



Emergency Department Impacts Due to an Unprecedented Extreme Heat Event in Vancouver Coastal Health, 2021

An extreme heat event affected much of British Columbia from June 25 - July 1, 2021. An Extreme Heat Alert was issued on June 25th, lasting until June 29th. Some of the highest daytime, as well as nighttime, temperatures ever recorded in the region were experienced, resulting in increased demand on the healthcare system, and significant adverse outcomes in Vancouver Coastal Health's (VCH) population. The number of deaths in BC increased significantly during that period. The BC Corners Service identified 619 deaths caused by this extreme heat event.¹

Extreme heat events are a growing public health risk due to human-caused climate change and can lead to adverse health effects through numerous pathways. High ambient temperatures are associated with increased all-cause mortality as well as mortality from specific causes such as heat stroke, cardiovascular disease, and respiratory disease. Additionally, emergency department visits and hospitalizations are further impacted during these events by a number of health outcomes including mental and behavioral disorders, acute renal failure and complications from pre-existing conditions such as diabetes.²

The health burden of heat events is not experienced equally across the population. People who are at increased risk of adverse health outcomes are seniors aged 65 years or older, people who live alone, infants and young children, pregnant people, those with pre-existing health conditions, those with mental illness, people with substance use disorder, people exposed during work in hot environments and those with situational and housing vulnerabilities.¹ While all members of the public can benefit from heat event preparedness, attempts to identify and focus additional supports on those with an increased risk of adverse outcomes can have a substantial effect on the prevention of heat related health impacts in our region.³

This report focuses on Emergency Department (ED) visits across the VCH region, including those in Vancouver, Richmond, the North Shore, and Howe Sound. At the time of analysis, ED data was not available for BC Children's Hospital, or for facilities on the Sunshine Coast (Powell River General Hospital, and Sechelt Hospital) or Central Coast (Bella Coola General Hospital, and R.W. Large Memorial Hospital).

The extreme heat event also had impacts on other health services and outcomes including ambulatory services, physician visits and mortality, further emphasizing the need for continued collaboration with our partners to understand the entire scope of health system burdens and outcomes due to heat and other environmental events. It is also recognized that there are impacts to health and wellbeing that are not captured by health system data, but contribute significantly to the impact of heat events on the population.

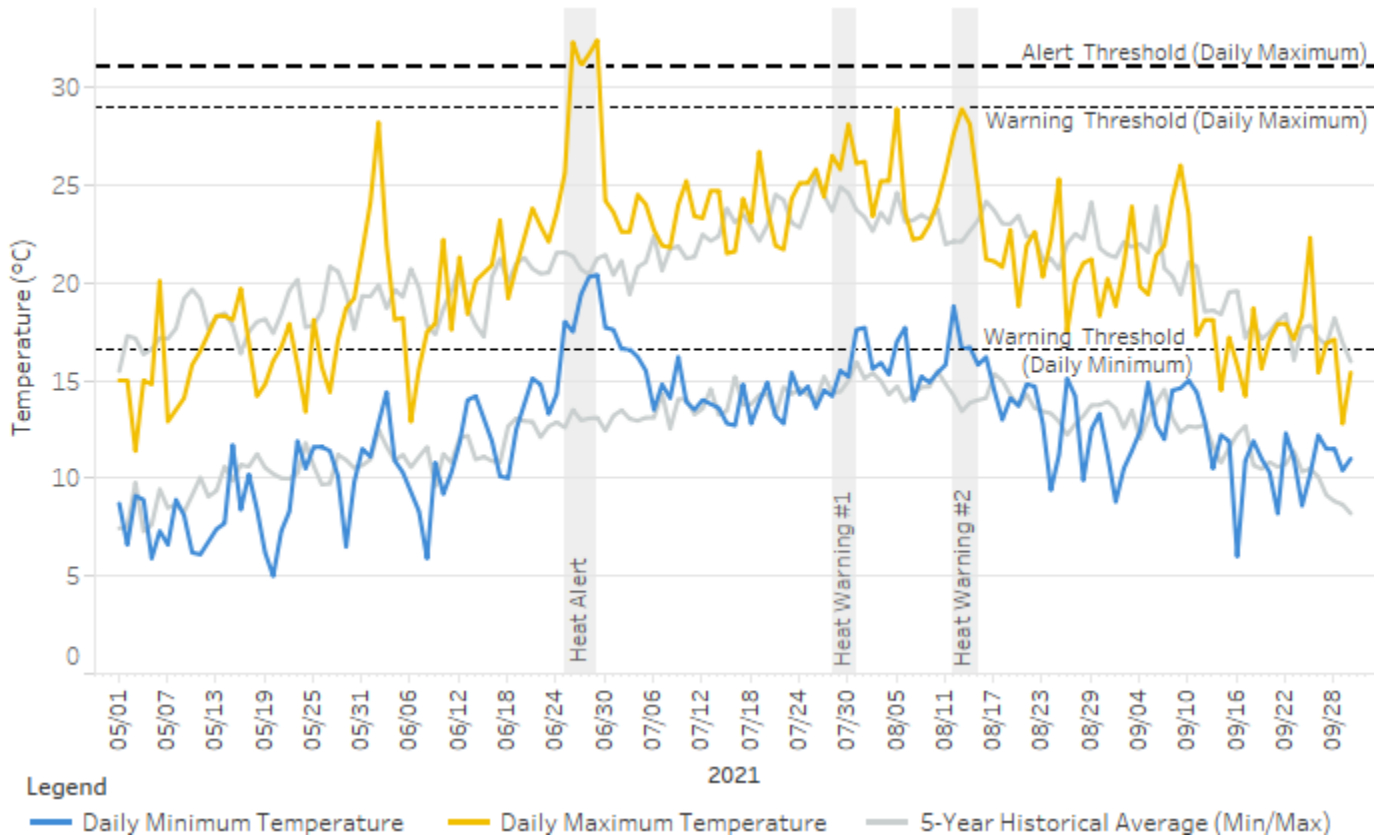
The province also experienced two heat warnings in 2021 between July 28 and 31 and between August 12 and 15. Temperatures during these events were lower than those observed during the June extreme heat event, and the resulting burden on the healthcare system and population was considerably less. As such, this document focuses on the impact of the June 2021 extreme heat event.

It is important to note that while temperatures during the June 2021 heat event normalized after July 1, 2021, health outcomes were often not immediate. To properly account for this delay from heat exposure to health outcomes, this report measures outcomes between June 25 and July 2, 2021.

The VCH Public Health Surveillance Unit has continuously refined clinical definitions and related algorithms for surveillance of heat-related health effects in partnership with the VCH and Providence Health Care (PHC) Emergency Medicine program, and this report reflects case-identification processes in place at the time of the 2021 heat dome. Heat-related ED visit definitions and analytic methods used in the report are available in the Appendix.

Part 1. Daily Temperature

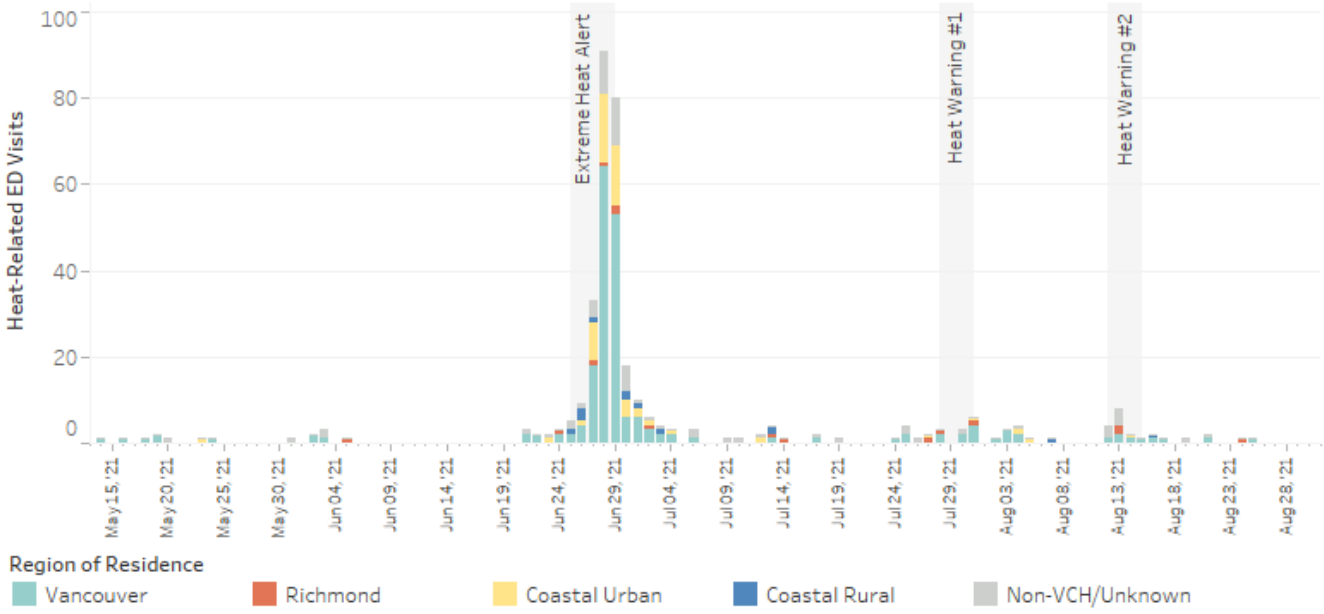
Figure 1. Daily Maximum and Minimum Temperatures, Vancouver International Airport (YVR) Temperature Monitoring Station, May 1–September 30, 2021



- Extreme temperatures were observed June 26–29, 2021 at YVR Station, peaking at 32.4°C on June 29th. Daytime high temperatures exceeded the 5-year average by over 10°C throughout this period. West Vancouver and Whistler stations recorded daytime high temperatures between June 25 and 29 that exceeded the 5-year average by as much as 20.7 degrees in Whistler (42.9°C on June 29th), and 19.8°C in West Vancouver (40.6°C on June 27th).
- Overnight minimum temperatures far exceeded the YVR station heat warning threshold of 16°C, surpassing 20°C on June 29th.

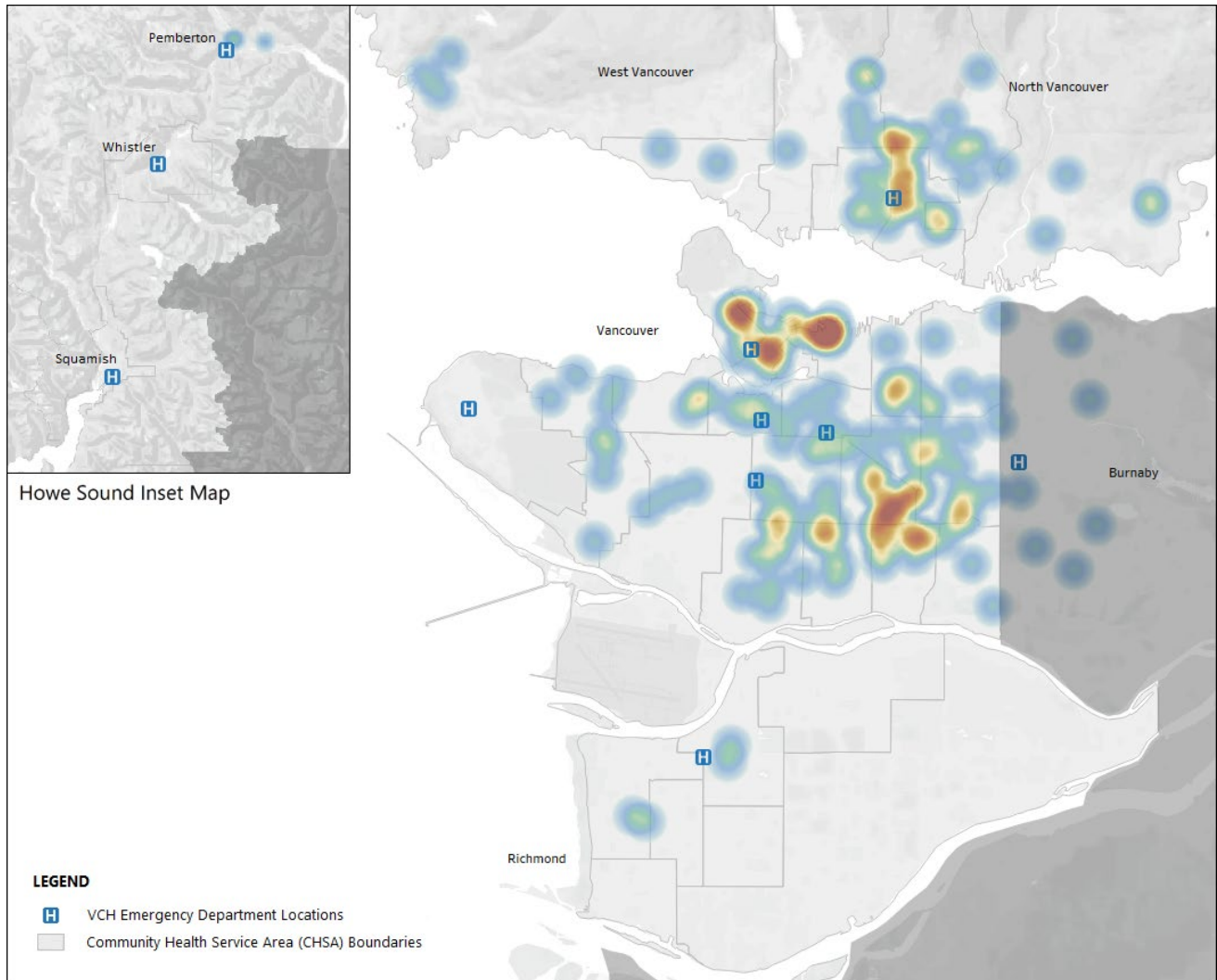
Part 2. Heat-Related ED Visits

Figure 2. Heat-Related ED Visits by Visit Date, May 1–September 30, 2021



- A total of 252 visitors to ED presented for heat-related reasons, across nine VCH facilities between June 25 and July 2, 2021.

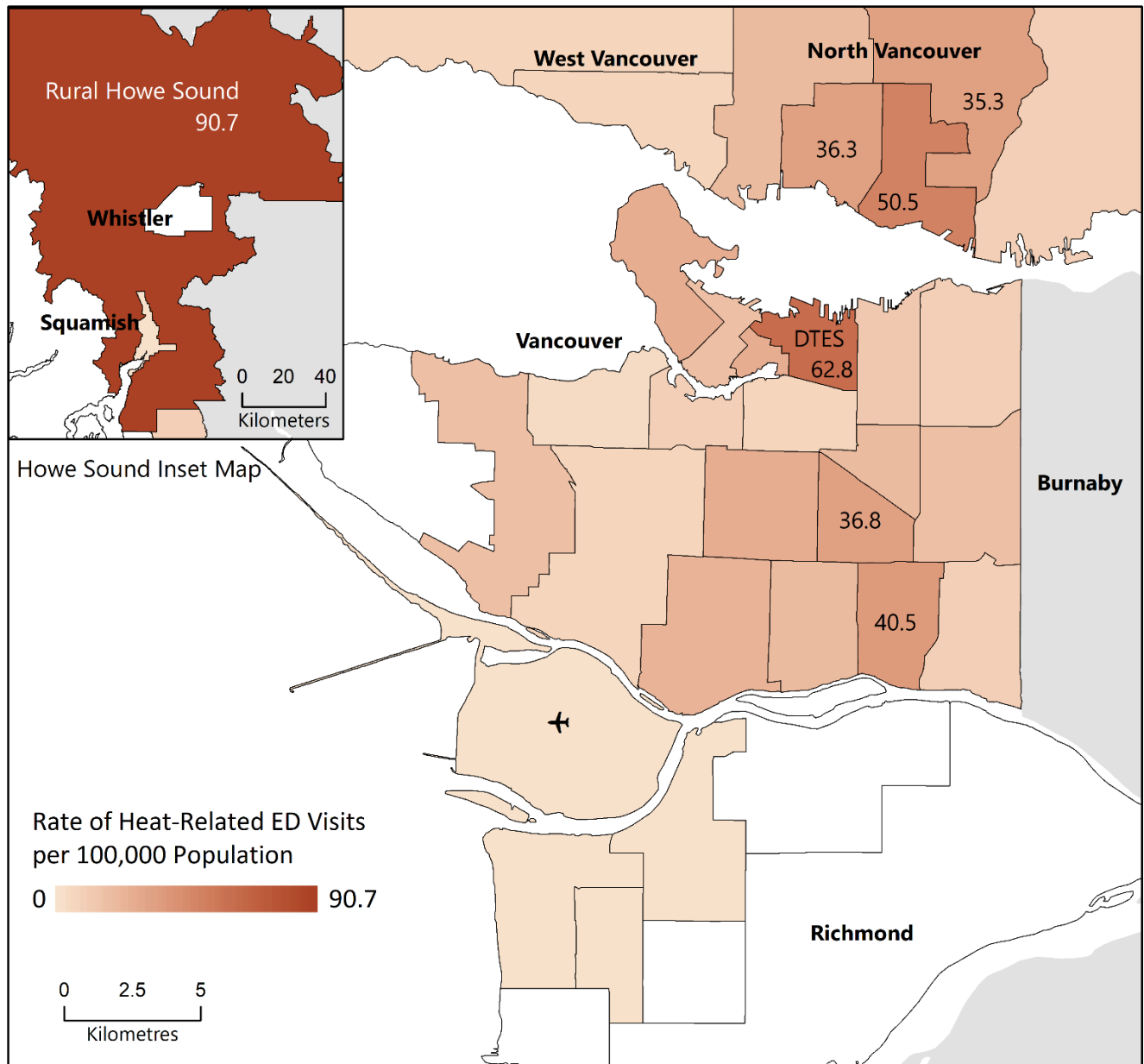
Map 1. Heat-Related ED Visits by Residence, June 25 – July 2, 2021



** residential locations have been shifted to preserve anonymity*

- The majority of identified heat-related ED visits occurred among residents of Vancouver (61.9%) followed by North Vancouver (18.7%), residents from Fraser Health region seeking care in VCH EDs (5.2%), Howe Sound (3.2%), West Vancouver (2.0%), and Richmond (2.0%). Residential location was not known for 7.1% of visitors (Map 1).
- Among Vancouver residents, a higher volume of ED visits were among people with home addresses from Downtown Eastside, West End, Kensington, and Victoria-Fraserview Community Health Service Areas (CHSAs) (Map 1).

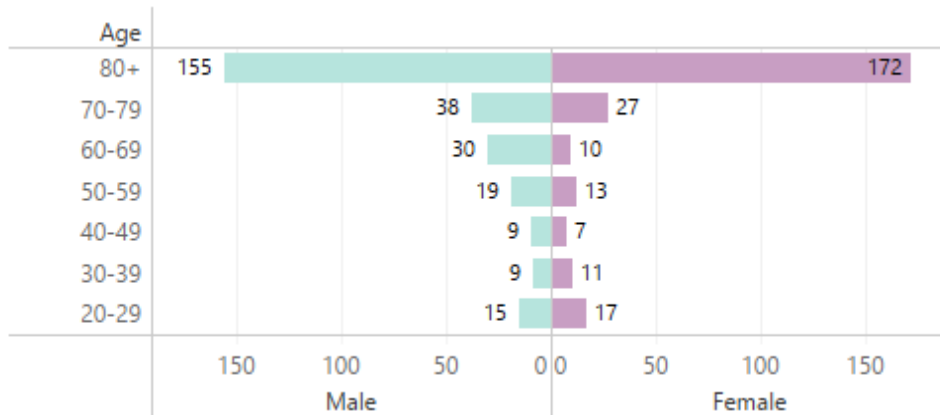
Map 2. Rate of Heat-Related ED Visits per 100,000 Population by Community Health Service Area of Residence, June 25 – July 2, 2021



Data note: CHSA rate is suppressed for areas where the number of heat-related ED visits is less than 5

- Comparing Community Health Service Areas, we see a difference between ED visit volumes (Map 1) and per-population rates (Map 2).
- In the urban CHSAs, a higher burden of visits per population were observed among residents of the Downtown Eastside, North Vancouver City-East, Victoria-Fraserview, Kensington, North Vancouver City – West, and North Vancouver DM - Central CHSAs (Map 2).
- Rural Howe Sound (includes Pemberton, D’Arcy, Lillooet) shows the highest rate amongst measured communities, despite relatively low visit volumes (n=7). Given the small number of total visits, this per-population rate should be interpreted with caution (Map 2).

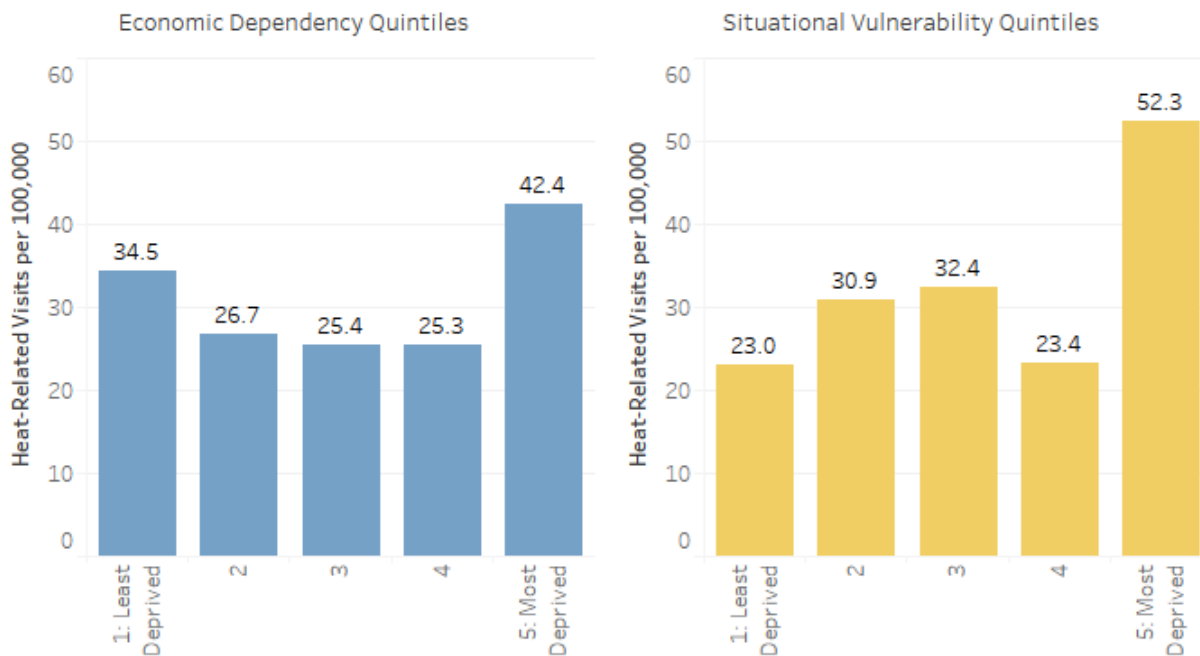
Figure 3. Rate of Heat-Related ED Visits by Age and Gender, per 100,000, June 25 – July 2, 2021 (n=251*)



Data Note: BC Children’s Hospital data is unavailable for analysis, resulting in incomplete data for infants and children. Therefore, rates of heat-related ED visits in infant/child populations are unable to be calculated. Gender is not known for one individual

- By age, the highest rate of ED visitation was observed among those aged greater than 80+ years (Figure 3) with 53.2% of visits among those aged 65 years or older.

Figure 4. Rate of Heat-Related ED Visits by Neighbourhood Residential Instability and Situational Vulnerability CIMD⁵ Deprivation Scales, June 25 – July 2, 2021

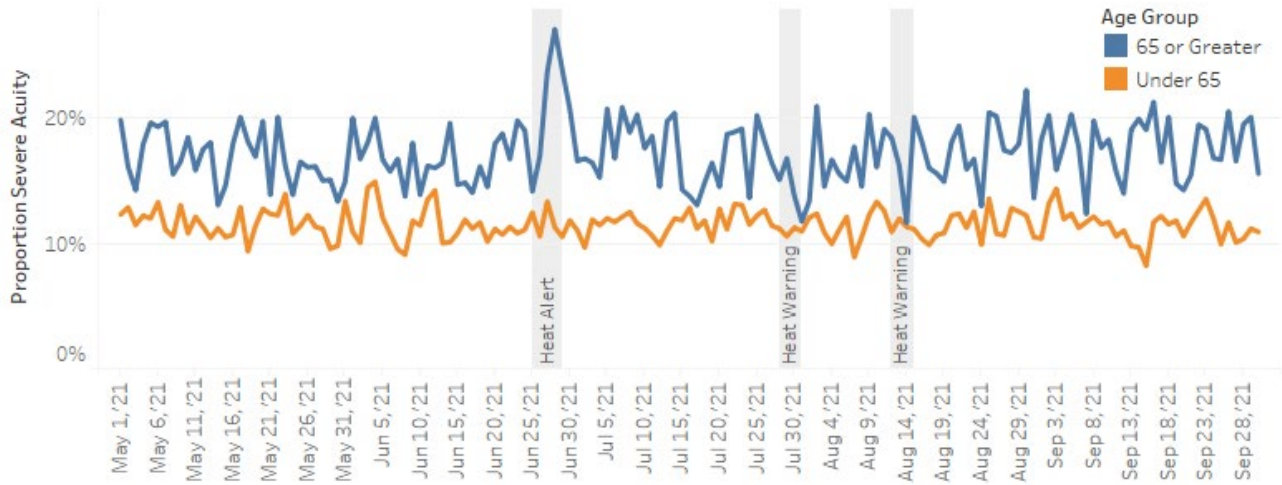


Data note: Situational Vulnerability and Economic Dependency definitions available in Appendix. Deprivation scores are assigned based on the dissemination area of residence. Situational Vulnerability and Economic Dependency are measures composed of multiple variables drawn from census data, and reflect geographic populations rather than individual-level characteristics.

- People who reside in the most deprived quintile neighborhoods for Situational Vulnerability or Economic Dependency experienced the highest rate of heat related ED visits (Figure 4). Certain neighbourhood-level deprivation measures were also associated with increased risk of death in BC, during the June heat event.⁴

Part 3. Overall ED Visits by Acuity Presentation and Discharge Disposition

Figure 5. Proportion of Emergency Department Visits Presenting with Severe Acuity* by Age Group, Vancouver Coastal Health, June 1 - August 31, 2021



* Severe Acuity refers to levels 1 and 2 of the Canadian Triage and Acuity Scale (CTAS), where level 1 involves resuscitation or other aggressive medical interventions, and level 2 is characterized as an emergency requiring rapid intervention to prevent loss of life, limb, or function.

- An increase in severe acuity presentation (CTAS 1: Resuscitation and CTAS 2: Emergent) was observed among those aged 65 or greater, during the initial 2021 extreme heat event (Figure 5).
- Between June 25th and July 2, 2021, 74 of 252 heat-related visits presented with severe acuity, 89% being at least 65 years old.

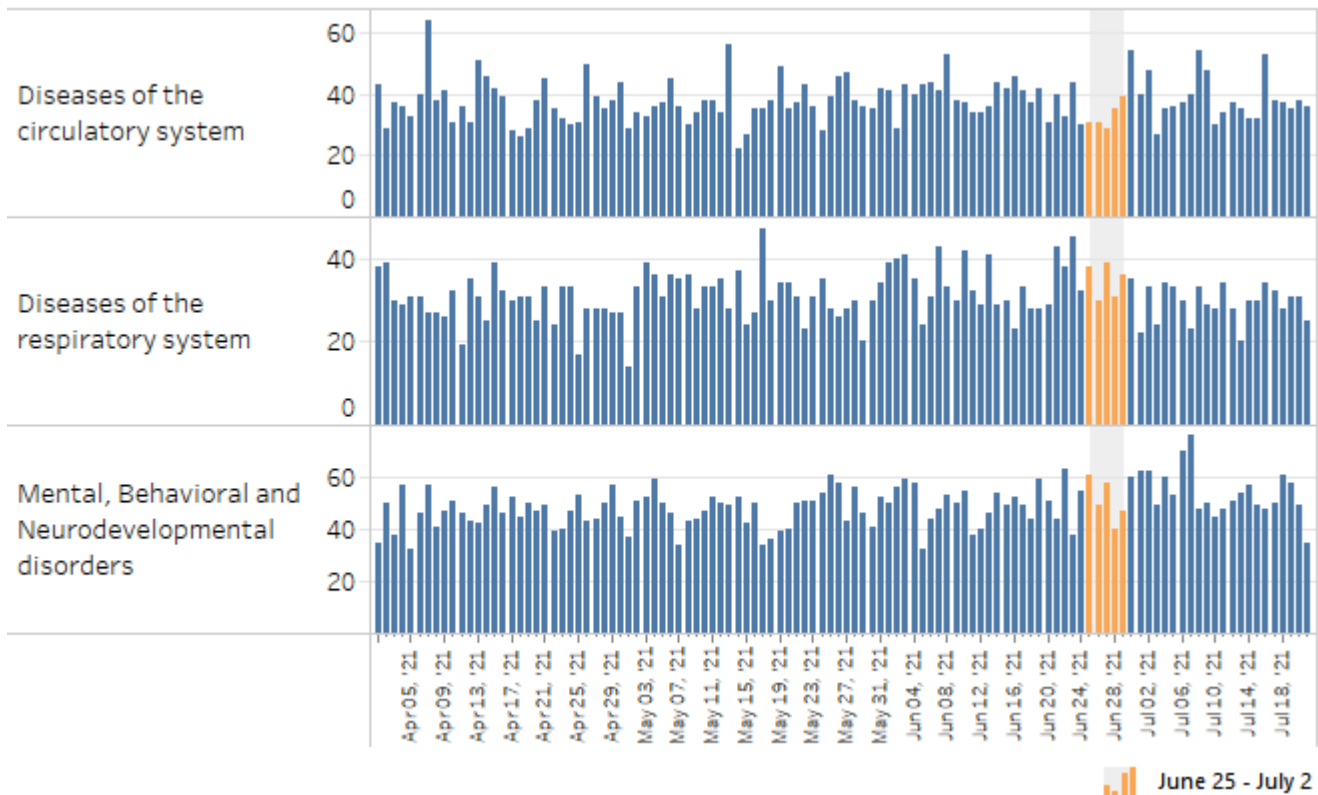
Table. Hospital Admissions among Heat-Related ED Visits by Age Group, VCH June 25-July 2, 2021

Age Group	Visited ED	Admitted to Hospital (% Admitted)
0-19 Years	16	0 (0%)
20-64 Years	102	3 (2.9%)
65+ Years	134	33 (24.6%)
Total	252	36 (14.3%)

- The proportion of patients who visited the ED for heat-related reasons that were further admitted to hospital varied substantially by age. Among patients aged 65 years and older, 24.6% were admitted to hospital representing 92% of all hospitalizations from heat-related ED visits (Table).
- Of note, some hospital admissions for conditions exacerbated by heat (e.g. cardiac, respiratory and renal conditions) may not have been captured as heat-related visits by the surveillance algorithm applied at the time of this heat event, resulting in a possible underestimation of both the number of ED visits and the number of admissions to hospital for conditions exacerbated by the heat event.

Part 4. ED Visits related to Other Conditions Potentially Effected by a Heat Related Event

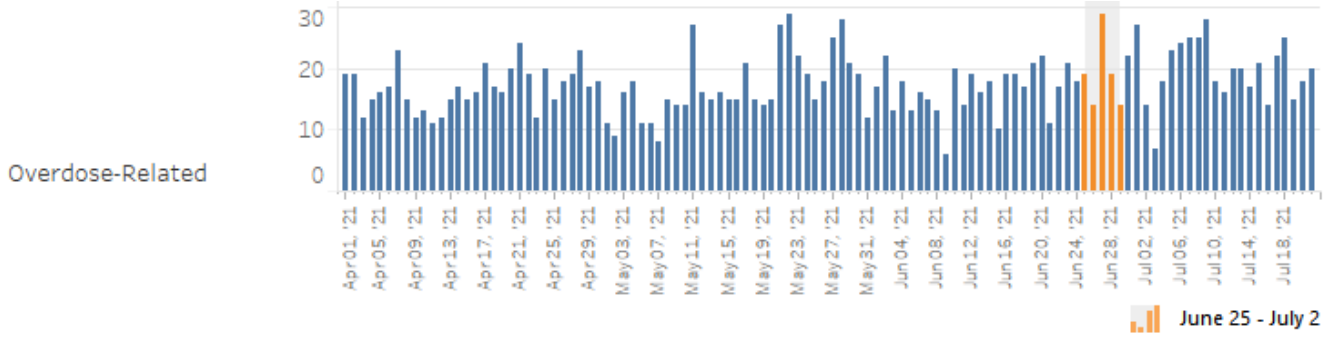
Figure 6: Diseases of the Circulatory System, Respiratory System, and Mental Health Related ED Visits, April 1 – July 21, 2021



Data note: ICD-10 Definitions: Diseases of the circulatory system (I00-I99), Diseases of the respiratory system (J00-J99), Mental, Behavioral and Neurodevelopmental disorders (F00-F99)

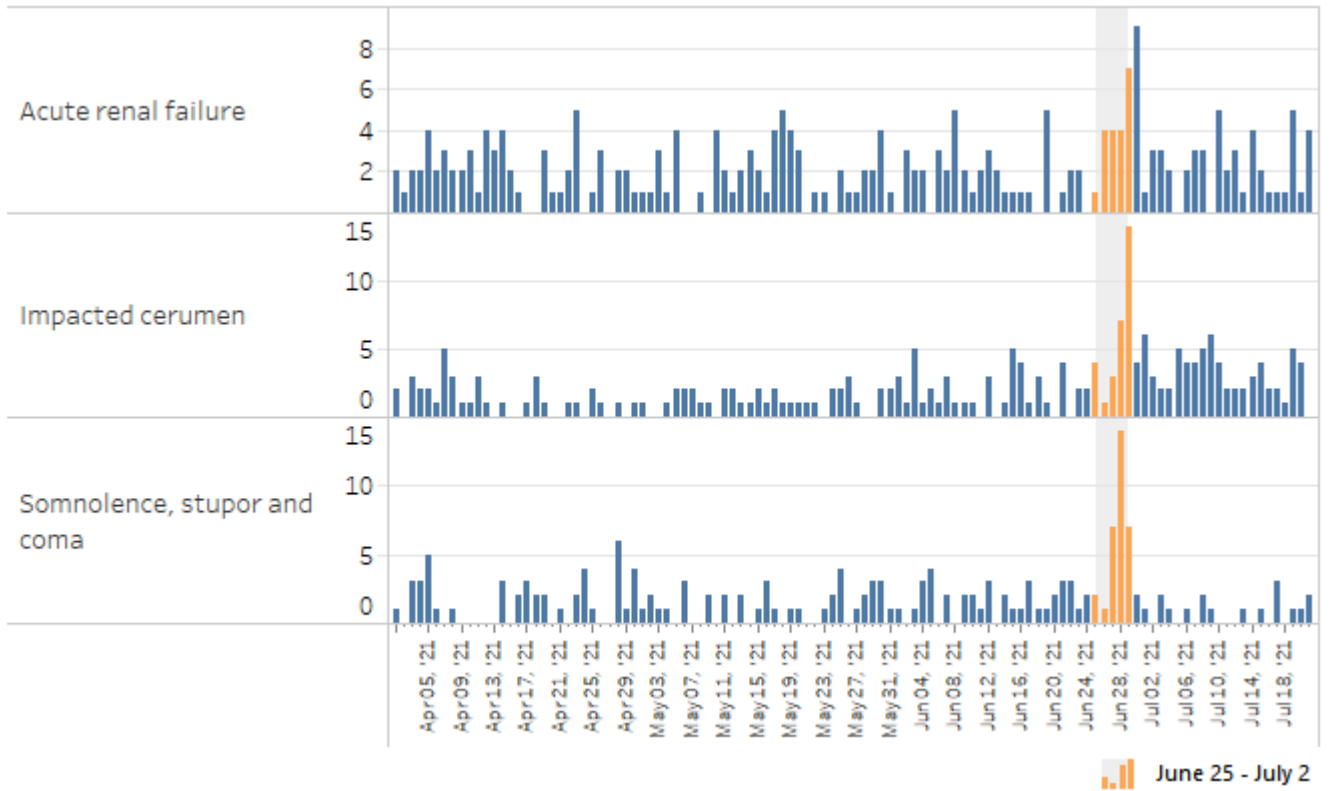
- We investigated ED visits during the extreme heat event for diseases of the circulatory, respiratory systems, as well as mental, behavioural and neurodevelopmental disorders, conditions for which adverse impacts have been reported in health research globally.⁶
- Overall, an increase in ED visits was not observed for these types of broad conditions in VCH during the extreme heat event in June 2021. Further exploration of specific diagnoses within these broad disease categories is under consideration as surveillance system refinement continues.

Figure 7: Overdose Related ED Visits, April 1 – July 21, 2021



- No prominent increase in overdose related ED visits were observed in the VCH region during the June 25-July 1, 2021 extreme heat event.

Figure 8: ED Visits for 'Acute Renal Failure', 'Other Disorders of the External Ear', and 'Somnolence, Stupor and Coma', April 1 – July 21, 2021



- There was an increase in ED visits for presenting issues and diagnoses recorded as “acute renal failure” (ICD-10 N17), “impacted cerumen (ear wax)” (ICD-10 H61.2), as well as “somnolence, stupor and coma” (ICD-10 R40). Acute renal failure and somnolence, stupor and coma are consistent with established knowledge on the health impacts of extreme heat. It is possible that some visits coded as impacted cerumen were diagnoses made following symptoms of dizziness or vertigo and related investigations.

Acknowledgements

We would like to acknowledge our colleagues at Vancouver Coastal Health and Providence Health Care Emergency Medicine for their knowledge and support on this report as well as ongoing refinement of our regional heat surveillance system.

Appendix

Data Sources

- VCH Emergency Room Visits Database include ED visits from CareCast System (Richmond Hospital, UBC Hospital, and Vancouver General Hospital) and CST System (Mount Saint Joseph Hospital, St. Paul's Hospital, Lions Gate Hospital, Pemberton Health Centre, Squamish General Hospital, and Whistler Health Care Centre).
- Temperature data for all stations referenced were provided by BCCDC.

Methodology

Criteria for Alerts and Warnings*:

Heat Warning

According to historical BCCDC data, the Heat Warning criteria indicate temperatures at which an increase in deaths in the community is expected. Criteria are specific to each region of BC. In the Southwest, warnings are issued for the region when criteria is met for either the Coastal or Inland station.

- **Coastal station** (Vancouver Airport): Two or more consecutive days of daytime maximum temperatures are expected to reach 29°C or warmer and nighttime minimum temperatures are expected to be at 16°C or warmer.
- **Inland station** (Abbotsford Airport): Two or more consecutive days of daytime maximum temperatures are expected to reach 33°C or warmer and nighttime minimum temperatures are expected to be at 17°C or warmer.

Extreme Heat Alert

An *Extreme Heat Alert* is declared when the expected risk to the public is extremely high. This is based on current and forecasted temperature criteria recommended by the BCCDC, in addition to a health authority assessment of anticipated risk to health.

- Two-day average of high temperatures is predicted to reach 36°C or above at Abbotsford Airport and/or is predicted to reach 31°C or above at Vancouver airport, based on 2pm measurements.

** Prior to the summer of 2022, the BC Provincial Health Alert and Response System (BC HARS)⁷ was developed, replacing the system described above.*

Heat-Related ED Visit Case Definition and Categorization

Heat-Related Illness Categories	Presenting Complaint	ICD Codes	Discharge Diagnosis
heat exhaustion/stroke	"heat exhaustion" "heat stroke" "heatstroke"	992.5 T67	"heat" and "stroke" "heat" and "exhaustion"
heat syncope		T67.9A	"heat" and "syncope"
heat cramps		T67.9C	"heat" and "cramps"
heat edema		T67.9B	"heat" and "edema"
effect of heat and light		T67.9D, T679	"effects" and "heat"
sunburn	"sunburn" "sun burn"	692.71, L55.9, L989 E	"sunburn"
heat-related illness presentation	"heat related illness" "heat illness"		

Inclusion criteria based on Presenting Complaint text search and ICD codes. Further heat related illness categorization takes into account text search terms from the discharge diagnosis field.

Validation of Heat-Related Visit Case Definition

Validation of this heat-related visit algorithm was conducted in July 2022 for ED visits pertaining to June 28, 2021, the peak ED visit day. This analysis found that the heat-related visit algorithm used in this report had a very high specificity (100%), but lower sensitivity (59%), which means there is high confidence that a visit designated as heat-related was in fact heat related using this algorithm, although other heat-related visits were missed. Further heat-related visit algorithm refinement and modification is being applied to the VCH extreme heat surveillance system for ongoing surveillance of health related outcomes of heat events in the VCH region.

Canadian Triage and Acuity Scale (CTAS) Level Definitions (CTAS Paramedic Guide v2)

Level 1: Resuscitation	Conditions that are considered threats to life or limb or have an imminent risk of deterioration requiring immediate aggressive interventions
Level 2: Emergent	Conditions that are a potential threat to life, limb or function requiring rapid medical interventions and the use of condition specific controlled medical acts
Level 3: Urgent	Conditions that could potentially progress to a serious problem requiring emergency interventions
Level 4: Less Urgent	Conditions that relate to patient age, distress, potential for deterioration or complications that would benefit from intervention or reassurance.
Level 5: Non Urgent	Conditions that may be acute but non-urgent as well as conditions which may be part of a chronic problem with or without evidence of deterioration.

Canadian Index of Multiple Deprivation (CIMD) Situational Vulnerability and Economic Dependency Scales

Situational Vulnerability	<ul style="list-style-type: none"> • Proportion of population that identifies as Aboriginal • Proportion of population aged 25-64 without a high school diploma • Proportion of dwellings needing major repairs • Proportion of population that is low-income • Proportion of single parent families
Economic Dependency	<ul style="list-style-type: none"> • Proportion of population participating in the labour force (aged 15 and older) • Proportion of population aged 65 and older • Ratio of employment to population • Dependency ratio (population aged 0-14 and aged 65 and older divided by population aged 15-64)

Cautions

- The data only represents information captured by VCH Emergency Room Surveillance System. This may underestimate the magnitude of heat-related visits across the Vancouver Coastal region due to the following reasons:
 - Differences in ICD-10 code entry practices may exist between practitioners and information systems.
 - Role of heat in a heat-related visit may not have been noted in presenting complaint.
 - The data represents ED visits presenting to any of nine VCH facilities for which data was available. ED visits to BC Children’s Hospital, St. Mary’s, qathet General, R.W. Large Memorial, and Bella Coola General Hospitals are absent from this report, due to data availability.
- The unit of analysis for this report is an ED visit episode. For instances in which a patient visits an emergency department more than one time during the heat event, multiple visits would be recorded for that individual.

References

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- ⁴ Henderson, S.B., McLean, K. E., Lee, M.J., & Kosatsky, T., 2022. Analysis of community deaths during the catastrophic 2021 heat dome: Early evidence to inform the public health response during subsequent events in greater Vancouver, Canada. *Environmental Epidemiology*, 6(1), e189.
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