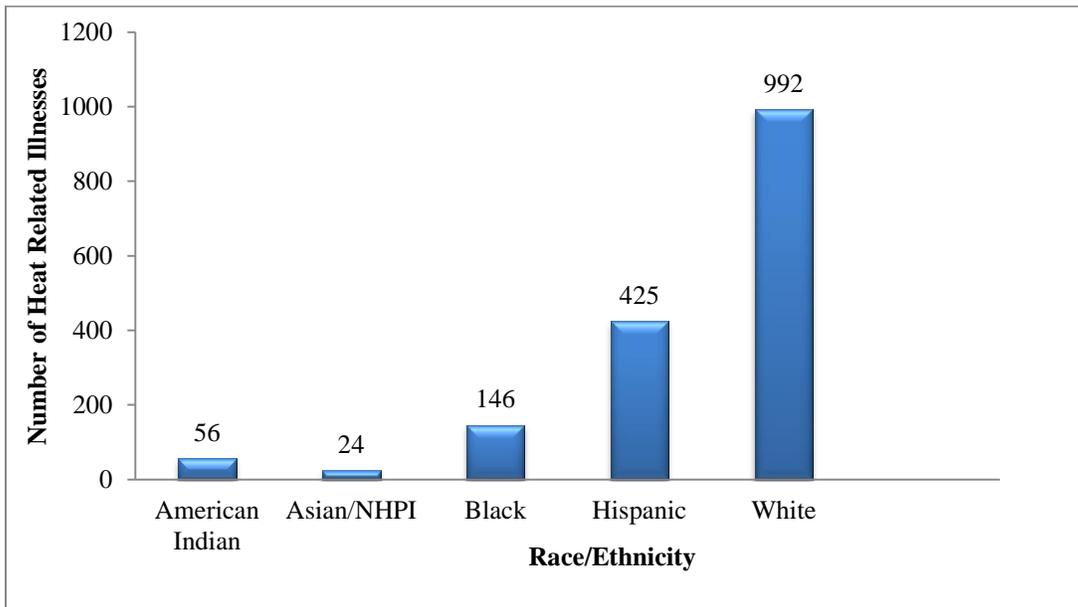
Graph 7. Heat related illness by age group and gender (n=1,653)*, Maricopa County, 2013



*Missing/unknown values were excluded from the total n value

Heat related illnesses were consistently higher among males (69%) than females, particularly for males ages 45-54.

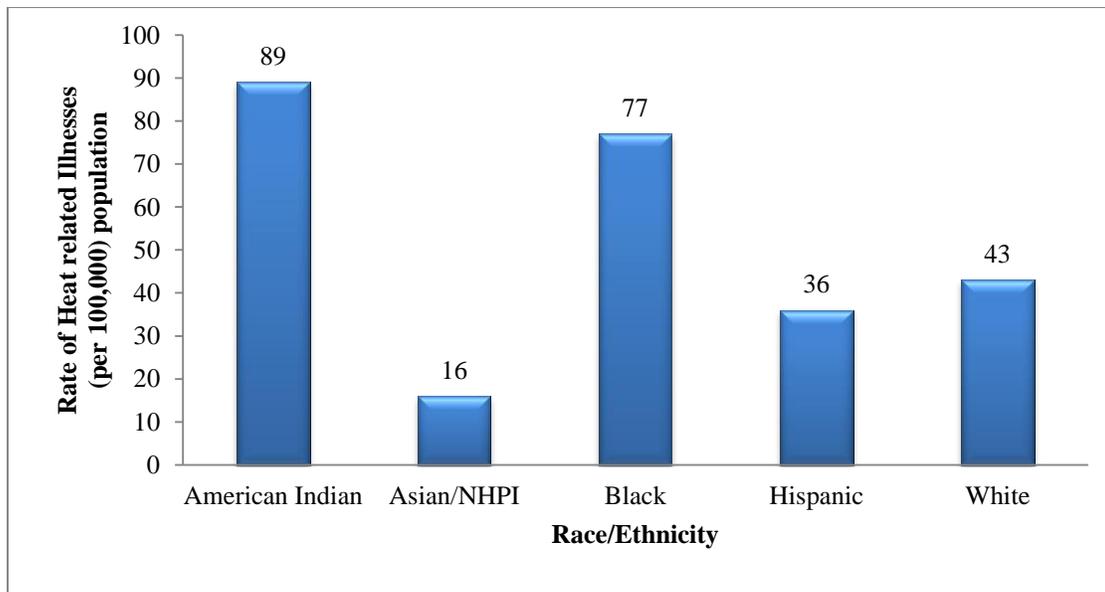
Graph 8. Heat related illness by race/ethnicity (n=1,643)*, Maricopa County, 2013



*Missing/unknown values were excluded from the total n value

In 2013, Whites had the highest percent of heat related illnesses at 60%, followed by Hispanics at 26%.

Graph 9. Rate of heat related illness by race/ethnicity (n=1,643)*, Maricopa County, 2013

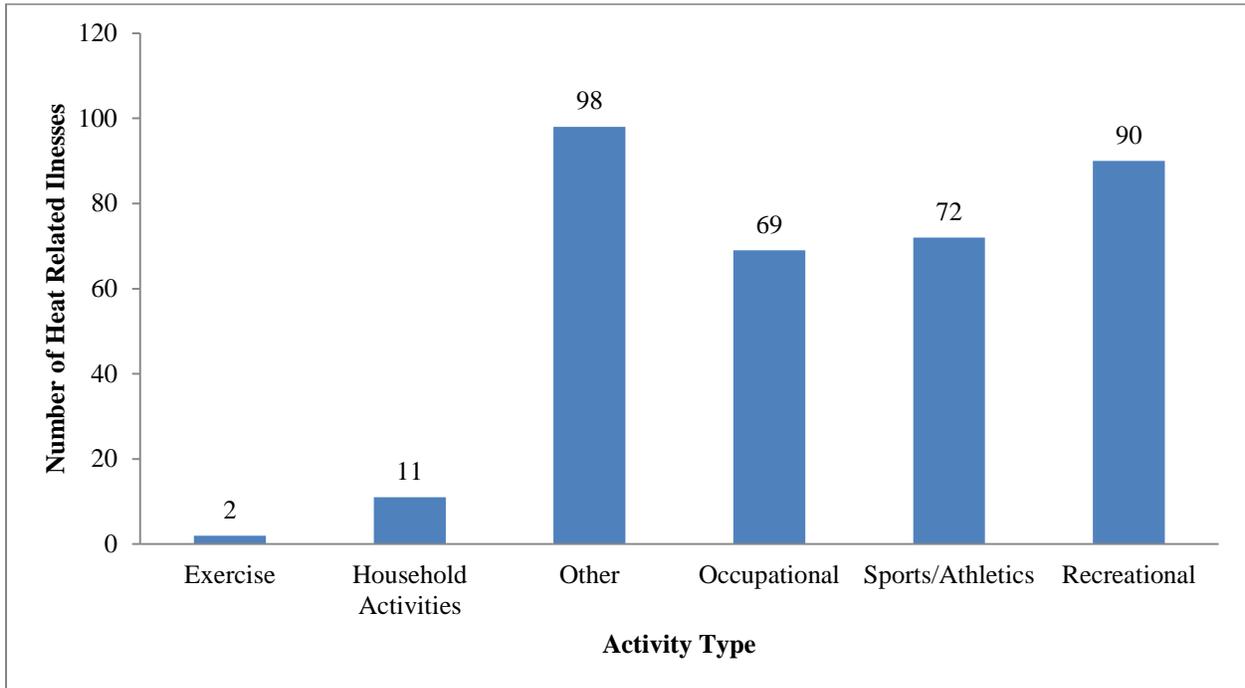


*Missing/unknown values were excluded from the total n value

While the total number of heat related illnesses was highest among Whites, the rate of incidence was highest amongst Blacks and American Indians.

Injury Characteristics

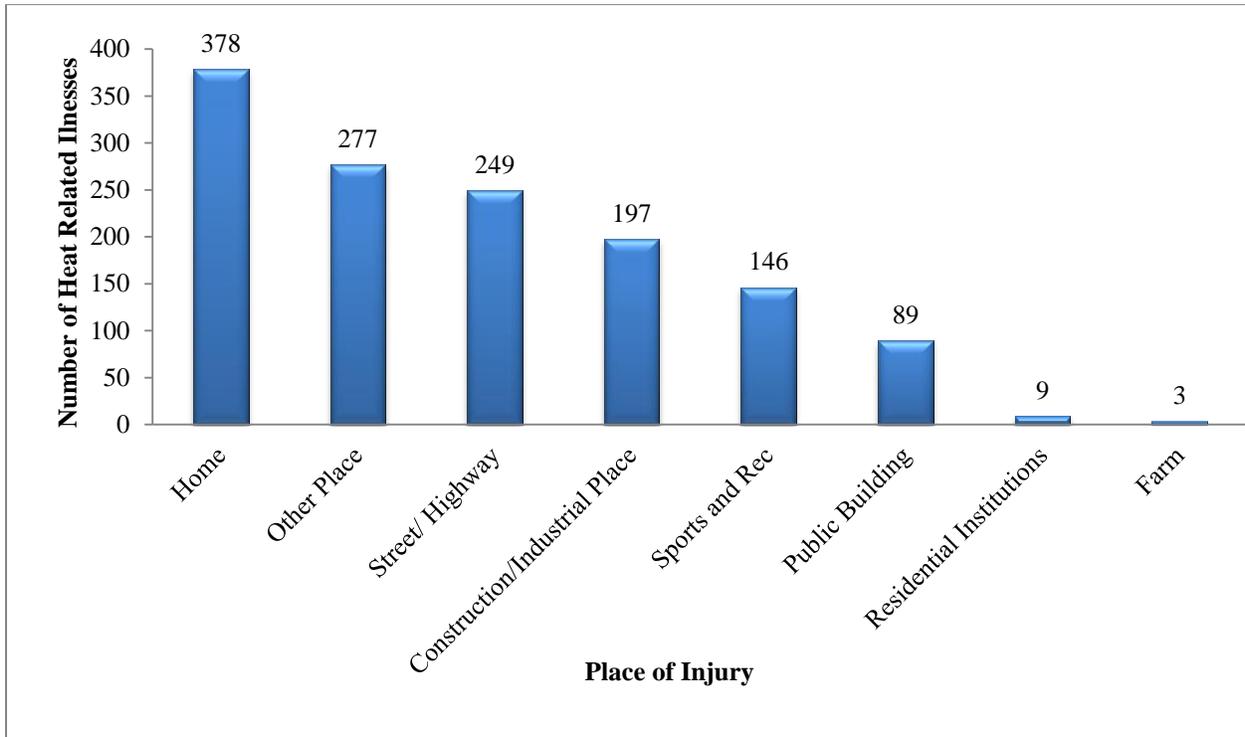
Graph 10. Heat related illness by activity type (n=342)*, Maricopa County, 2013



*Excludes 1403 cases where no activity was listed.

In 2013, heat related illnesses were highest among recreational activities (26%), followed by sport/athletic activities (21%).

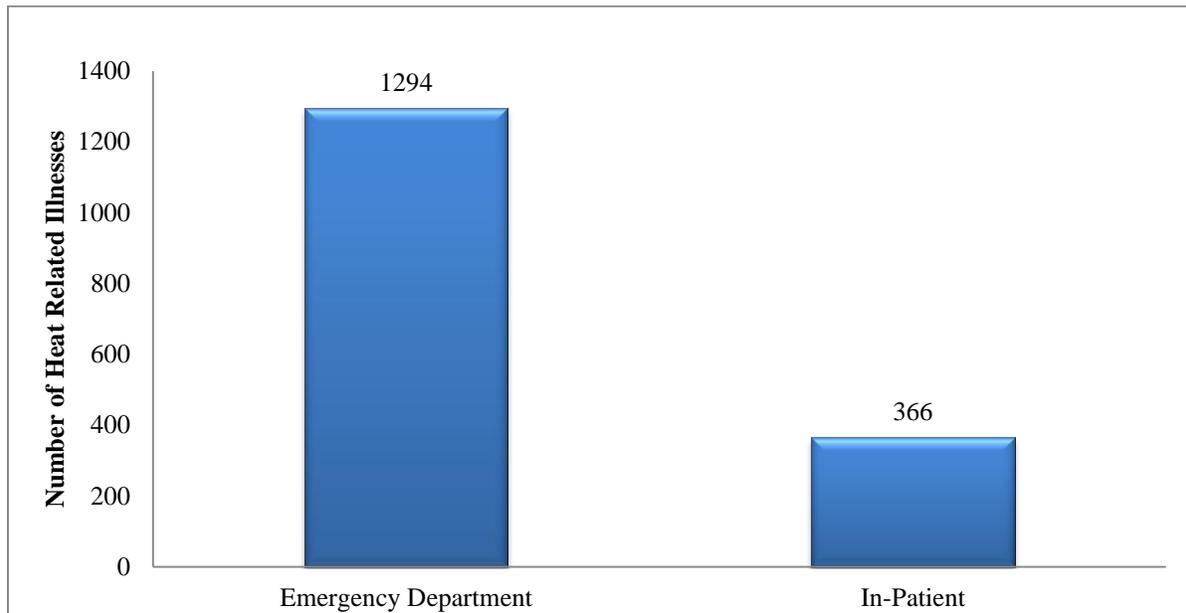
Graph 11. Heat related illness by place of injury (n=1,348)*, Maricopa County, 2013



*Excludes 312 unknown cases

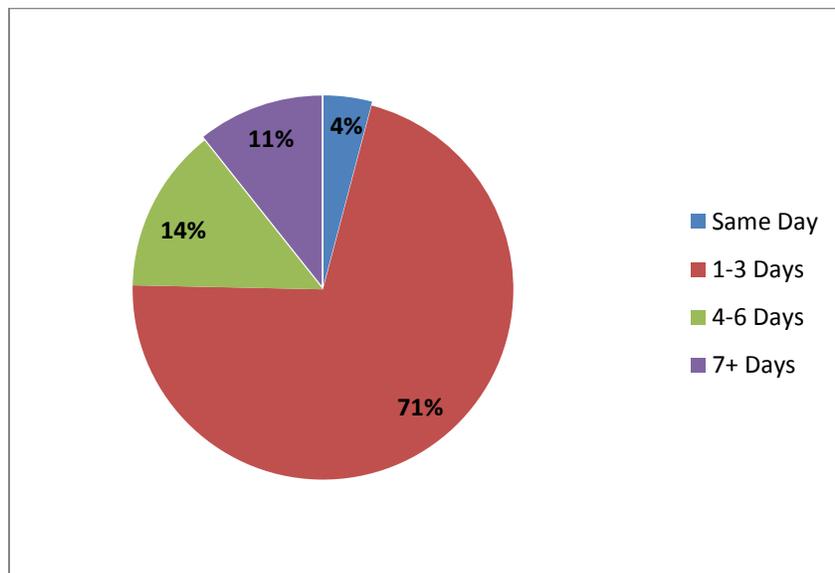
From those cases in 2013 where place of injury was known, a large proportion of heat related illnesses occurred at the home (28%). Different from Graph 12, this graph looks at where the injury took place vs. what type of activity was taking place at the time of the injury. The activity taking place does not necessarily correlate with the place of injury.

Graph 12. Heat related illness by visit type (n=1,660), Maricopa County, 2013



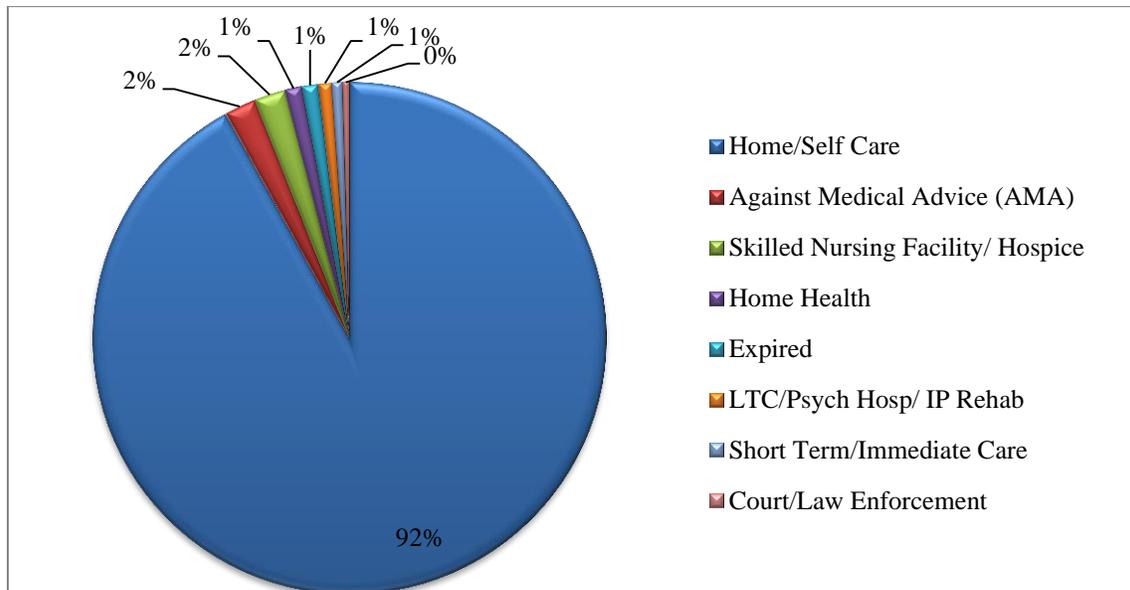
In 2013, more patients were seen for heat related illness in the Emergency Department (78%) than In-patient (22%).

Graph 13. Heat related illness by inpatient length of stay (n=366), Maricopa County, 2013



For patients admitted to the hospital for heat related illness, 71% required hospitalization for 1-3 days and 4% of patients required same day hospitalization. The median length of stay was two days.

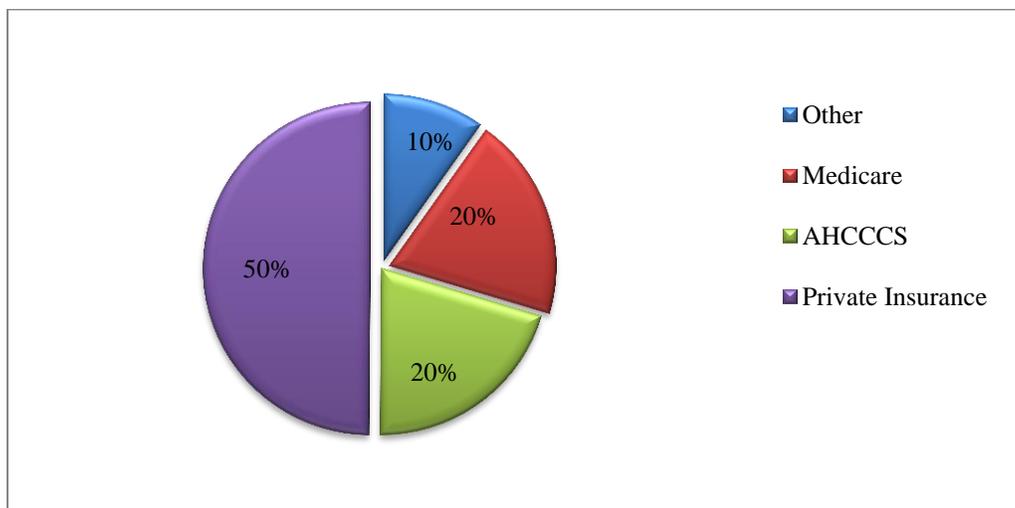
Graph 14. Heat related illness by discharge status (n=1,660), Maricopa County, 2013



After being seen in the hospital for heat related illness (either in the Emergency Department or Inpatient), the majority of discharged statuses for 2013 were ‘Home/Self Care’ (92%).

Insurance Characteristics

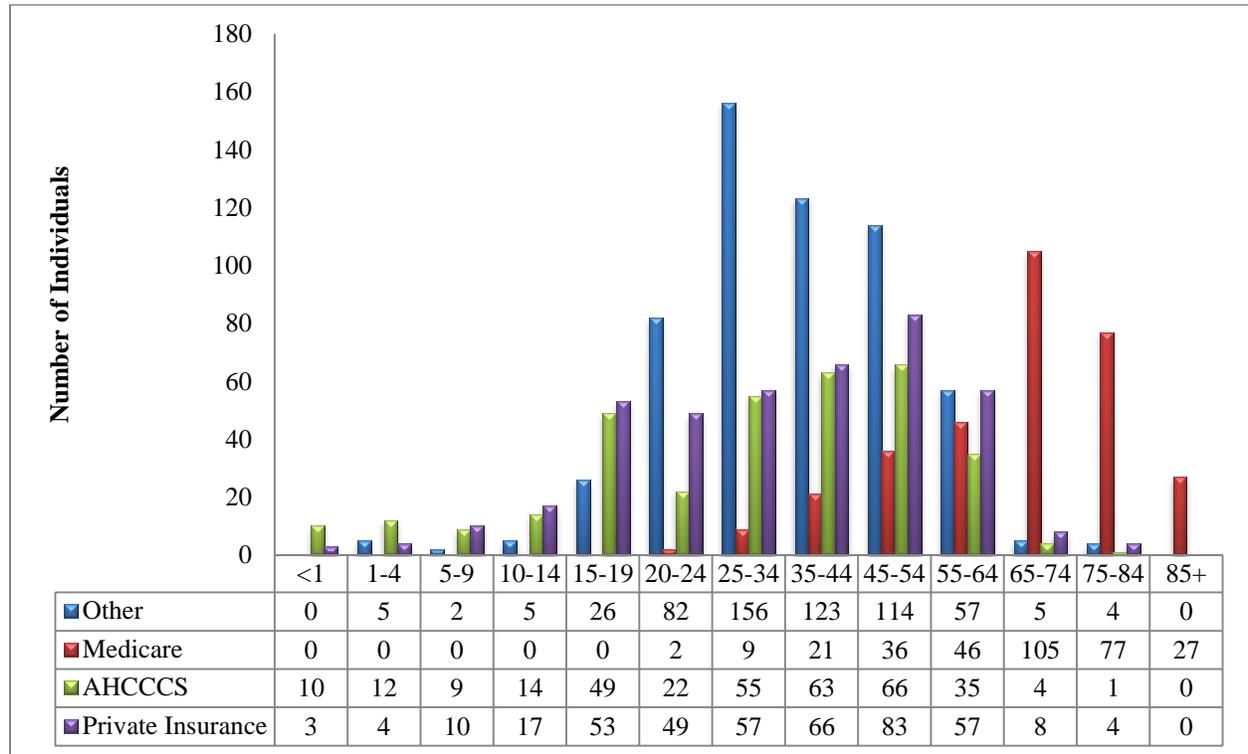
Graph 15. Heat related illness by insurance type (n=1,653)*, Maricopa County, 2013



*Missing/unknown values were excluded from the total n value

Half of the insurance used was private insurance (50%).

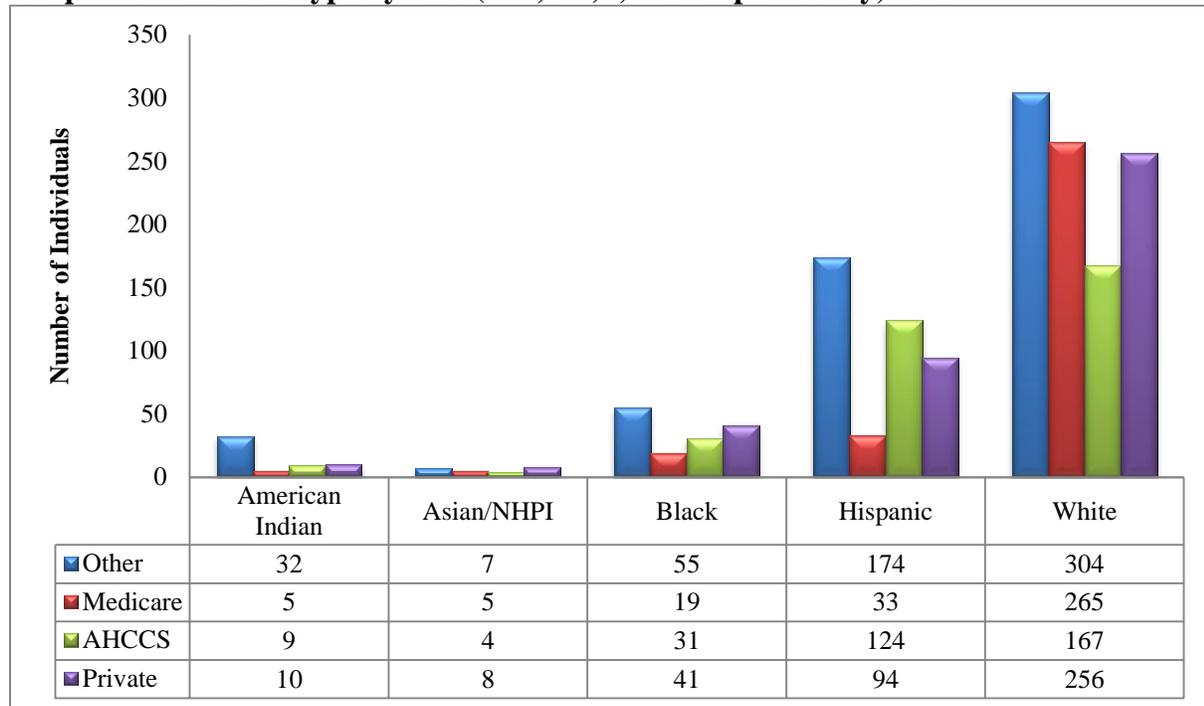
Graph 16. Insurance type by age group (n=1,653)*, Maricopa County, 2013



*Missing/unknown values were excluded from the total n value

Fifty six percent of those on Medicare are between the ages of 65-84. Of the individuals on AHCCCS, 38% are between the ages of 35-54. Twenty five to fifty four year olds represent 50% of the individuals with private insurance coverage.

Graph 17. Insurance type by race (n=1,643)*, Maricopa County, 2013



*17 missing values were excluded

Whites represent having the most insurance between all groups (60%).

Limitations

While the HDD provides valuable information regarding heat related illnesses in Maricopa County, it has some limitations. Reviewing hospital discharge data is a retrospective surveillance method and does not provide real-time updates about the current state of HRI in the county which restricts the public health response to a heat related event. There are also numerous differences in ICD-9 coding used by facilities and providers and HRIs may also be described using various keywords for the same condition making it difficult to accurately obtain true HRIs. Additionally, the time it takes to review Hospital Discharge Data (HDD) for patients with multiple admissions and to ensure that certain cases meet the case definition for HRI can be quite extensive.

Conclusions

The number of hospital visits due to heat-related illnesses in 2013 was consistently higher in the summer months, and most commonly seen amongst males age 25-64. Highlights of the analysis include:

Highlights of the analysis include:

- In 2013, June-August made up 78% of all heat related illnesses, with the month of July experiencing the highest percent of heat related illness (30%).
- More males experienced heat related illness compared to females, with a ratio of 2.4:1, males to females. As well as, a higher proportion of males were seen in-patient, than females.
- The highest number of hospital visits due to HRI occurred in those aged 25-34 years of age
- While the total count of HRIs is highest among White individuals, the rate of HRI per 100,000 population is highest amongst Blacks.
- The majority of all HRI visits were the result of a recreational or sport activity.
- A large portion of HRI occurred in a home and most patients were discharged from hospital care to a home or other self-care entity.
- Of those patients that were required to stay in-patient, over half of them had a length of stay of 1-3 days; however some patients were admitted for longer than a week.
- Fifty six percent of those on Medicare are between the ages of 65-84. Of the individuals on AHCCCS, 38% are between the ages of 35-54. Twenty five to fifty four year olds represent 50% of the individuals with private insurance coverage.
- Whites represent the majority of those with insurance (60%).

Despite its limitations, hospital discharge data is a very useful tool for heat morbidity surveillance in Maricopa County. The volume of cases that can be reviewed from facilities across the county and the amount of data from each case that can be collected is very useful, especially for gathering information about potential risk factors for HRI. Future outreach efforts to mitigate the effects of HRI could be tailored to different areas based on the characteristics of cases seen at the various facilities.

This data is also very useful for long-term heat morbidity surveillance. The data is very thorough and can be analyzed for an array of factors over a long period of time for the entire county. Even though it cannot provide real-time data, it can show changes over time from year to year.

APPENDIX*2013 Tables***Table 1. Heat Related Illness by Month and Visit Type, Maricopa County, 2013**

Month	Visit Type				Total	
	ED		IP			
		Col %		Col %		Col %
January	2	0.16	0	0	2	0.12
February	2	0.16	1	0.27	3	0.18
March	29	2.26	0	0	29	1.76
April	50	3.90	10	2.73	60	3.64
May	87	6.79	14	3.83	101	6.13
June	362	28.24	107	29.23	469	28.46
July	361	28.16	133	22.39	494	29.98
August	255	19.89	62	36.34	317	19.24
September	114	8.89	34	16.94	148	8.98
October	16	1.25	4	9.29	20	1.21
November	3	0.23	1	1.09	4	0.24
December	1	0.08	0	0.27	1	0.06
Total	1282	100.00	366	100.00	1648	100.00

Table 2. Heat Related Illness by Age Group and Month, Maricopa County, 2013

Month	Age Group							
	0-4	5-19	20-34	35-44	45-54	55-64	65+	Total
January	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 0.12	2 0.12
February	0 0.00	1 0.06	1 0.06	0 0.00	0 0.00	1 0.06	0 0.0	3 0.12
March	0 0.00	2 0.12	11 0.67	3 0.18	3 0.18	2 0.12	7 0.42	28 1.73
April	4 0.24	8 0.48	16 0.97	8 0.49	7 0.43	6 0.37	11 0.67	60 3.71
May	2 0.12	8 0.49	40 2.44	17 1.04	14 1.99	11 0.85	8 0.49	100 6.20
June	11 0.67	57 3.47	114 6.92	75 4.57	82 4.99	53 3.23	67 4.08	459 28.4
July	10 0.61	45 2.74	127 7.9	94 5.72	92 5.70	49 3.03	67 4.08	484 30.0
August	1 0.06	40 2.49	77 4.77	53 3.23	115 7.12	38 2.35	23 1.42	347 19.1
September	3 0.19	22 1.36	38 2.35	21 1.30	27 1.67	17 1.05	16 0.99	144 8.92
October	1 0.06	1 0.06	0 0.00	0 0.00	2 0.12	0 0.00	0 0.00	4 0.24
November	1 0.06	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.06
December	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.06	1 0.06
Total	33 1.43	184 11.4	424 26.3	271 16.8	342 21.2	177 11.0	202 12.5	1633 100.0

Table 3. Heat Related Illness by Gender and Visit Type, Maricopa County, 2013

Gender	Visit Type		Total	
	ED	IP	N	%
Female	431	82	513	31.13
Male	851	284	1135	68.87
Total	1282	366	1648	100.00

Table 4. Heat Related Illness by Age Group, Gender, and Visit Type, Maricopa County, 2013

Age Group	Sex				All
	F		M		
	Visit Type		Visit Type		
	ED	IP	ED	IP	
	N	N	N	N	
0-4	10	2	19	3	34
5-19	80	2	98	5	185
20-34	92	6	282	49	429
35-54	134	27	294	115	570
55-64	46	13	80	51	190
65-74	33	10	44	34	121
75+	35	21	30	26	112
All	430	81	847	283	1641

Table 5. Heat Related Illness by Age Group and Visit Type, Maricopa County, 2013

Age Group	Visit Type		Total	
	ED	IP	N	%
0-4	29	5	34	2.07
5-19	178	7	185	11.27
20-34	374	55	429	26.14
35-54	428	142	570	34.73
55-64	126	64	190	11.57
65-74	77	44	121	7.37
75+	65	47	112	6.83
Total	1277	364	1641	100.00

Table 6. Heat Related Illness by Race/Ethnicity and Visit Type, Maricopa County, 2013

Race/Ethnicity	Visit Type		Total	
	ED	IP	N	%
American Indian	45	11	56	3.40
Asian/NHPI	18	6	24	1.46
Black	121	25	146	8.86
Hispanic	340	84	424	25.73
White	746	235	981	59.53
Unknown	12	5	17	1.03
Total	1282	366	1648	100.00

Table 7. Heat Related Illness by Activity Type and Visit Type, Maricopa County, 2013

Type of Activity	Visit Type		Total
	ED	IP	
No Activity Listed	996	313	1309
walking & running	61	12	73
water & water craft	11	0	11
climbing, rappelling, & jumping off	2	1	3
dancing & other rhythmic movement	2	0	2
other sports & athletics - individual	33	3	36
other sports & athletics - team or group	31	2	33
other specified sports & athletics	3	0	3
other cardiorespiratory exercise	1	0	1
other muscle strengthening exercises	1	0	1
personal hygiene & household maintenance	6	2	8
food preparation, cooking & grilling	2	0	2
property & land maintenance, building & construction	49	20	69
animal care	1	0	1
Other activity	66	9	75
Unspecified activity	17	4	21
Total	1282	366	1648

Table 8. Heat Related Illness by Source of Admission and Visit Type, Maricopa County, 2013

Source of Admission	Visit Type		All
	ED	IP	
	N	N	N
Non-Health Care Facility Point of Origin	1275	356	1631
Transfer from a Hospital (different facility)	1	4	5
Clinic	2	2	4
Transfer from another Health Care Facility	4	14	18
Court/Law Enforcement	4	3	7
Information not available	0	0	0
All	1286	379	1665

Table 9. Heat Related Illness by Length of Stay, Maricopa County, 2013

Length of Stay	Total
Same Day	15
1-3 Days LOS	260
4-6 Days LOS	51
7+ Days LOS	40
Total	366

Table 10. Heat Related Illness by Discharge Status and Visit Type, Maricopa County, 2013

Source of Discharge	Visit Type				Total	
	ED		IP			
	No.	%	No.	%	No.	%
Home/Self Care	1249	75.7	276		1525	92.5
AMA	11	0.66	19	1.15	30	1.82
Skilled Nursing Fac.	3	0.18	21	1.27	24	1.46
Home Health	4	0.24	14	0.85	18	1.70
Short Term Fac.	4	0.24	7	0.42	11	0.67
Expired	3	0.18	12	0.72	15	0.91
Psychiatric Hospital	3	0.18	6	0.36	9	0.55
Hospice-Facility	0	0.00	4	0.24	4	0.24
Court/Law Enforcement	4	0.24	3	0.18	7	0.42
Intermediate Care Fac.	0	0.00	0	0.000	0	0.00
IP Rehab	1	0.06	3	0.18	4	0.24
Other HC	0	0.00	0	0.00	0	0.00
LTC Hospital	0	0.00	1	0.06	1	0.24
Home w/Hospice	0	0.00	0	0.00	0	0.00
Total	1282	77.7	366	22.2	1648	100