



HEAT-RELATED ILLNESS EMERGENCY DEPARTMENT VISITS IN DELAWARE

2019-2023



DELAWARE HEALTH AND SOCIAL SERVICES
Division of Public Health

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Executive Summary

From 2018 to 2020, over 3,000 people died from excessive heat exposure in the United States (U.S.) and during the same time period, an estimated 277,000 individuals sought heat-related illness (HRI) medical care in an U.S. Emergency Department (ED) (Spencer & Garnett, 2022) (Dring P, 2022).

Extreme hot ambient temperature poses an emerging public health threat, particularly in the context of climate change and rising global temperatures (Dring P, 2022). Today, Delaware has on average only two days over 100 degrees Fahrenheit each year. But by 2100, Delaware is expected to have as many as 28 days over 100 degrees Fahrenheit (Delaware Sea Grant, n.d.).

This is the first report published by the Delaware Department of Health and Social Services, Division of Public Health (DPH) on heat-related morbidity in Delaware. The findings in this five-year surveillance report identified a trend of substantial burden of HRI and determined populations most at risk for heat-related health impacts. These data can be used to guide preparedness planning efforts, to inform extreme heat response strategies and public health messaging during a heat wave, and to evaluate and monitor future trends.

Between 2019 and 2023, Delaware hospitals recorded a total of 1,454 HRI ED visits with an annual median of 268. The five-year trends have not been stable, with 2019 and 2020 experiencing the highest and lowest numbers, respectively, compared to the 2021–2023 stable baseline. The majority of HRI ED visits were among working adults aged 20 to 64 years. July recorded the highest number of visits each year.

The median annual rate for Delaware residents was 23.0 HRI ED per 100,000 population, with male rates higher than females although female rates trended upward. Most HRI ED visits were among individuals who were outside, compared to those who were indoors. Almost half of the records provided some information on specific locations and activities in which HRI patients were engaged during the heat exposure incident. Therefore, location and activity findings should be interpreted with caution because of the limited data although the findings in this report are similar to other states. The leading activities that individuals engaged in during heat exposure were working (both paid and unpaid) and recreation, sport, and exercise activities. Of those with information on work status, most reported work was for pay compared to unpaid work, indicating an occupational risk of HRI in Delaware.

Males and Black Delawareans were disproportionately impacted by HRI with rates higher than their respective counterparts. A high prevalence of chronic disease among those with HRI was consistently found across the five years including: 31% to 41% with a circulatory disease, 25% to 35% with an endocrine/metabolic disease, and 21% to 35% with a mental health and/or behavioral health issue. From 2019 to 2023, 6% of the total HRI ED visits were individuals experiencing homelessness and the frequency of HRI visits among this population increased 63%.

The overwhelming majority (85%) of patients were treated and released from the ED but 5% either required hospitalization or transfer, and 0.3% died. Serious HRI diagnoses were found such as acute renal failure (11%), heat stroke (4%), and rhabdomyolysis (4%), highlighting negative HRI health outcomes.

This report provides the first baseline surveillance description of HRI ED visits in Delaware and identified a trend of noteworthy burden of HRI between 2019 and 2023. The results of this report can be used to guide prevention efforts, inform extreme heat response strategies and public health messaging, and monitor trends.

Background and Purpose

Exposure to heat can result in heat-related illness (HRI) including heat syncope, severe heat exhaustion, and heat stroke requiring individuals to seek urgent medical attention at an Emergency Department (ED) (CDC, n.d.). Between 2018 and 2020, over 3,000 people died from excessive heat exposure in the United States (U.S.) and during the same time period, an estimated 277,000 individuals sought HRI care in an U.S. ED (Spencer & Garnett, 2022) (Dring P, 2022). Extreme hot ambient temperature poses an emerging public health threat, particularly in the context of climate change and rising global temperatures (Dring P, 2022) (U.S. Global Change Research Program, 2016) (Appendix A1). Today, Delaware experiences an annual average of two days over 100 degrees Fahrenheit which is projected to increase to 28 days by 2100 (Delaware Sea Grant, n.d.).

As extreme heat incidents become more frequent and severe, health departments need to establish an effective morbidity surveillance strategy to monitor and respond to spikes of HRI and promptly identify populations at greatest risk (Council of State and Territorial Epidemiologists, 2013). Populations at greatest risk are individuals who are outdoors without access to cooling devices, individuals with cardiovascular and respiratory conditions, older adults, and young children.

In the U.S., the average annual HRI incidence rate is 26.2 ED visits per 100,000 population with the majority of HRI visits occurring among those working aged 18 to 64 years and males (Dring P, 2022). Increases of HRI ED visits occur in July and among individuals working or playing outdoors and those with cardiovascular or respiratory comorbidities. Recent reports highlight the upward trends of HRI ED visits with drug and alcohol involvement and among individuals experiencing homelessness (Lozano & Gettel, 2024) (Maryland Department of Health, 2024) (CDC, 2024).

The Delaware Department of Health and Social Services, Division of Public Health (DPH) uses Delaware ED data from the Electronic Surveillance System for Early Notification of Community-based Epidemics (ESSENCE) to conduct near real-time HRI surveillance from April to November. To better understand HRI trends, DPH examined ESSENCE ED data in the five-year period, 2019–2023, to determine the baseline burden and historical trends of HRI in Delaware. The findings can help identify the most at-risk populations and areas to target public health actions and to inform current HRI ESSENCE surveillance strategy.

The purpose of this report is to present the basic epidemiology and risk factors of HRI ED visits in Delaware from 2019 to 2023. This information can assist in the planning and preparedness for heat prevention and response in Delaware with the goal to protect the public from future extreme heat associated health impacts.

Methodology

DPH extracted ESSENCE ED visits between April 1, 2019 to November 30, 2023, using the Centers for Disease and Control and Prevention (CDC) National Syndromic Surveillance Program (NSSP) HRI v2 Definition. This definition identifies any visits assigned an International Classification of Diseases version 10 (ICD-10) diagnosis code of T67, (Effect of heat and light), X30 (Exposure to excessive natural heat), and and/or a chief complaint text consistent with excessive exposure to environmental heat. Additionally, the HRI v2 definition excludes ICD-10 diagnosis code W92 (Exposure to excessive heat of man-made origin). The case definition was a visit that either had a description of heat exposure in the chief complaint with an ICD-10 code of T67 and/or X30 or an ICD-10 code plausible medical condition(s) (e.g., dehydration, acute renal failure). Visits with non-ambient temperature heat exposure were excluded.

All records were reviewed to determine if the visit met the case definition. Suspected cases were records that only listed an HRI related ICD-10 code(s) or had a description of heat exposure in the chief complaint field, but all other variables fields were blank. Excluded visits were those records with heat exposure from non-environmental sources (e.g., house fire, hot kitchen) or obvious misspelling (e.g., “heat with a bat”). From this line level record review, DPH created and coded several new variables: 1) location of the heat exposure, whether it occurred outdoors or indoors; 2) specific location of heat exposure either at a place of work, recreational space, street, private residence, vehicle, or public building/business; and 3) specific activity engaged in during heat exposure, either working (paid and unpaid), recreational, sports/athletics, exercise, and household.

ESSENCE maps ICD-10 diagnosis discharge codes to Clinical Classification Software Refined (CCSR) categories promoted by the Agency for Healthcare Research and Quality (AHRQ). The CCSR aggregates more than 80,000 ICD-10 codes into approximately 320 clinically meaningful categories based on body systems. ESSENCE data are mapped to CCSR categories version 2023 (Agency for Healthcare Research and Quality, 2023). Using the CCSR codes facilitated the ability to determine the leading chronic diseases of interest for risk of HRI.

All calculations involving “rates” were calculated using the Annual Projections from the Delaware Population Consortium for Delaware population estimates and only ED visits that were Delaware residents (The Delaware Population Consortium, 2023). “Number of” included ED visits of both Delaware and non-Delaware residents.

Results

Heat-Related Illness Emergency Department Visits Trends in Delaware

Population Considerations

Delaware is a small coastal state with a thriving tourism industry. In 2022, the population of Delaware was 1.018 million and it is estimated that there were 9.8 million overnight visitors to the state and a record-breaking 28.6 million total visitors for business and leisure (Chesney, 2020) (Visit Delaware, 2022).

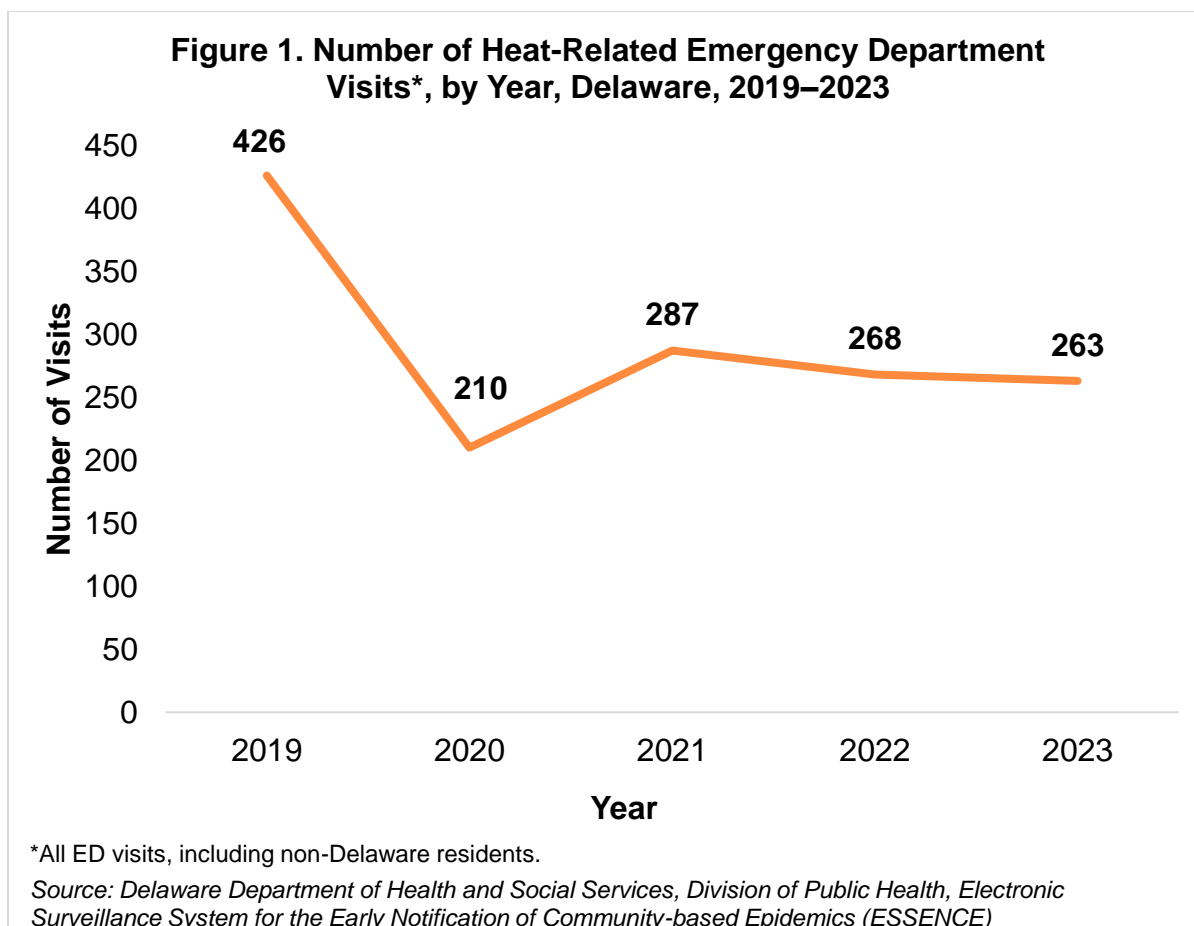
Outdoor workers can be especially vulnerable to heat. In Delaware, the construction industry is one of the largest employers with over 22,000 workers, including up to 4,590 landscape and groundskeeping workers (Associated General Contractors of America, 2023) (U.S. Bureau of Labor Statistics, 2024).

Like other states, more individuals are experiencing homelessness in Delaware. Housing Alliance Delaware and Delaware Continuum of Care conduct an annual Point-in-Time (PIT) count to generate a yearly homelessness census including type of housing and household make up (Housing Alliance Delaware, 2023). Between 2019 and 2023, a median of 1,245 individuals were identified as experiencing homelessness, either as occupying a shelter bed or an unsheltered location such as an encampment. The U.S. Department of Housing and Urban Development reported that homelessness was about 0.12% of Delaware’s population in 2023 (U.S. Department of Housing and Urban Development, 2023).

According to *The Burden of Chronic Disease in Delaware, 2024* report, Delaware residents reported chronic disease conditions that could make them susceptible for heat-related illness (Delaware Division of Public Health, 2024). Seven percent of Delaware adults reported being told they have chronic obstructive pulmonary disease (COPD), 14% reported having asthma, 14% reported having diabetes, and 34% reported being overweight.

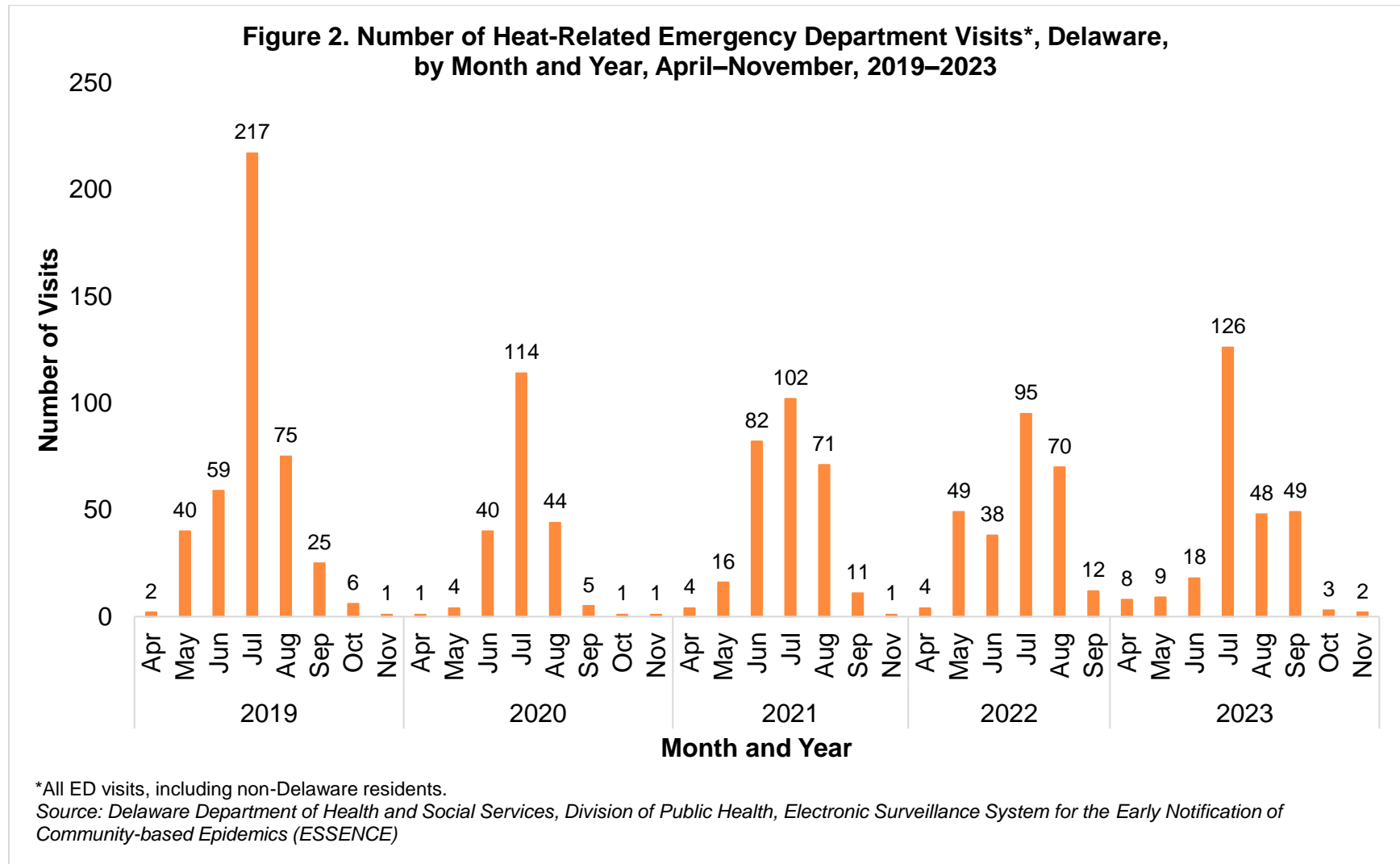
Trends by year and month

Between 2019 and 2023, Delaware experienced a total of 1,454 HRI ED visits with an annual median of 268 HRI ED visits (Figure 1). The highest number of visits occurred in 2019, followed by a steady trend over the rest of the study period.



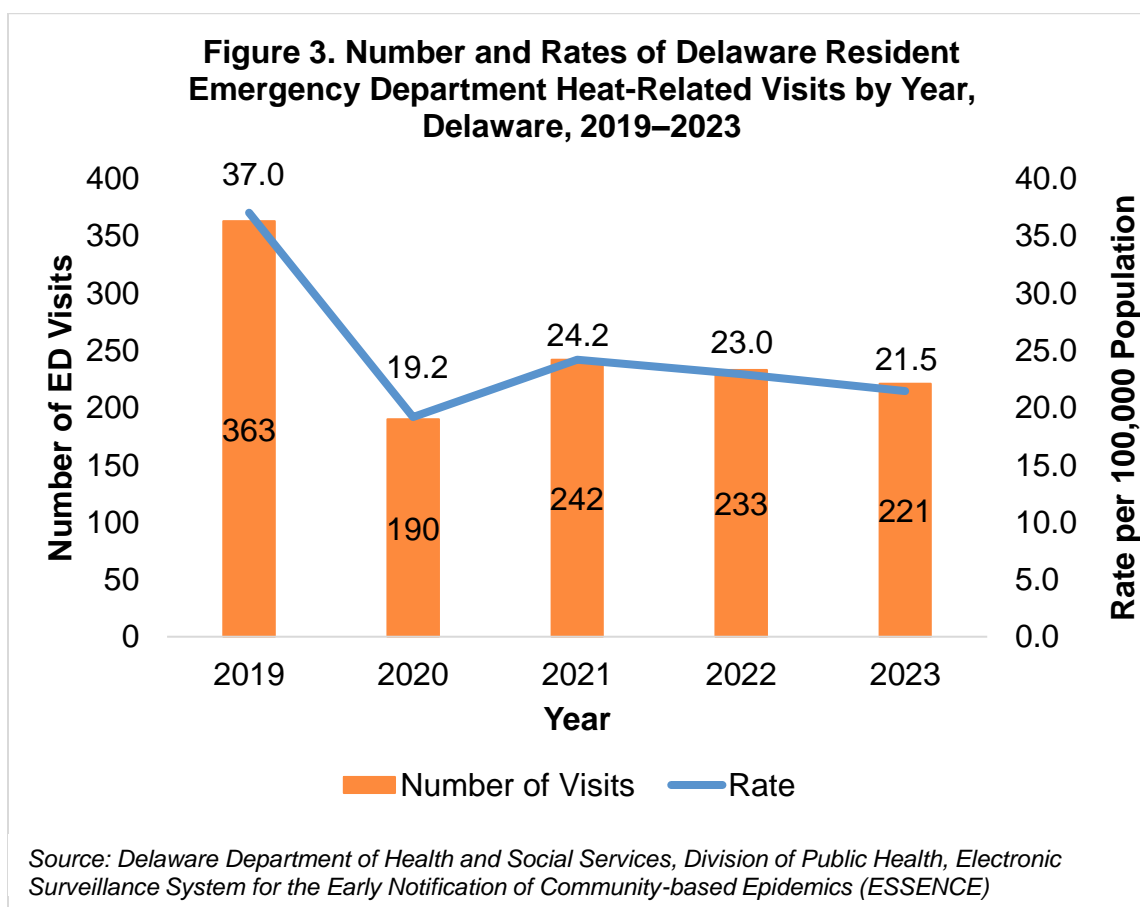
Heat-Related Illness Emergency Department Visits in Delaware, 2019-2023

July ED visits accounted for 45% of all HRI ED visits, followed by August (21%) and June (16%) (Figure 2). This includes all ED visits by both Delaware residents and non-residents. Heat-related illness visits occurred in spring and early fall.



Trends and Rates by Year for Delaware Residents Only

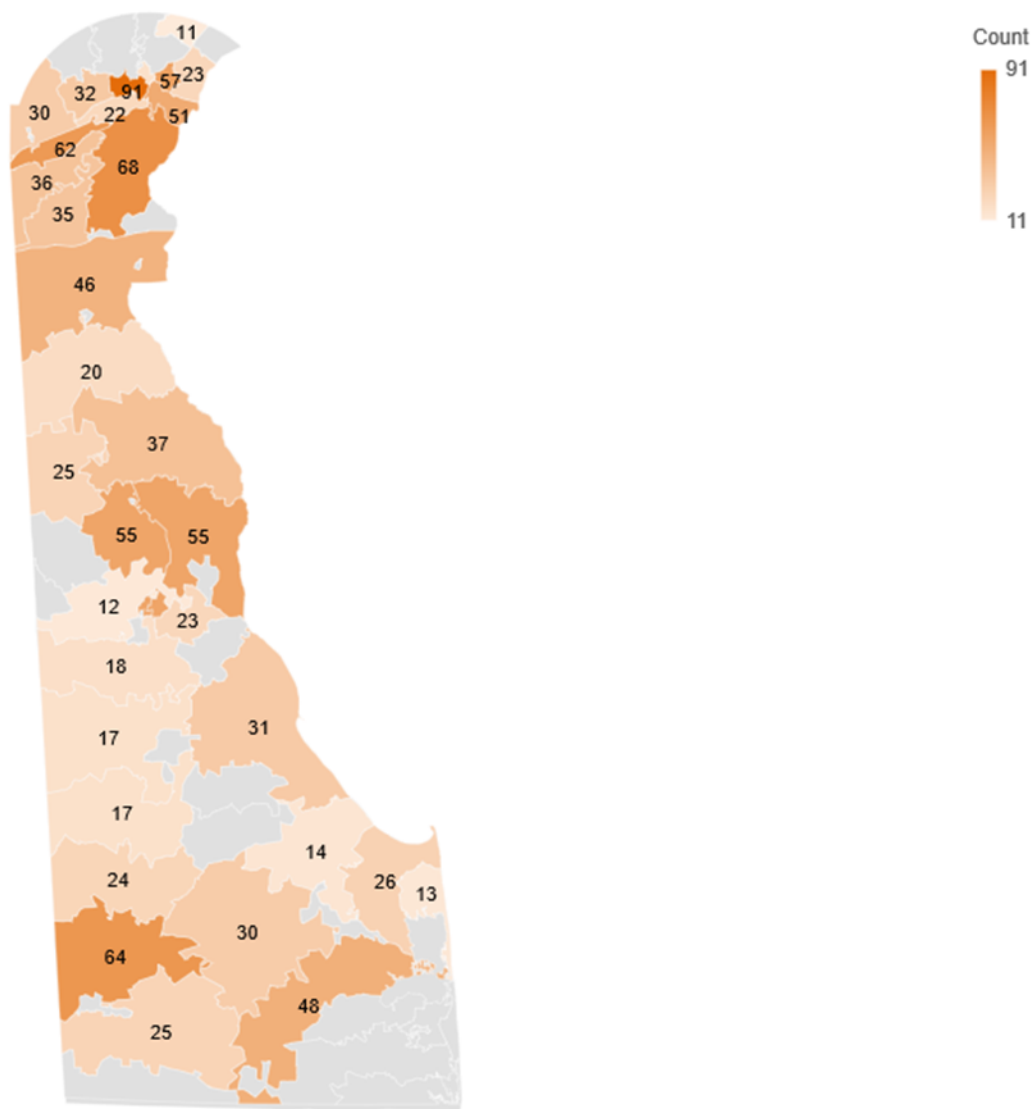
Delaware residents made up the majority of ED visits with a median of 233 HRI ED visits per year (Figure 3). From 2021 to 2023, where trends to appear to be stable, the rates ranged between 21.5 to 24.2 HRI visits per 100,000 population.



Map of Heat-Related Illness ED Visits by ZIP Code and County Frequency and Rates

Of the 1,454 heat-related ED visits from 2019 to 2023, 1,249 were Delaware residents. The heatmap shows the numbers by resident ZIP Code; data is not shown for ZIP Codes with fewer than 11 visits or populations with fewer than 2,500 people (Figure 4). Eight ZIP Codes had a total of at least 50 HRI visits across all five years, with 19805 having the most resident hospital visits (91), followed by 19720 (68 visits), 19973 (64 visits), 19713 (62 visits), 19802 (57 visits), 19901 (55 visits), 19904 (55 visits), and 19801 (51 visits) (Appendix A2).

Figure 4. Heatmap of the Frequency of Heat-Related Emergency Department Visits by Resident ZIP Code, Delaware, 2019–2023



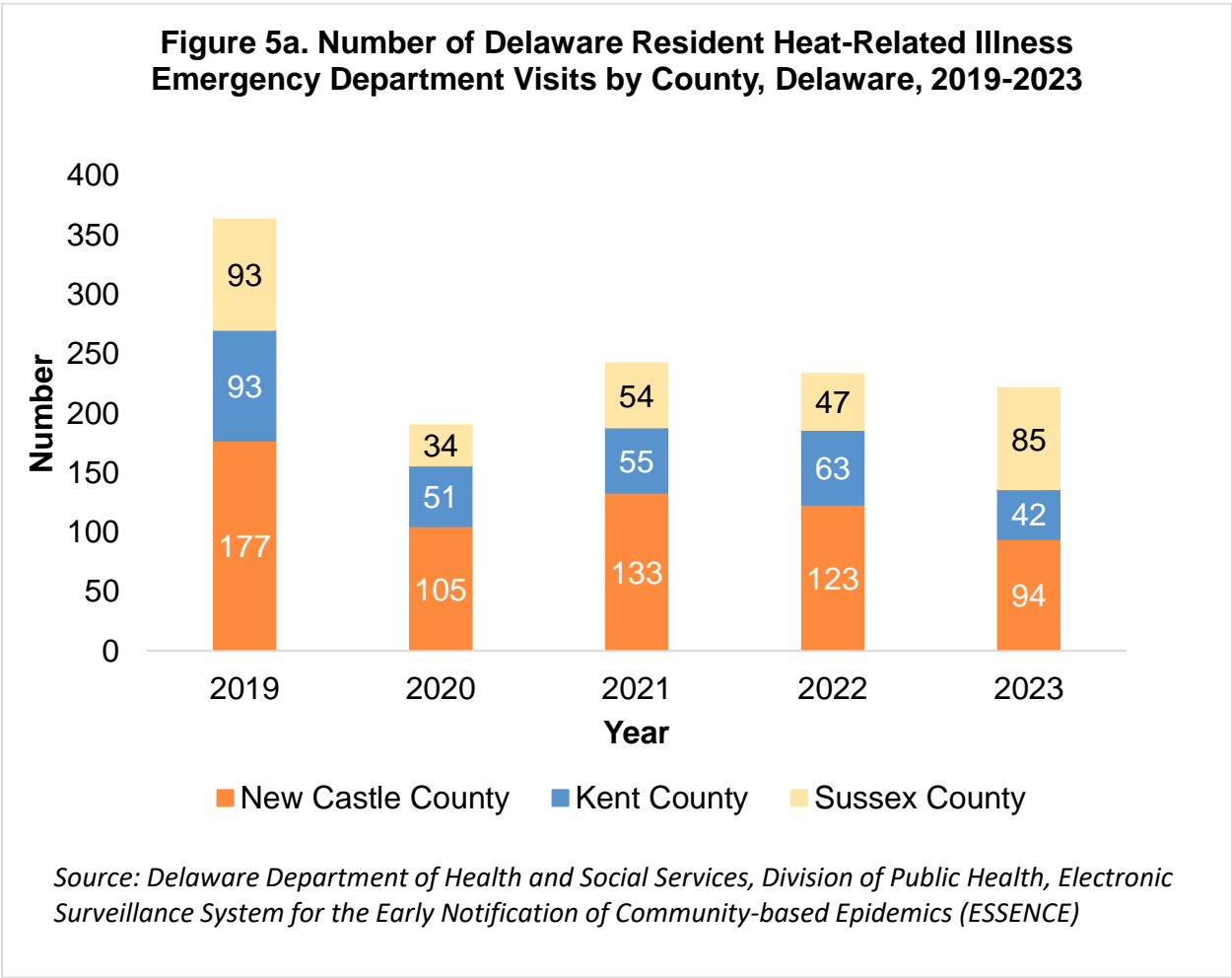
Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

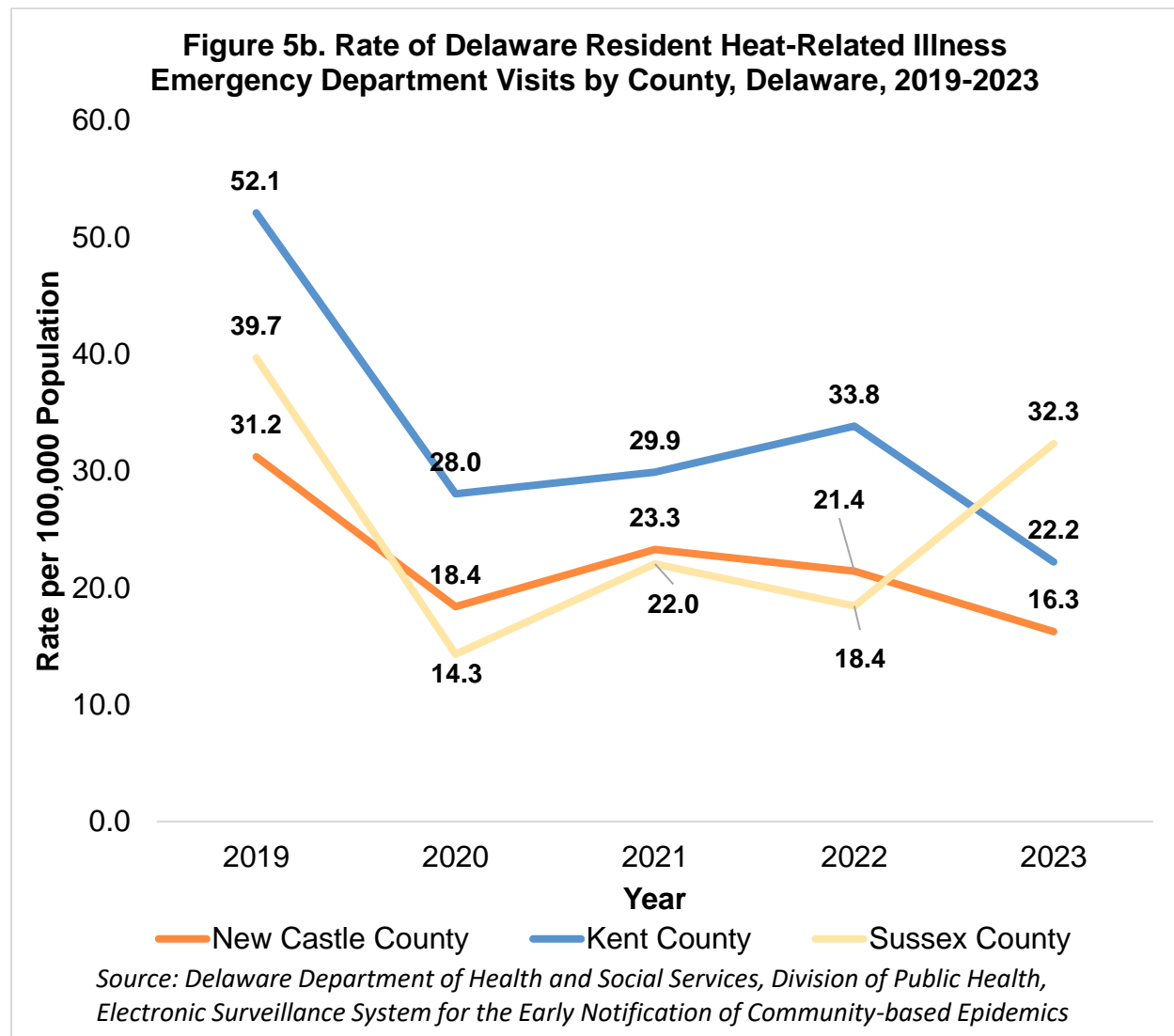
*Areas in gray had between 0-10 Emergency Department visit counts across all five years.

Heat-Related Illness Emergency Department Visits in Delaware, 2019-2023

New Castle County had the highest number of HRI visits (632) over the five-year period, which was 51% of the total Delaware resident visits recorded (Figure 5a). During this same period, New Castle County recorded the lowest rates of ED visits per capita in the state, and in 2023, the county’s rate was notably lower compared to Kent and Sussex counties despite having the highest frequency of visits that year (94) (Figure 5b).

Sussex County reported the second highest count of visits (313), 25% of the total visits. In 2023, Sussex County saw a sharp increase in the HRI visit rate (32.3 per 100,000 population), compared to 2022 (18.4 per 100,000 population). Kent County is the least populous county; however, the number of HRI visits (304) was similar to Sussex County, resulting in having the highest county HRI rate each year in the state except for 2023. Numbers and rates on Figures 5a and 5b are presented in table format in Appendix A3.

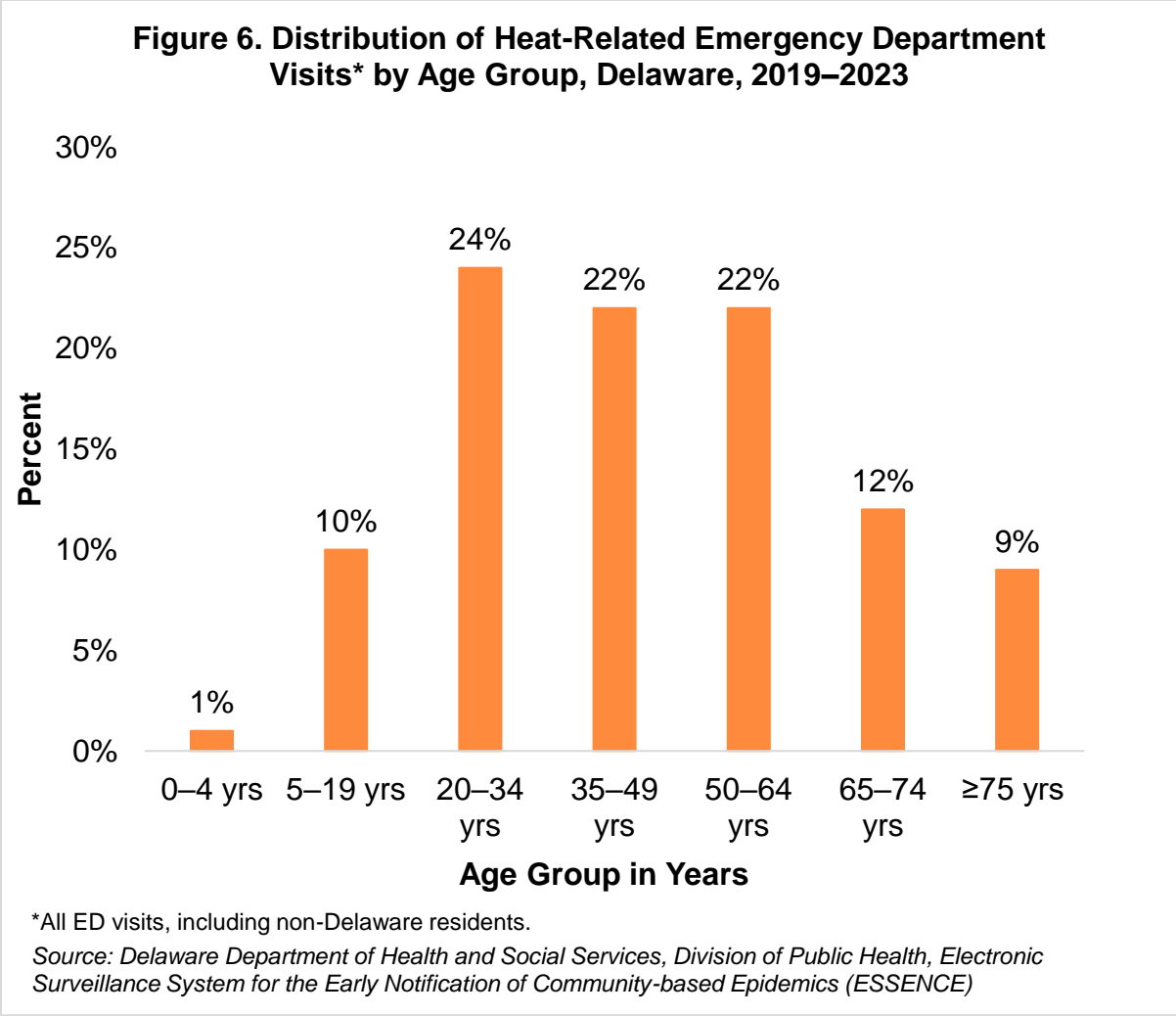




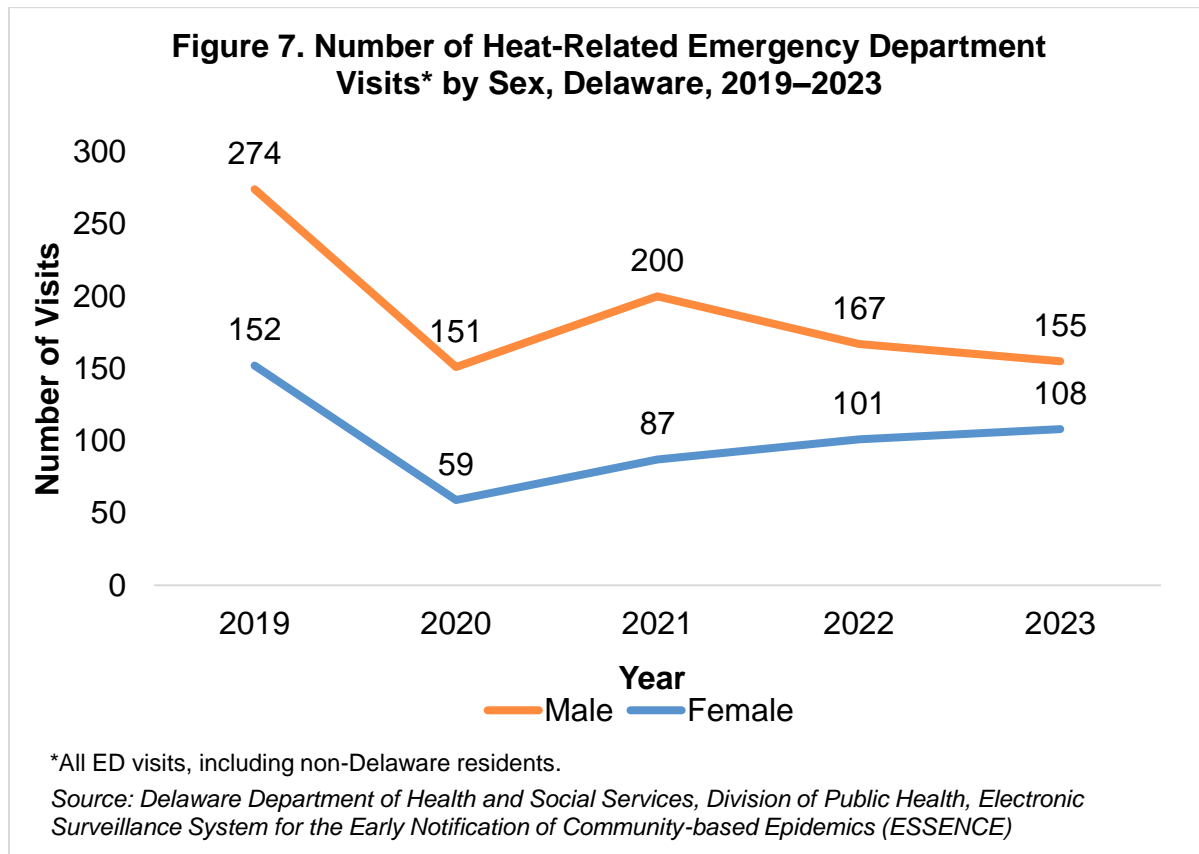
Demographic Overview

Age, Sex, and Race

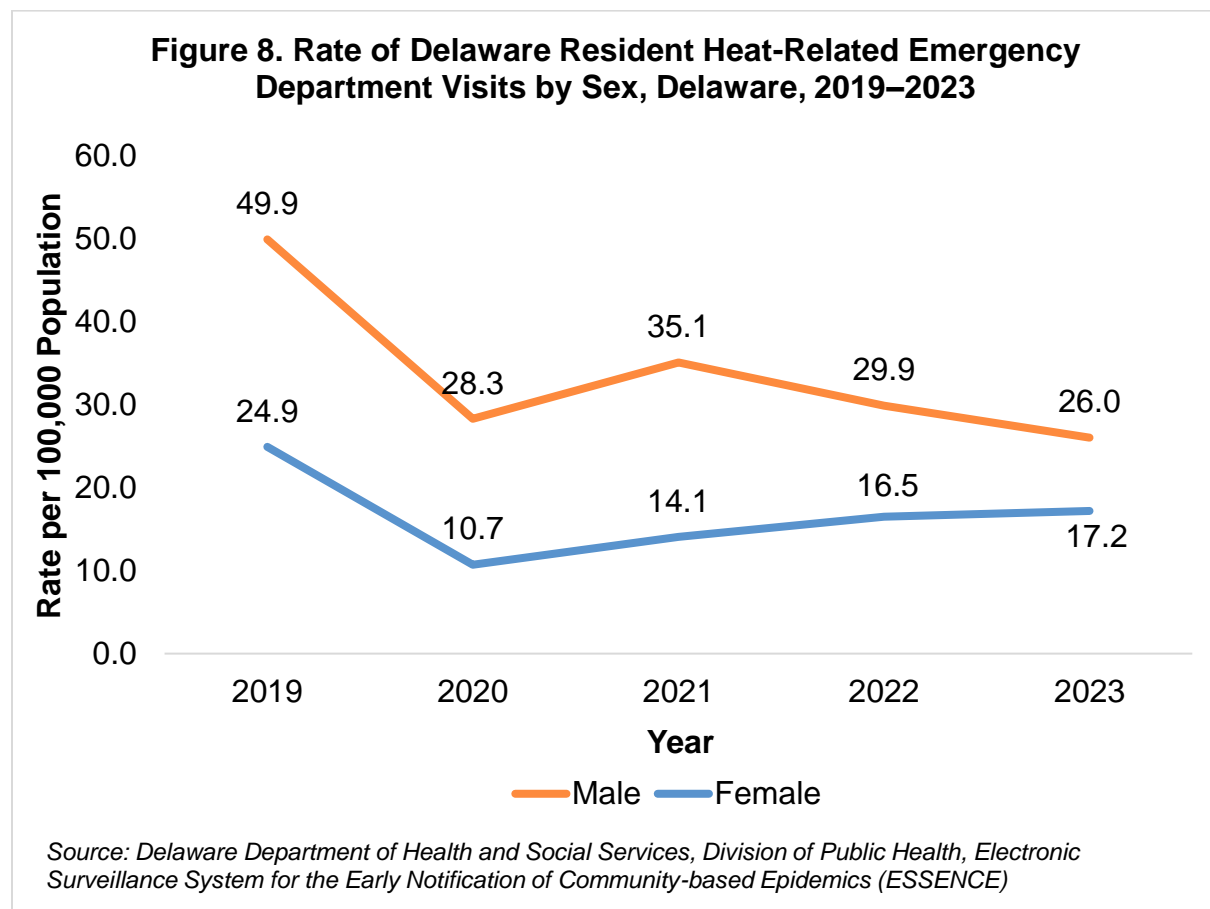
Of all HRI ED visits, 68% occurred among individuals between 20 and 64 years old, 21% were older adults (age 65 years old and older), and 11% were age 19 years old and younger (Figure 6).



Between 2019 to 2020, there was a decrease in the frequency of all HRI ED visits. Since 2021, the overall number of male visits decreased, but female visits increased (Figure 7).

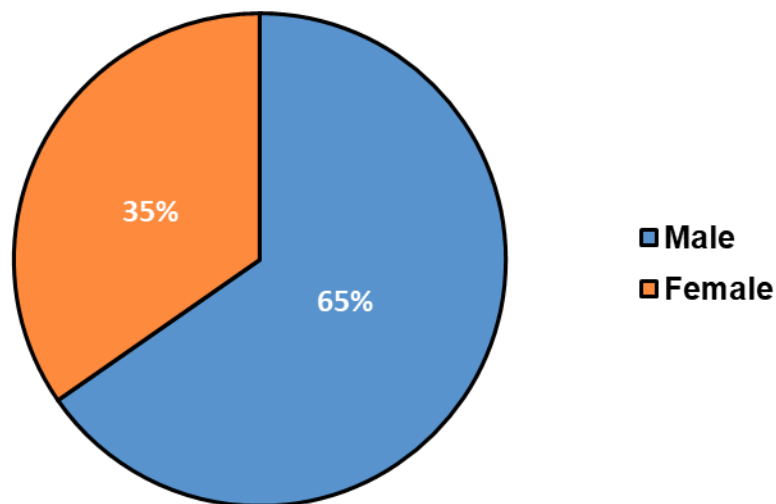


The rates of HRI visits per 100,000 population is consistently higher in males than in females among Delaware residents (Figure 8). Since 2021, HRI visit rates for males were 2.5 times to 1.5 times higher compared to female rates. The trending rates for male HRI visits is lowering since 2021 and female rates are trending upwards since 2020.



For all Delaware resident HRI ED visits between 2019 and 2023, the majority (65%) were among males and just over a third (35%) were among females (Figure 9).

Figure 9. Percentage of Delaware Resident Heat-Related Emergency Department Visits by Sex, Delaware, 2019–2023

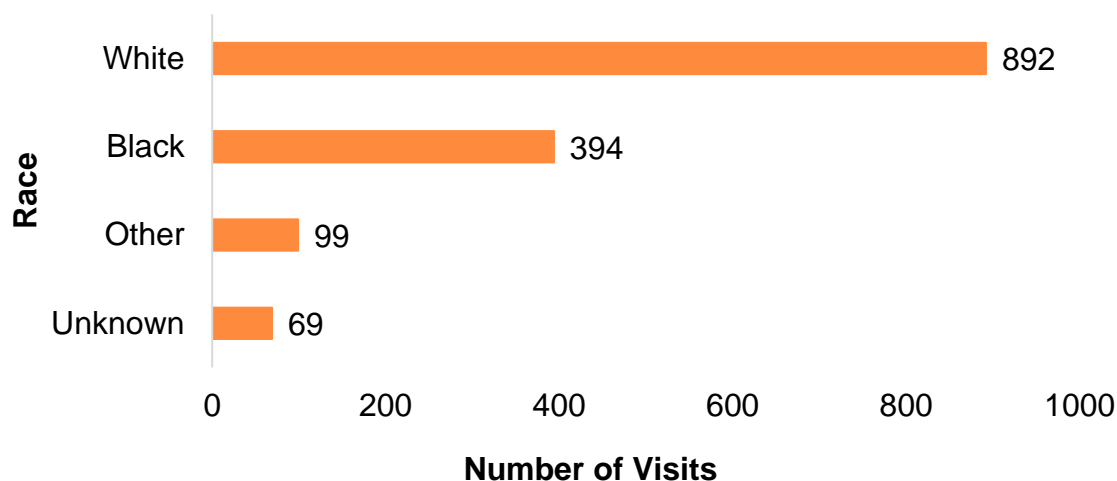


Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

White patients constituted the majority (61%) of the total ED visits (892/1,454) followed by Black patients who made up 27% of the overall HRI visits (Figure 10).

When examining rates of ED visits among Delaware residents alone, Black Delawareans saw the highest rate of HRI visits based on the proportion of Black residents in the state. However, the gap in ED visit rates across Black, White, and other races has closed and in 2023 rates across these three categories were similar. Rate data for Other Race for 2020 and 2022 were suppressed due to numbers too low to reliably calculate a rate; therefore, no data are shown (Figure 11).

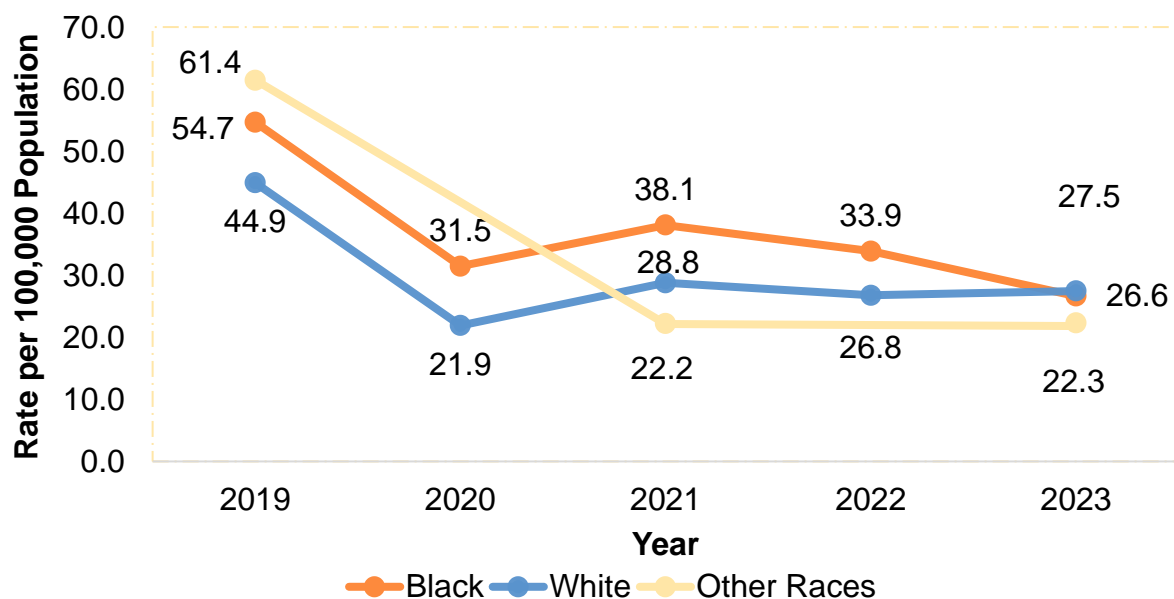
Figure 10. Number of Heat-Related Emergency Department Visits* by Race, Delaware, 2019–2023



*All ED visits, including non-Delaware residents.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Figure 11. Trends of Delaware Resident Heat-Related Emergency Department Visit Rates by Race, Delaware, 2019-2023



Note: for "Other Races" in 2020 and 2022 data are not shown due to less than 20 visits.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Residency

Between 2019 and 2023, approximately 15% of HRI ED visits in the hospitals were non-Delaware residents (Figure 12). Of the 205 non-Delaware residents who accessed ED care for HRI, 88% were residents from Mid-Atlantic states with the majority being from Maryland (75), Pennsylvania (65), and New Jersey (24) (Table 1).

The yearly trends for non-Delaware residents were stable between 2021 and 2023 but notably, the number of HRI ED visits among Maryland residents nearly doubled from 2021 to 2023.

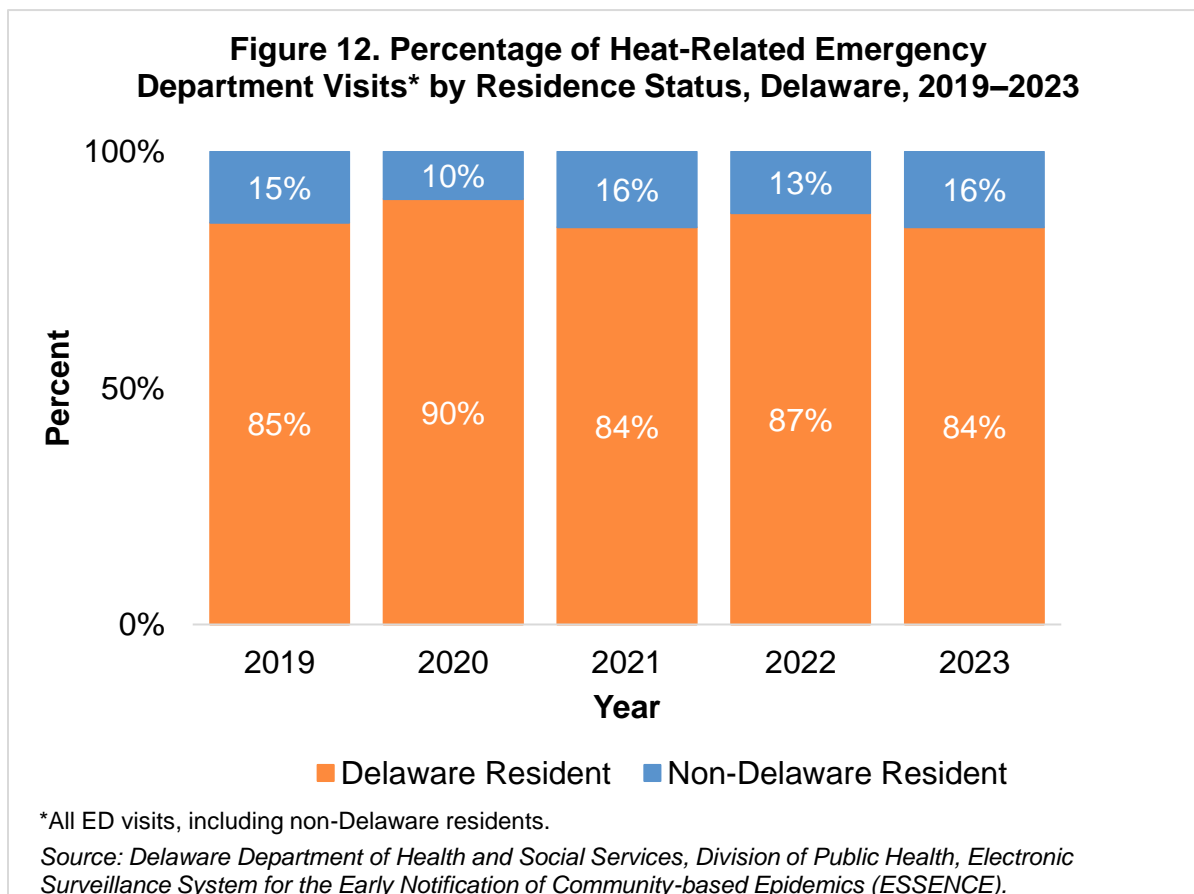


Table 1. Non-Delaware Resident Heat-Related Emergency Department Visits, by State of Residence*, Delaware, 2019–2023						
State	Year					State Totals
	2019	2020	2021	2022	2023	
Maryland	29	7	11	8	20	75
Pennsylvania	17	4	18	15	11	65
New Jersey	5	4	6	5	4	24
New York	3	0	2	2	2	9
Virginia	3	1	1	1	1	7
Other*	6	4	7	4	4	25
Yearly Totals	63	20	45	35	42	205

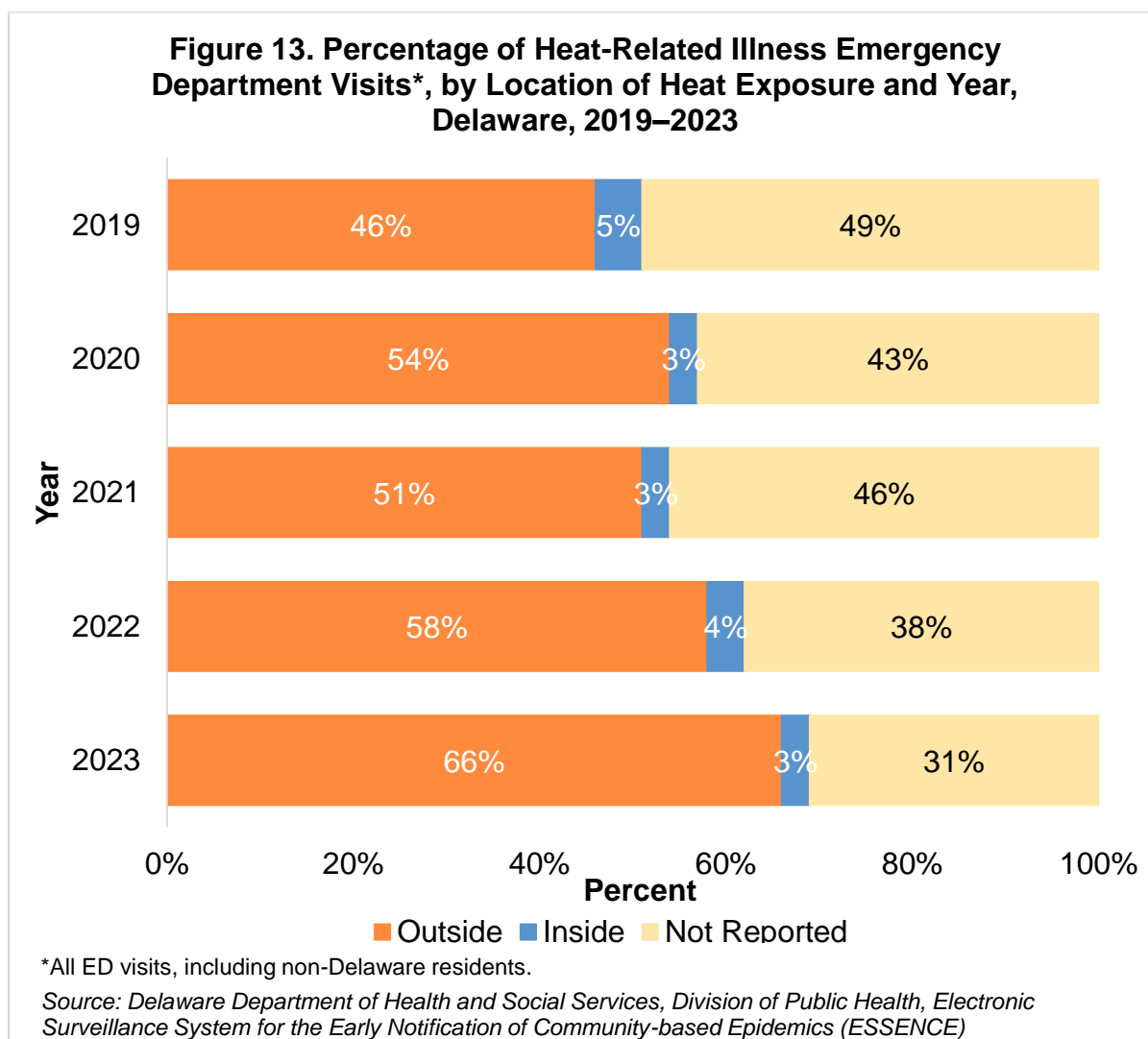
*"Other" = U.S. states including CA, CT, FL, GA, IA, LA, MI, MO, NC, TX, WI, WV, WY, and any other territory (OT).

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE).

Circumstances of Excessive Heat Exposure of Heat-Related Illness Visits

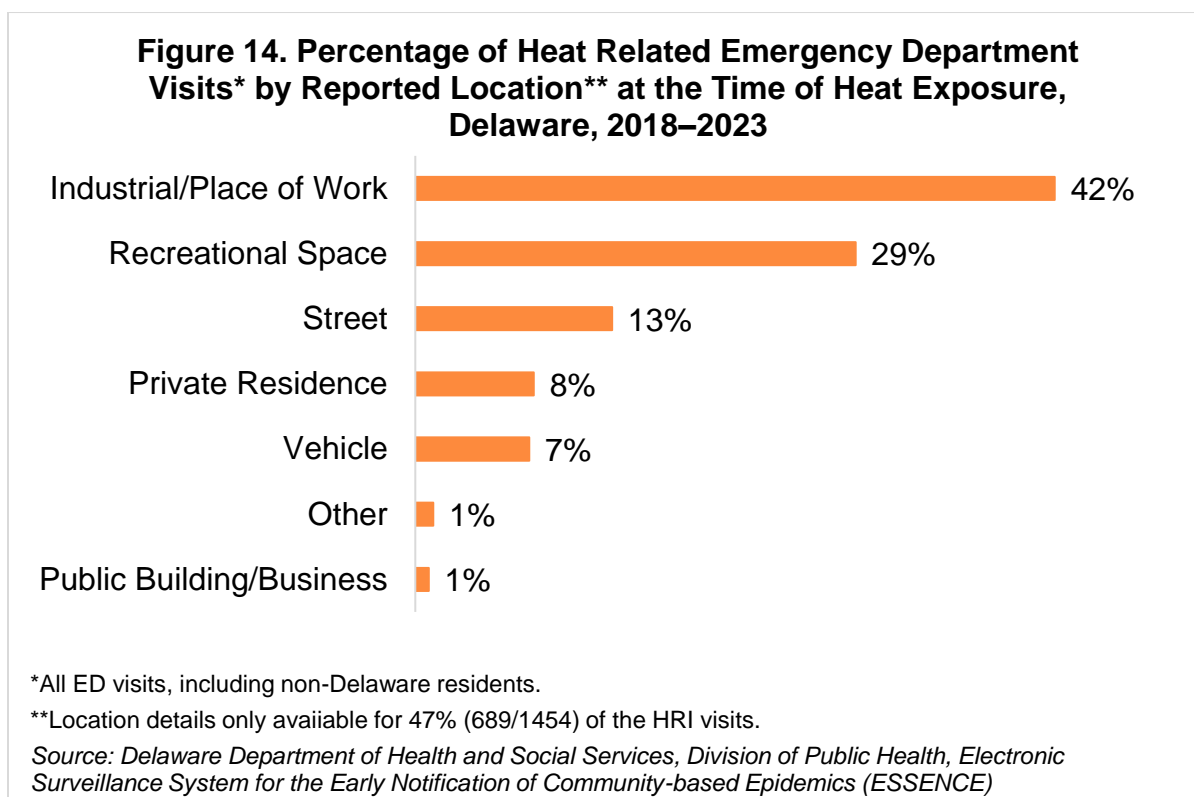
Outdoor or indoor location of exposure

Of the visits that indicate whether the patient was inside or outside, the vast majority reported being outdoors at the time of the heat exposure (Figure 13). Depending on the year, 31% to 49% of the location of exposure information was not reported in HRI ED records. Since 2019, the documentation of whether a patient was inside or outside increased. The upward trend of outdoor exposure is notable with over 60% of the visits in 2023 being reported outdoors during heat exposure.



Locations and Activities during Heat Exposure

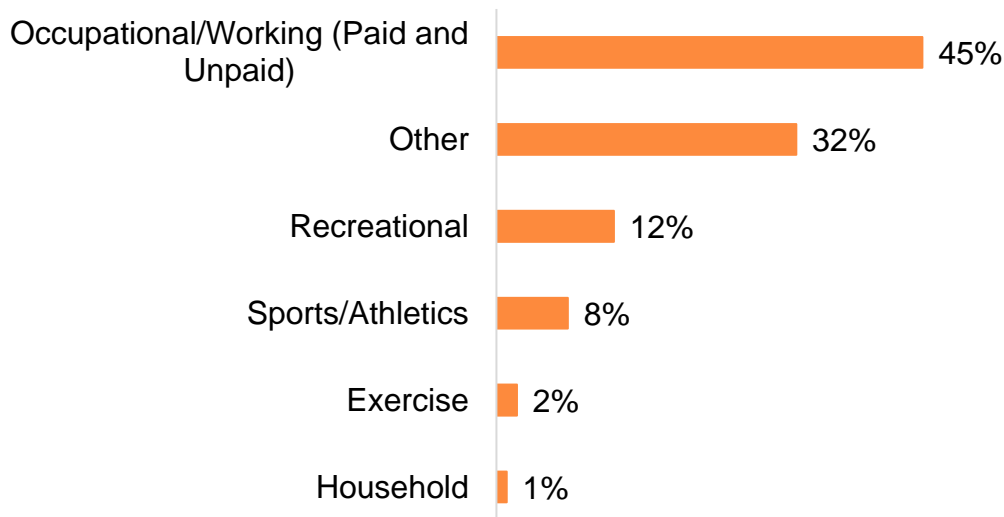
Of the 689 HRI visits with information on the physical location where the heat exposure occurred, 42% reported being at a place of work and nearly 30% occurred in a recreational space (Figure 14). Additionally, 13% reported exposure while on a street and another 11% were exposed while in a motor vehicle, both of which are high-risk locations.



Heat-Related Illness Emergency Department Visits in Delaware, 2019-2023

Of the 741 HRI ED visits with information about activity at the time of heat exposure, 45% were working either for pay or as unpaid work activities (Figure 15). Another 22% were engaged in some type of physical movement activity: recreational activity (12%), organized sport or athletics (8%), or personal exercise (2%).

Figure 15. Percentage of Heat Related Emergency Department Visits* by Reported Activity at the Time of Heat Exposure, Delaware, 2018–2023**



*All ED visits, including non-Delaware residents.

**Activity details only available for 50% (741/1454) of the HRI visits.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Work-relatedness: Informal and Formal Work

Of the 1,454 HRI ED visits across all five years, 52% or 344 records indicated that the heat exposure occurred while the individual was working (Figure 16). The majority (43%) of work was determined to be formal or paid work, 9% was deemed informal or unpaid work, and 48% of the work-related visits had incomplete information; therefore, it was not possible to determine if the work was paid or unpaid work. The trends of paid and unpaid work appear to be stable over time, especially in 2022 and 2023, when more complete data were available (Figure 17).

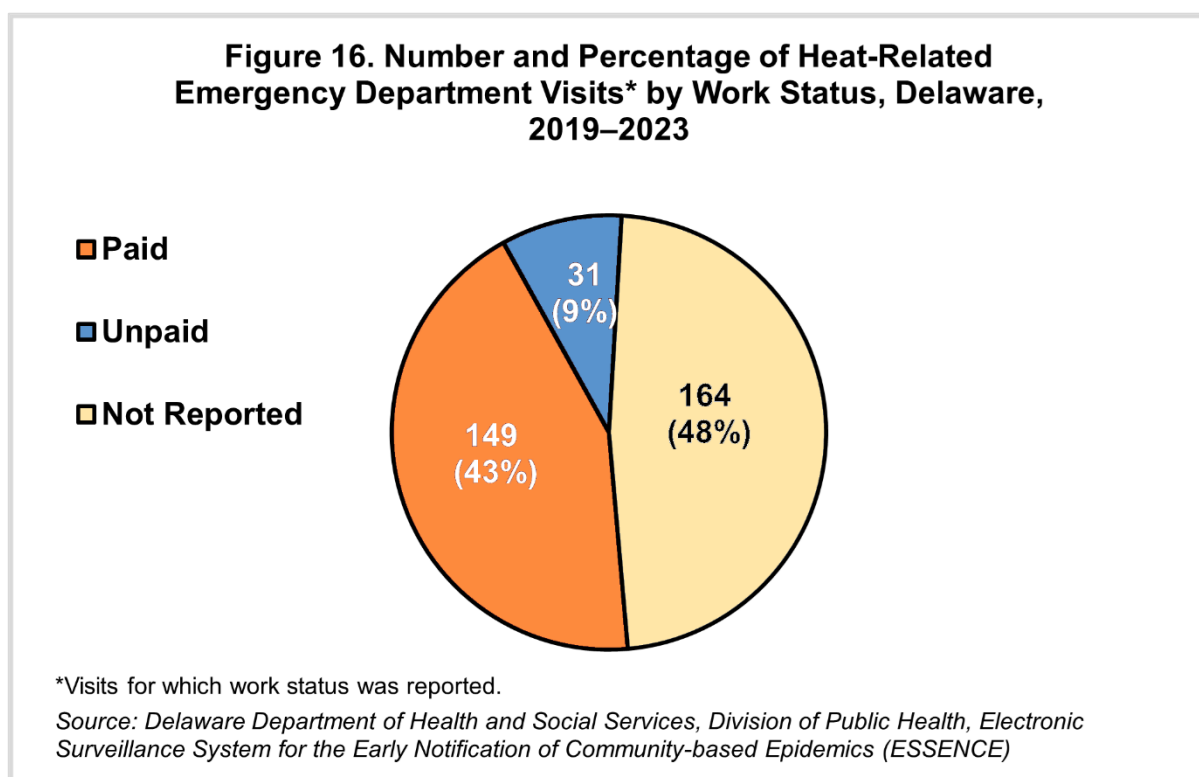
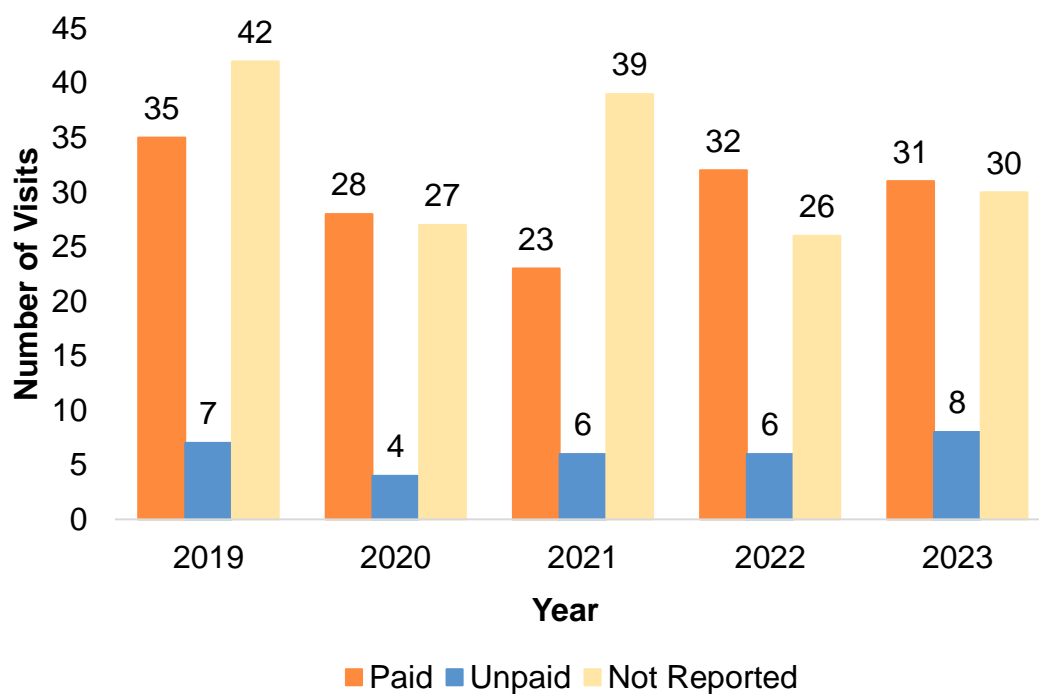


Figure 17. Trends of Available* Information for Heat-Related Emergency Department Visits by Work Status, by Year, Delaware, 2019–2023



*Visits for which work status was reported.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Use of Substances and Housing Status

The number of HRI visits with drug and alcohol involvement decreased during the five-year study period (Figure 18).

The number of HRI ED visits among those experiencing homelessness increased by 63% from 2019 to 2023 (Figure 19). Of the total HRI visits, 6% were reported among individuals experiencing homelessness (Figure 20).

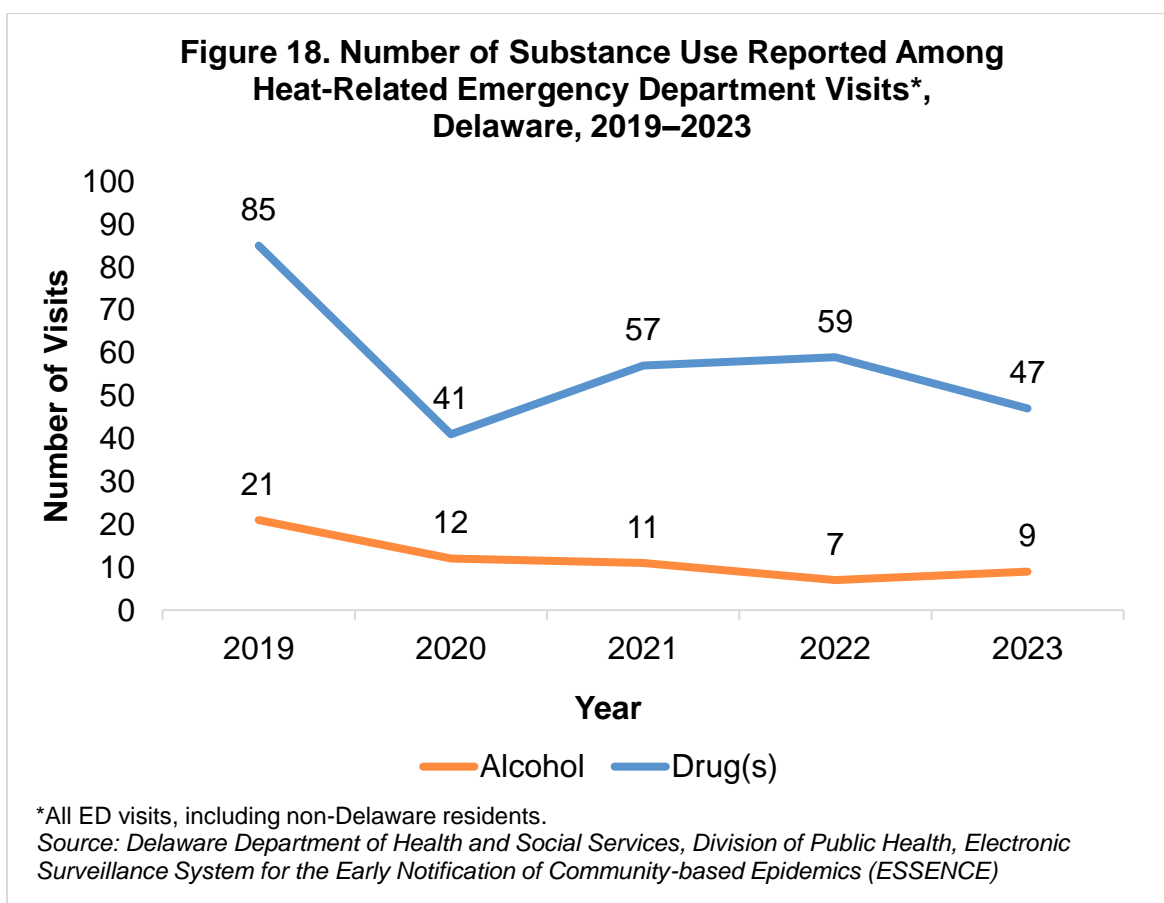
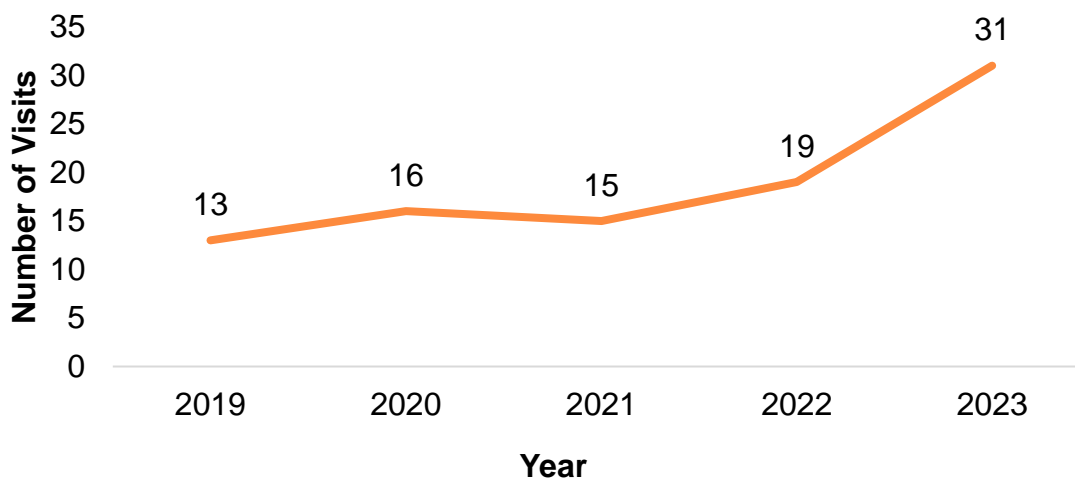


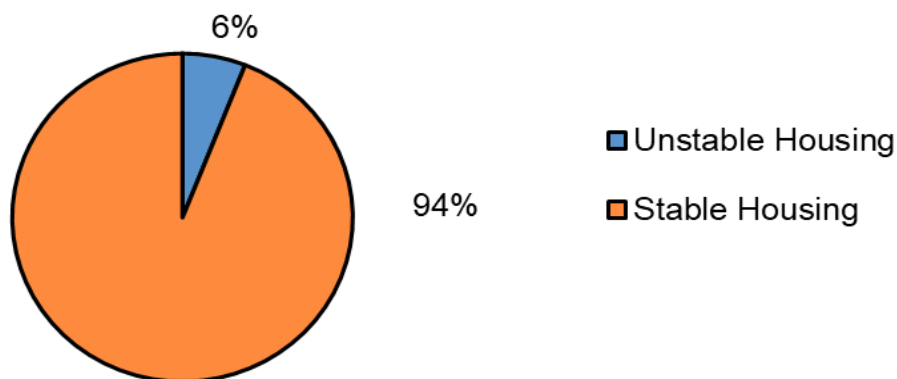
Figure 19. Number of Heat-Related Emergency Department Visits* Among People Experiencing Unstable Housing by Year, Delaware, 2019–2023



*All ED visits, including non-Delaware residents.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Figure 20. Percentage of Heat-Related Illness Emergency Department Visits*, by Housing Status, Delaware, 2019–2023



*All ED Visits, including non-Delaware residents.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Outcomes and Key Risk Factors

Heat-Related Illness Diagnoses

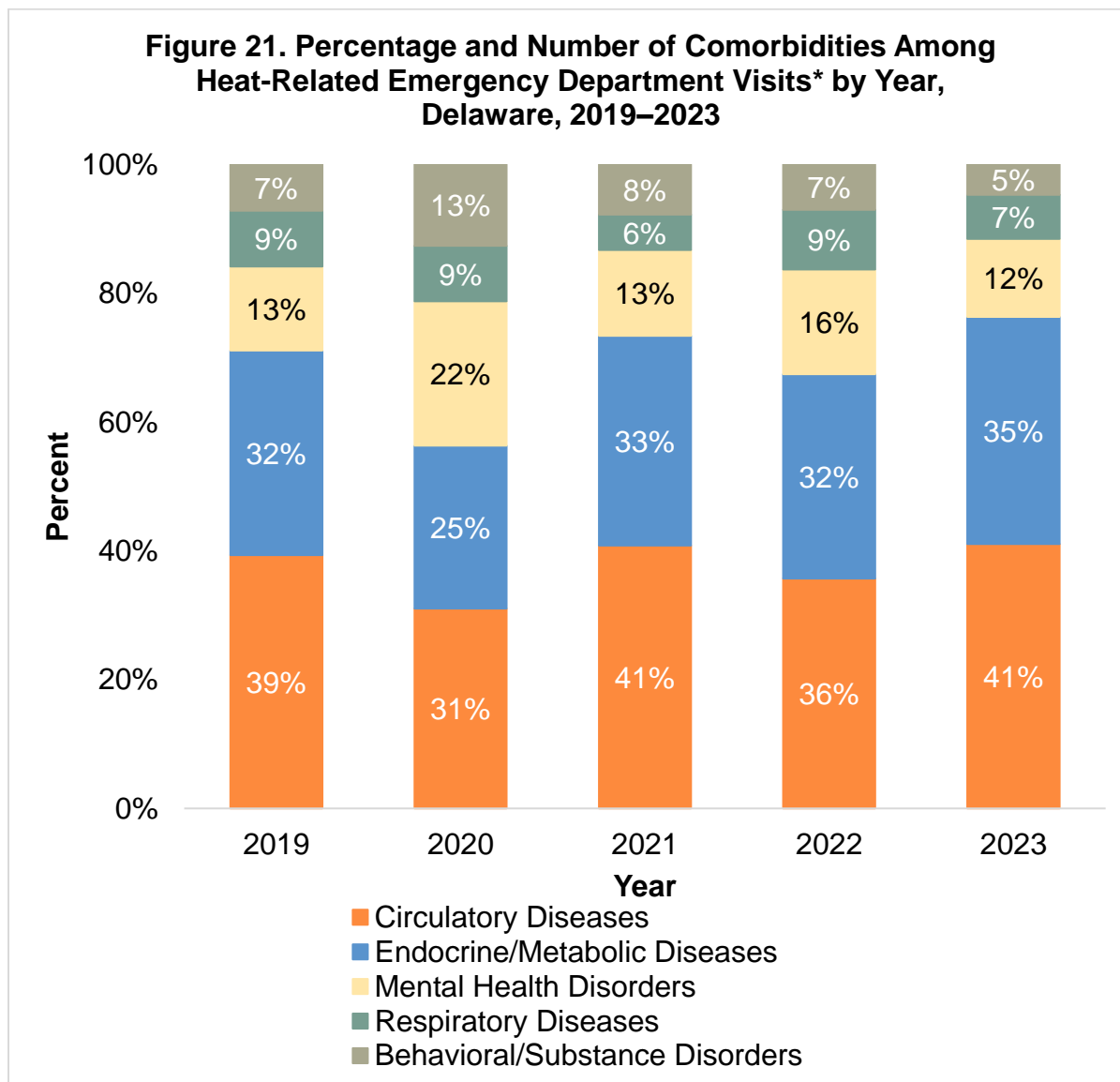
The leading diagnoses of HRI conditions were heat exhaustion and heat syncope (Table 2). Of the most serious health outcomes of HRI visits, ED diagnoses were acute renal failure (11%), rhabdomyolysis (4%), and heat stroke (4%).

Table 2. Number of Heat-Related Emergency Department Diagnoses*, Delaware, 2019–2023		
Heat Diagnosis	Number	Percent
Heat Exhaustion	560	39
Heat Syncope	359	25
Acute Renal Failure	165	11
Rhabdomyolysis	63	4
Heat Stroke	58	4
All Others (e.g., dehydration, heat cramps, heat rash)	982	68

*All ED visits, including non-Delaware residents.
Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Chronic Diseases

The prevalence of chronic diseases among HRI ED visits to Delaware hospitals was notable and relatively consistent between 2019 and 2023 (Figure 21). Annually, between 31% and 41% of HRI patients had a circulatory disease, 25% to 35% had an endocrine/metabolic disease, 16% to 22% had mental health issue, 6% to 9% had respiratory disease, and 5% to 13% had a behavioral/substance issue. The leading diagnoses for each of these category groups were hypertension, diabetes, anxiety/depression, asthma, and chronic kidney disease (Appendix A4).



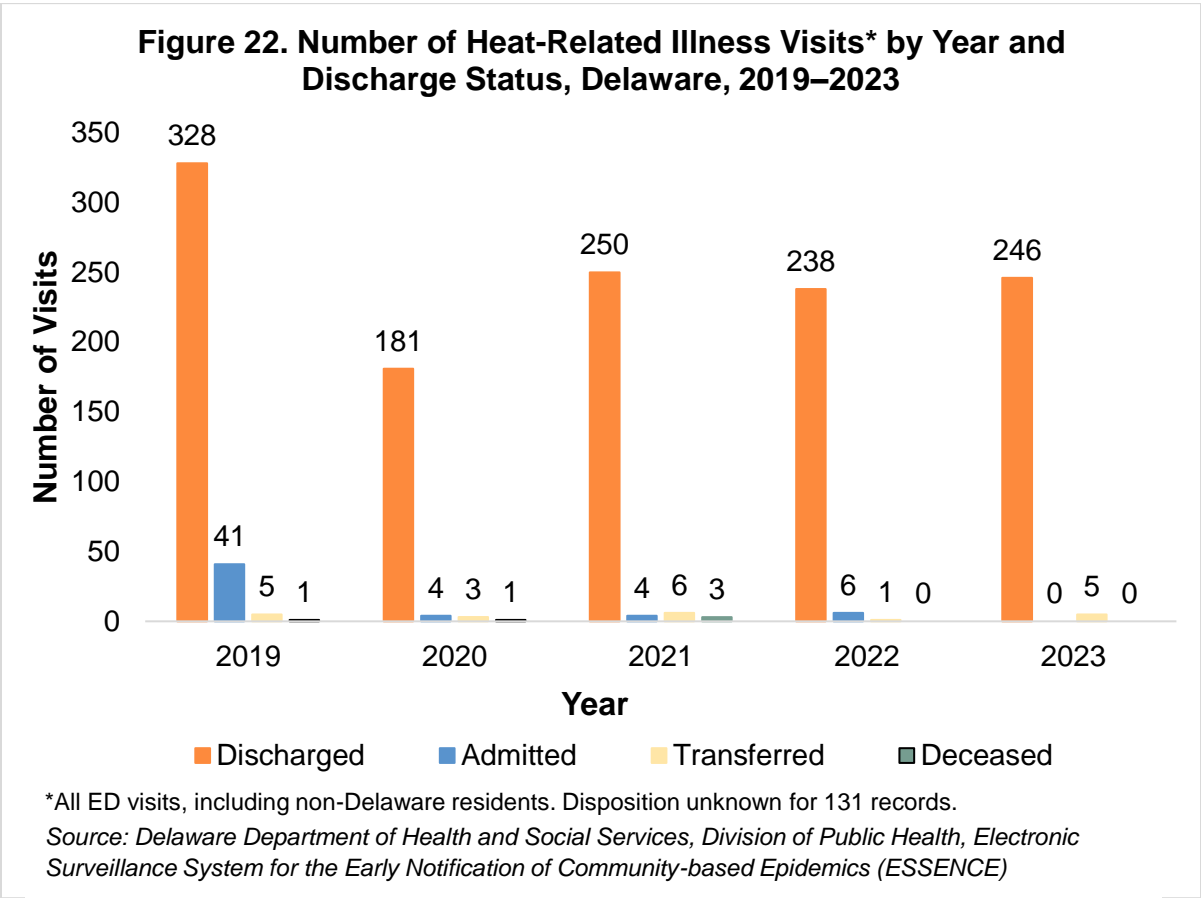
Conditions	2019	2020	2021	2022	2023
Circulatory	181	54	89	81	78
Endocrine/ Metabolic	146	44	71	72	67
Mental Health	60	39	29	37	23
Respiratory	40	15	12	21	13
Behavioral/ Substance	33	22	17	16	9

*All ED visits, including non-Delaware residents.

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

Disposition

The majority (85%) of the HRI ED visits were treated and released from the ED and this trend was consistent during the study period of 2019 to 2023 (Figure 22). During the same period, 55 individuals who visited the ED for HRI were admitted to the hospital, 20 were transferred to another health care facility, and five died during this same period.



Limitations

The limitations of this report should be considered when reviewing the report's findings. An important limitation is the lack of available ethnicity data and other incomplete data in ESSENCE for this analysis. Race was available but the burden of HRI among individuals of Hispanic ethnicity in Delaware is still unknown therefore any subsequent HRI surveillance activities and reports should examine ethnicity, if the data are available. Missing data for 'location of heat exposure and activity' improved over time but still was high so using these results with caution is warranted.

ESSENCE records often captured detailed information about the individual's exposure to heat which was used to create new variables of interest, and this was a time-consuming and manual process with two authors having to review and reach consensus. While not uncommon, this method might be difficult to reproduce and might impact the ability to compare these findings with future trends.

Lastly, the trends for the five-year study period had outlier years in 2019 and 2020, which recorded very high and very low frequency of annual HRI ED visits compared to 2021 through 2023. It would be preferable to use a decade of data to help mitigate the impact of outliers, but this report selected the years based on the completeness of available data in ESSENCE.

Addressing Emerging Excessive Heat in Delaware

Prevention and Response

DPH coordinates with other state agencies, county emergency managers, health care systems emergency coordinators, emergency medical services (EMS), and community organizations to collaborate on extreme heat prevention and heat wave response activities. Key collaborative activities include public health messaging, encouraging the establishment and use of cooling centers, and maintaining protocols for monitoring and responding to HRI. These activities should increase the general public's and workers' awareness of heat risk and useful preventative measures, facilitate access to cooling resources especially for those at high risk for HRI, and strengthen the health care capacity to promptly recognize and treat HRI.

Treatment and Policy

In 2024, the CDC published several new clinical guidance tools for mitigating HRI (CDC, n.d.). Tools for providers include a heat risk screening tool, a quick start guide on how to query patients on heat risk, and instruction on a heat action plan for patients. This could be particularly helpful for patients with chronic diseases and foreign-born residents who may be unaware of the risk of extreme heat impacts and actions to take.

Occupational Health

The Delaware Department of Labor through Safe DE provides helpful heat prevention tips and resources at their website (DE DOL, n.d.). Other resources for workers can be found on CDC's National Institutes of Occupational Safety and Health (NIOSH) heat stress webpage (NIOSH, n.d.) and the Occupational Safety and Health Administration (OSHA) heat page (OSHA, n.d.).

Health Equity

This report highlighted several important results in terms of equity. Efforts to address heat health risks should consider that in Delaware during the five-year period examined:

- There were disproportionate higher rates of HRI among Black patients.
- There was a consistent trend of males making up a higher percent of HRI ED visits.
- There was a sharp increase of HRI among individuals experiencing homelessness.
- In 20% of the total HRI visits, patients reported working at the time of heat exposure.

Each of these populations will likely need specific consideration in terms of messaging and outreach activities to encourage action.

Epidemiology, Data, and Surveillance: Seasonal and Responding to Heat Waves

Since 2022, DPH formally initiated daily active surveillance of HRI in ESSENCE during the summer months to identify at unusual increases in HRI activity in hospital EDs. This is the first report published by DPH on heat-related morbidity in Delaware. The findings in this five-year surveillance report identified a trend of substantial burden of HRI and determined Delaware populations most at risk for heat-related health impacts. These data can be used to guide preparedness planning efforts, inform extreme heat response strategies and public health messaging during a heat wave, evaluate and monitor future trends, and promptly monitor spikes during extreme heat waves. The capacity to conduct surveillance depends on sufficient resources to maintain staffing levels and systems upgrades. With additional resources, surveillance staff can consider expanding this extreme heat surveillance work to extreme cold weather and generate surveillance reports such as annual heat and cold reports or other topics of interest.

Conclusions

This is the first report published by DPH on heat-related morbidity in Delaware. The findings in this five-year surveillance report identified a trend of substantial burden of HRI and determined Delaware populations most at risk for heat-related health impacts. This report can be used by state agencies and non-government organizations to ensure that data-driven strategies are employed to mitigate effects from climate change and future extreme heat incidents.

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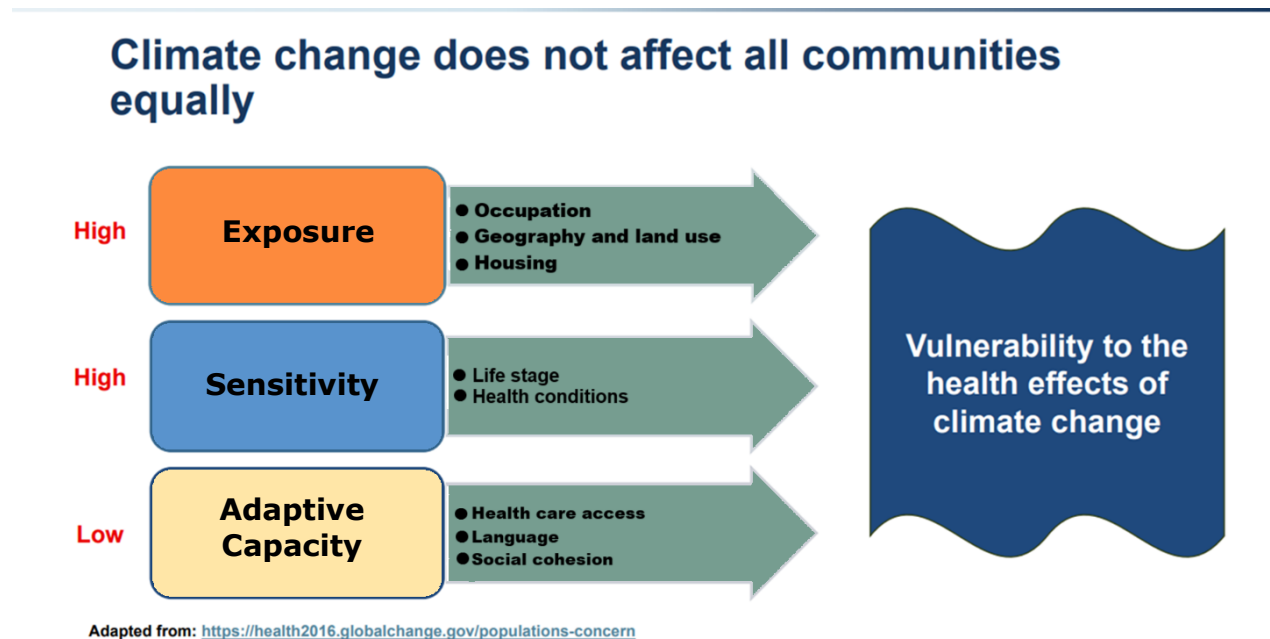
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Appendix

A1. Logic Model for Heat-Related Illness Risk Related to Climate Change*



*Logic model slide used with permission from author.

Source: J. Gamble, J. Balbus, M. Berger, et al., 2016: Ch. 9: Populations of Concern. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. U.S. Global Change Research Program, Washington, DC, 247–286. <http://dx.doi.org/10.7930/J0Q81B0T>.

A2. Number of Heat-Related Illness Emergency Department Visits by ZIP Code, Delaware, 2019-2023

ZIP Code	Number
19805	91
19720	68
19973	64
19713	62
19802	57
19901	55
19904	55
19801	51
19966	48
19709	46
19977	37
19702	36
19701	35
19808	32
19963	31
19711	30
19947	30
19958	26
19938	25
19956	25
19933	24
19809	23
19962	23
19804	22
19734	20
19943	18
19806	17
19950	17
19952	17
19968	14
19971	13
19934	12
19810	11

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

A3. Number and Rate* of Delaware Resident Heat-Related Illness Emergency Department Visits by County and Year, Delaware, 2019-2023

Year	New Castle Number (n=632)	New Castle Rate	Kent Number (n=304)	Kent Rate	Sussex Number (n=313)	Sussex Rate	Delaware Number	Delaware Rate
2019	177	31.2	93	52.1	93	39.7	363	37.0
2020	105	18.4	51	28.0	34	14.3	190	19.2
2021	133	23.3	55	29.9	54	22.0	242	24.2
2022	123	21.4	63	33.8	47	18.4	233	23.0
2023	94	16.3	42	22.2	85	32.3	221	21.5

**Rate was calculated as ED visits per 100,000 population for the county and state.*

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)

A4. Most Common Chronic Diseases Reported Among Heat-Related Visits, by CCSR Codes*, Delaware, 2019–2023

Most Common Chronic Diseases Reported Among Emergency Department Heat-Related Visits, by CCSR Codes*, Delaware, 2019-2023			n	%
Diseases of the Circulatory System (CIR)			483	33.2%
CIR007	Essential Hypertension		235	48.7%
CIR017	Cardiac dysrhythmias		67	13.9%
CIR011	Coronary atherosclerosis and other heart disease		49	10.1%
CIR008	Hypertension with complications and secondary hypertension		36	7.5%
CIR016	Conduction disorders		31	6.4%
CIR019	Heart Failure		19	3.9%
CIR003	Diabetes mellitus with complication		9	1.9%
CIR026	Peripheral and visceral vascular disease		8	1.7%
CIR023	Occlusion or stenosis of precerebral or cerebral arteries without infarction		6	1.2%
CIR015	Other and ill-defined heart disease		7	1.4%
CIR032	Other specified and unspecified circulatory disease		4	0.8%
CIR005	Myocarditis and cardiomyopathy		4	0.8%
Other	Other CIR conditions (i.e., CIR001, CIR014, CIR024-025, CIR029, CIR036)		8	1.7%
Endocrine, Nutritional and Metabolic Diseases (END)			400	27.5%
END010	Disorders of lipid metabolism		116	29.0%
END005	Diabetes mellitus, Type 2		93	23.3%
END002	Diabetes mellitus without complication		66	16.5%
END003	Diabetes mellitus with complication		37	9.3%
END016	Other specified and unspecified nutritional and metabolic disorders		38	9.5%
END001	Thyroid disorders		29	7.3%
END009	Obesity		13	3.3%
END004	Diabetes mellitus, Type 1		4	1.0%
Other	Other END0 conditions (i.e., END015, END013)		4	1.0%
Mental, Behavioral and Neurodevelopmental Disorders (MBD)			293	20.2%
<i>Mental/Neurodevelopmental Disorders</i>			196	66.9%
MBD005	Anxiety and fear-related disorders		58	29.6%
MBD002	Depressive disorders		37	18.9%
MBD003	Bipolar and related disorders		30	15.3%
MBD001	Schizophrenia spectrum and other psychotic disorders		28	14.3%
MBD014	Neurodevelopmental disorders		18	9.2%
MBD012	Suicidal ideation/attempt/intentional self-harm		8	4.1%
MBD007	Trauma- and stressor-related disorders		5	2.6%
Other	Other MBD conditions (i.e., MBD004, MBD013, MBD006)		4	2.0%

Most Common Chronic Diseases Reported Among Emergency Department Heat-Related Visits, by CCSR Codes*, Delaware, 2019-2023			n	%
<i>Behavioral/Substance Use Disorders (Continued)</i>			97	33.1%
MBD017	Alcohol-related disorders		48	49.5%
MBD018	Opioid-related disorders		16	16.5%
MBD025	Other specified substance-related disorders		11	11.3%
MBD019	Cannabis-related disorders		8	8.2%
MBD021	Stimulant-related disorders		5	5.2%
MBD022	Hallucinogen-related disorders		5	5.2%
MBD026	Mental and substance use disorders in remission		4	4.1%
Diseases of the Respiratory System (RSP)			101	6.9%
RSP009	Asthma		75	17.8%
RSP008	Chronic obstructive pulmonary disease and bronchiectasis		18	7.9%
Other	Other RSP: disabilities conditions (i.e., RSP007, RSP013, RSP016)		8	7.9%
Diseases of the Genitourinary System (GEN)			53	3.6%
GEN003	Chronic kidney disease		39	73.6%
GEN006	Other specified and unspecified diseases of kidney and ureters		14	26.4%

* CCSR=Clinical Classification Software Refined organized ICD-10 codes into meaningful categories

Unmapped=71, Other chronic diseases:

CIR025 Sequela of cerebral infarction and other cerebrovascular disease

CIR001 Chronic rheumatic heart disease

CIR014 Pulmonary heart disease

CIR024 Other and ill-defined cerebrovascular disease

CIR029 Aortic; peripheral; and visceral artery aneurysms

CIR036 Post thrombotic syndrome and venous insufficiency/hypertension

END015 Other specified and unspecified endocrine disorders

END013 Cystic fibrosis

MBD013 Miscellaneous mental and behavioral disorders/conditions

MBD004 Other specified and unspecified mood disorders

MBD006 Obsessive-compulsive and related disorders

RSP007 Other specified and unspecified upper respiratory disease

RSP016 Other specified and unspecified lower respiratory disease

RSP013 Lung disease due to external agents

Source: Delaware Department of Health and Social Services, Division of Public Health, Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE)