

Impacts of
**EXTREME HEAT EVENTS
ON EMERGENCY DEPARTMENT
VISITS AND DEATHS**
in Fraser Health, 2021

POPULATION AND PUBLIC HEALTH



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TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
1 BACKGROUND AND OBJECTIVES	4
2 DATA AND METHODS.....	5
3 SUMMARY OF FINDINGS.....	5
3.1 Total emergency department visits slightly increased during Heat Event #1, with a larger proportion of visits with high acuity.	5
3.2 Emergency department visits for heat or sun stroke had a steep increase during Heat Event #1	6
3.2.1 The majority of emergency department visits were from older adults, although all age groups were impacted by Heat Event #1..	7
3.2.2 The highest rate of emergency department visits were observed in the Eastern region of Fraser Health	8
3.2.3 Increased rates of emergency department visits in more deprived neighborhoods	8
3.3 Large increase in deaths observed during Heat Event #1	9
4 CONCLUSIONS AND LIMITATIONS.....	10
5 ACKNOWLEDGEMENT.....	10
6 REFERENCES.....	12
APPENDIX 1: Map of the Canadian Multiple Index of Deprivation (CIMD)	13
APPENDIX 2: Heat maps of heat and sunstroke related Emergency Department (ED) visits.....	13

EXECUTIVE SUMMARY

During the summer of 2021, Metro Vancouver and the Fraser Valley experienced three major heat waves. An Extreme Heat Alert was issued for the first of these heat waves during June 25 to June 29 with record-breaking temperatures. Extreme hot weather events are known to cause excess morbidity and deaths in British Columbia and around the world. This report aims to provide an overview of the impact of the three heat events on Emergency Department (ED) visits and deaths in the Fraser Health region.

Overall, substantial impacts on both ED visits and deaths were observed during the extreme heat event in late June, while minimal impact was observed in the two subsequent heat events in July and August. During the extreme heat event in late June, there was a slight

increase in all-cause ED visits, and a larger proportion of these visits required immediate and complex care. There was a steep increase in ED visits for heat or sun stroke. The increase was seen across all age groups, with the greatest impact on older adults. Higher rates of ED visits for heat or sun stroke were seen in Fraser East and in more deprived neighborhoods. A large increase in all-cause and potentially heat-related deaths was also observed in Fraser Health; the highest rates for deaths potentially related to heat were in Fraser North. The areas with high rates of ED visits and those with high rates of death during extreme heat events did not always overlap, indicating that there might be different risk factors for these two outcomes that warrant further study.

ACRONYMS

ED	Emergency Department	LHA	Local Health Area
ICD10	International Classification of Diseases, 10th Revision	CHSA	Community Health Services Area
PM2.5	Fine particulate matter with diameter smaller than 2.5 micrometer	DA	Dissemination Area
HSDA	Health Services Delivery Area	CTAS	Canadian Triage and Acuity Scale
		CIMD	Canadian Multiple Index of Deprivation

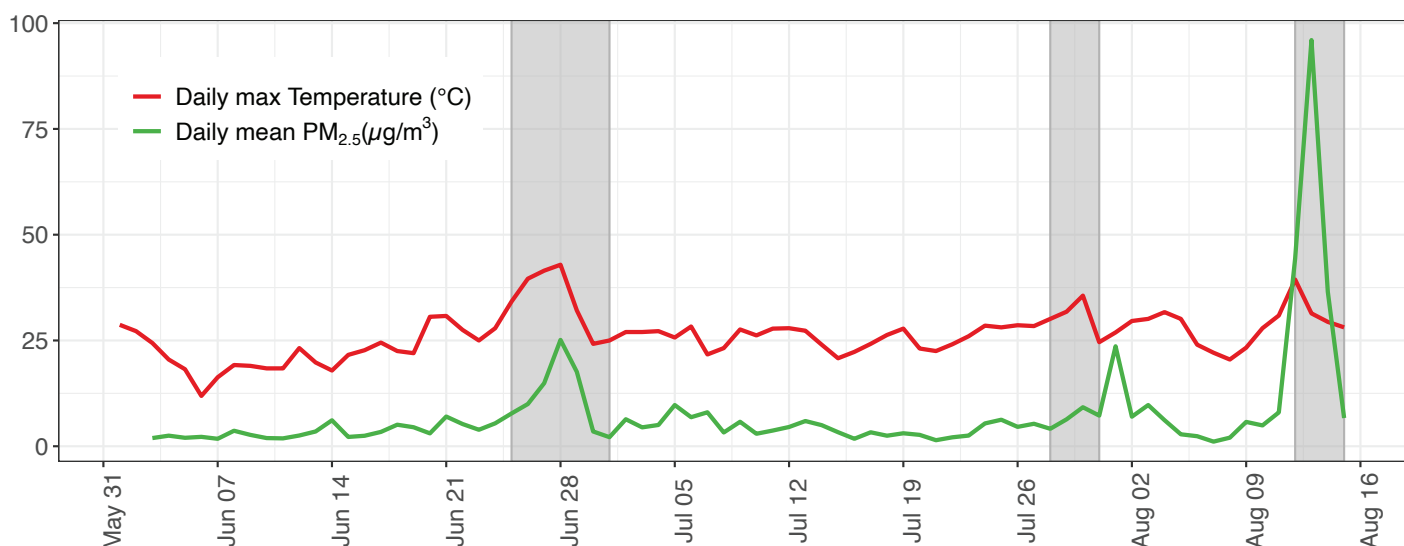
1 BACKGROUND AND OBJECTIVES

On June 22, 2021, Environment and Climate Change Canada (ECCC) issued a heat warning for the province of British Columbia (B.C.); on June 25, 2021, B.C. health authorities issued an Extreme Heat Alert, which lasted until June 29. The criteria for a heat warning in 2021 was based on predicted temperatures exceeding certain thresholds for two days at the Vancouver International Airport (YVR) or Abbotsford, while criteria for an Extreme Heat Alert required higher threshold temperatures at the two locations, as measured at 14:05 daily, averaged with the following day's predicted maximum temperature. From June 25 to June 29, Metro Vancouver and the Fraser Valley experienced a record-breaking heat wave with temperatures ranging up to 43 degrees Celsius (Figure 1). From June 25 to July 1, 354 deaths in Fraser Health were reported to the BC Coroners Service, compared with an average of 50 deaths reported in the same time period in previous years. Fraser Health then experienced two additional heat events; one from July 28 to 31 and another from August 12 to 15. These later heat events each met the criteria for a heat warning but did not meet the criteria for an Extreme Heat Alert. These three heat events are referred to as Heat Event #1, #2 and #3 in the rest of this report. During Heat Events #1 and #3, there were also significant elevation in air pollutants in some parts of the region (Figure 1).

Fraser Health is one of five regional health authorities in B.C. working together with the Ministry of Health. It is responsible for the delivery of hospital and community-based health services to over 1.9 million people in 20 diverse communities from Burnaby to Fraser Canyon on the traditional territories of the Coast Salish and Nlaka'pamux Nations. The communities include a diverse multicultural population and approximately 62,000 Indigenous Peoples, associated with 32 First Nation communities and five Métis chartered communities, based on census data in 2016.

This report describes the findings from a descriptive analysis to examine the impacts of the heat events on emergency department (ED) visits and deaths in the Fraser Health region, as well as some characteristics of the population most impacted by these events. It is important to examine the trends and patterns in both ED visits and deaths, because these two outcomes may reflect the impact of the heat events on populations with different characteristics, and thus may require different prevention strategies in the future. These findings can form the basis for further investigation and provide local evidence to inform future planning and decision making to mitigate the public health impact of extreme heat events.

FIGURE 1 Daily maximum temperature and mean fine particulate matter (PM_{2.5}) in Abbotsford, June 1 to August 15, 2021. Periods of the three heat events are highlighted in gray.



2 DATA AND METHODS

Data for all ED visits in Fraser Health were extracted for the period of June 1 to August 15, 2021, including information on patient demographics, region of residence, and reason and acuity level of the visit. ED visits due to heat or sun stroke were defined as those with diagnostic ICD-10-CA code T67.0 (heat stroke and sun stroke) or with any key words (heat, heat-stroke, sun stroke, heat exhaustion, heat related illness, heat related) in the patient stated complaints or chief complaint notes.

Fraser Health received monthly data of all deaths among Fraser Health residents from the BC Vital Statistics Agency. Data for all deaths during the period of June 1 to August 15, 2021 were extracted on January 7, 2022, including information on patient demographics, location of death and cause of death. Potentially heat-related deaths were defined as those with ICD10 code X30 (Exposure to excessive natural heat), T67 (heat stroke and sun stroke) or R99 (Other ill-defined and unspecified causes of mortality) in the

underlying or contributing cause of death. R99 was included because a large proportion of deaths during Heat Event #1 were still under coroner investigation at the time of this report and coded as R99 in the database.

Rates of ED visits were calculated and mapped at the Health Services Delivery Area (HSDA) and Community Health Services Area (CHSA) level using population estimates for HSDA and CHSA in 2021. Rates of ED visits were calculated at the Dissemination Area (DA) level with population data from 2016 census, and presented as quartile ranking in the map (i.e. DAs in Quartile 4 had the highest rate of ED visits while those in Quartile 1 had the lowest rate. Category 0 on the map indicates no ED visits). Patients with no known home postal codes were not included in the maps for ED visit rates. Rates of deaths were calculated at the HSDA and Local Health Area (LHA) level, with population estimates in 2021. All rates are crude rates without accounting for the different age and sex structures of the population in different regions.

3 SUMMARY OF FINDINGS

3.1 TOTAL EMERGENCY DEPARTMENT VISITS SLIGHTLY INCREASED DURING HEAT EVENT #1, WITH A LARGER PROPORTION OF VISITS WITH HIGH ACUITY.

The total number of ED visits (for all causes) slightly increased on June 27 and 28 during Heat Wave #1 but no significant changes were observed during the following heat events (Figure 2). The average daily number of visits was 2,193 during Heat Event #1, compared with 2,109 and 2,115 during Heat Event #2 and #3, respectively. The average daily number of visits was 2,122 for dates without heat events between June 1 and August 15.

Emergency Departments in Fraser Health use the Canadian Triage and Acuity Scale (CTAS) to assign a level of acuity for patients to ensure that they are managed based on their level of illness and need for care. Patients assigned a CTAS level 1 and 2 are those

with the most severe conditions that need immediate medical attention and are considered 'high acuity'. Even a small increase in the number of these patients can potentially lead to strain on the health care system, as they have longer stays and require care that is substantially more complex. Increased numbers of patients with CTAS 1 and 2 were observed during Heat Event #1 (Figure 3). Of note, the proportion of CTAS 1 ED visits on June 28 was five times the average from June 1 to 25 (3.0% vs. 0.6%). For CTAS 2, the proportion on June 28 was 1.2 times the average from June 1 to 25 (18.5% vs. 15.5%). The proportion of high acuity patients did not substantially increase during Heat Events #2 and #3.

FIGURE 2 Daily total emergency department visits (all causes) in Fraser Health, June 1 to August 15, 2021. Periods of the Heat Event #1, #2 and #3 are highlighted in gray.

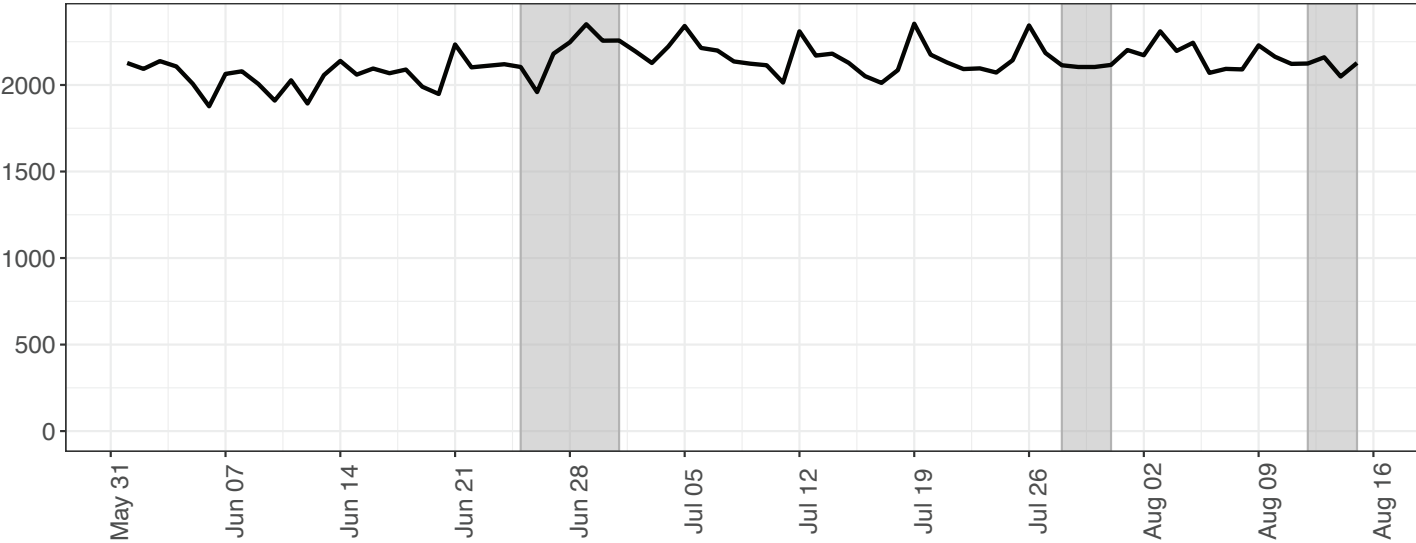
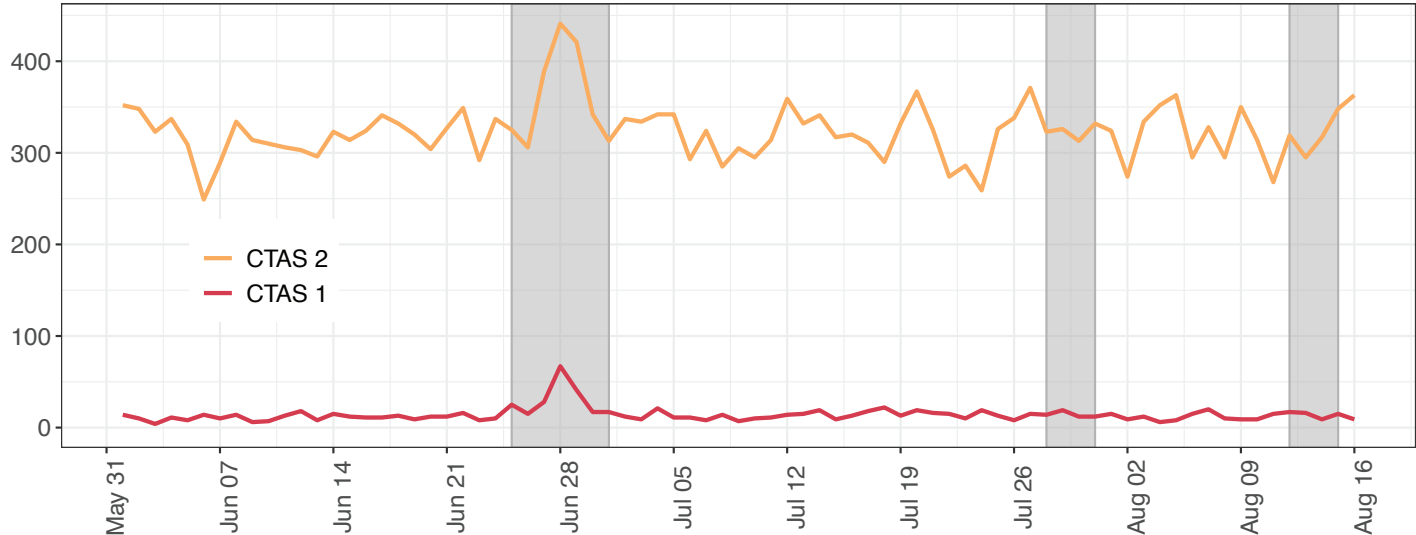


FIGURE 3 Daily number of emergency department visits of high acuity (CTAS 1 and 2) in Fraser Health, June 1 to August 15, 2021. Periods of the Heat Event #1, #2 and #3 are highlighted in gray.

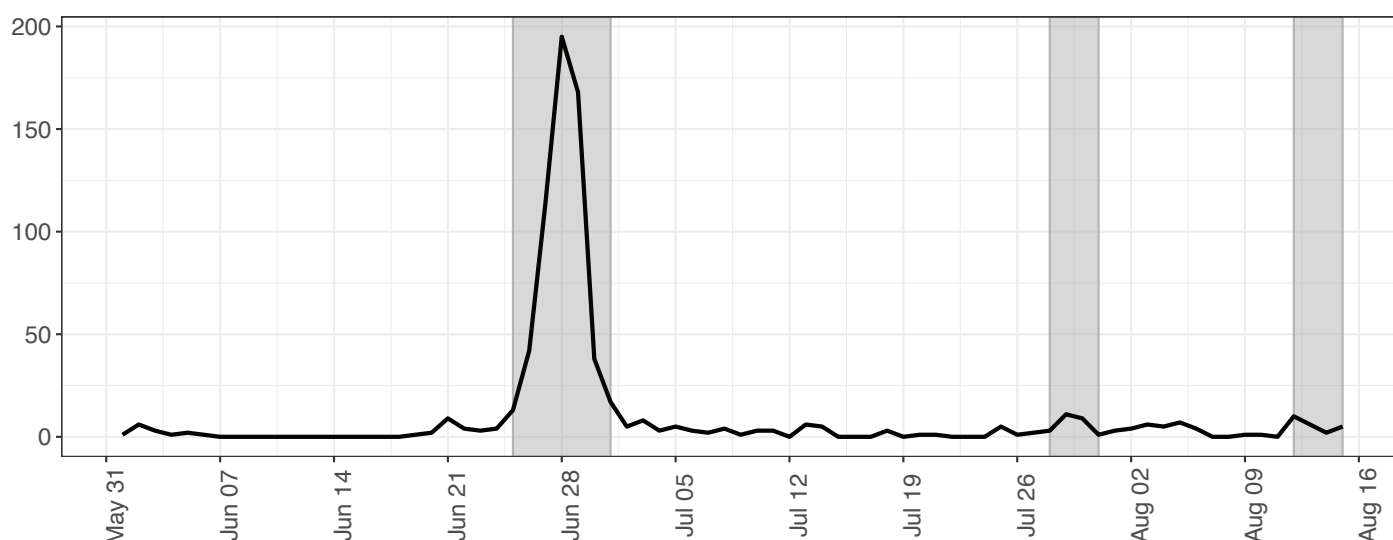


3.2 EMERGENCY DEPARTMENT VISITS FOR HEAT OR SUN STROKE HAD A STEEP INCREASE DURING HEAT EVENT #1

When looking specifically at ED visits due to heat or sun stroke, there was a sharp increase on June 27 to 28, 2021, during Heat Event #1 (Figure 4), and slight increases for the subsequent Heat Event #2 and #3 in July and August. There were 195 visits due to heat or

sun stroke on June 28, which was about 100 times the averaged daily number of visits for the same reason on the days when there were no heat events from June 1 to August 15, 2021. The remainder of the figures and data for ED visits in this section focus on Heat Event #1.

FIGURE 4 Daily number of emergency department visits due to heat or sun stroke in Fraser Health, June 1 to August 15, 2021. Periods of the Heat Event #1, #2 and #3 are highlighted in gray.

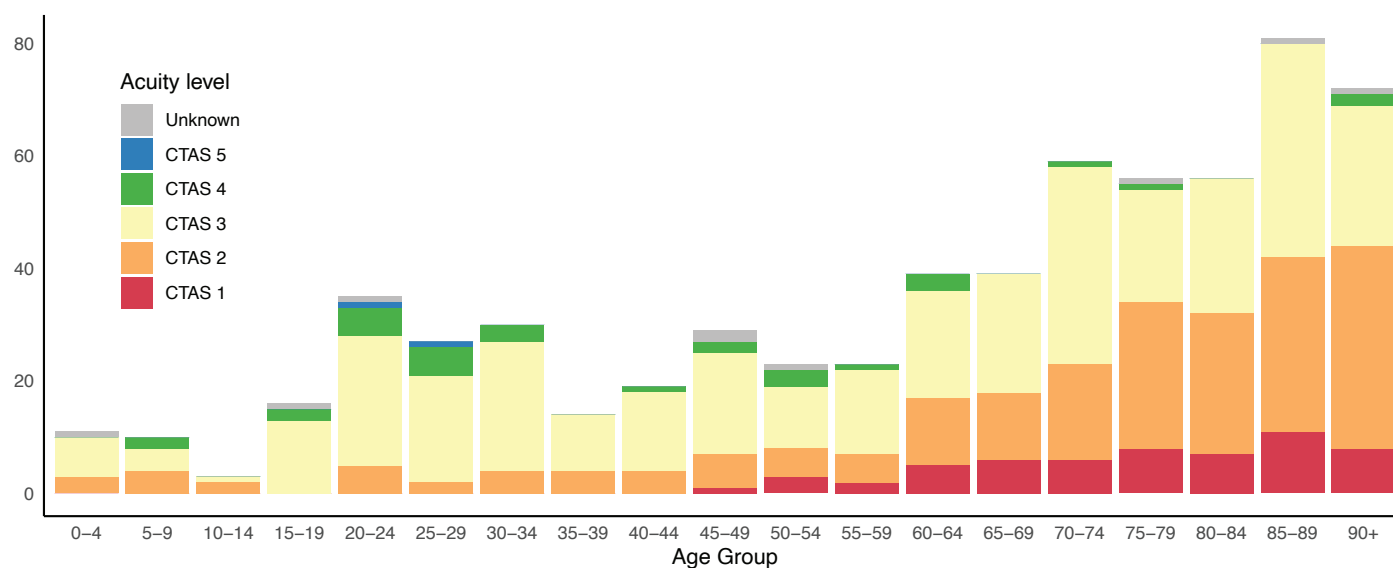


3.2.1 The majority of emergency department visits were from older adults, although all age groups were impacted by Heat Event #1

Among ED visits due to heat or sun stroke during Heat Event #1, 62 per cent were from adults aged 60 years and older (Figure 5). There are two peaks in the age distribution of ED visits, with the largest peak for the oldest age groups (age 85 and over), and a small peak

among young adults aged 20 to 34. The majority of high acuity visits (i.e. patients with severe illness and requiring immediate medical attention, assigned CTAS level 1 or 2) were from older adults, but there were patients of moderate to high acuity across all age groups.

FIGURE 5 Cumulative number of emergency department visits due to heat or sun stroke by age groups and acuity level during Heat Event #1, Fraser Health, June 25 to July 1, 2021.



3.2.2 The highest rate of Emergency Department visits were observed in the eastern region of Fraser Health

Fraser Health is comprised of three Health Services Delivery Areas (HSDAs): Fraser North, Fraser South, and Fraser East. The increase in ED visits due to heat or sun stroke was observed across all HSDAs, with the highest rate in Fraser East. The cumulative rates during Heat Event #1 were 35.8 visits per 100,000 population for Fraser East, compared with 24.7 and 25.0 for Fraser North and Fraser South, respectively.

The three HSDAs in Fraser Health are divided into 13 Local Health Areas (LHAs), which are further divided into 43 Community Health Services Areas (CHSAs). The CHSAs with the highest rate of ED visits during Heat Wave #1 were North Chilliwack (76 per 100,000), Central Abbotsford (62 per 100,000), Hope (56 per 100,000), and South Mission (51 per 100,000). Haney and South Langley Township (48 per 100,000) and North Surrey (47 per 100,000) also had moderately high rates (Figure 7).

Dissemination area (DA) is the smallest standard geographic area for which census data are available, which typically has a population size of 400 to 700. A map of the quartile ranking of the rates by DA shows

the distribution of the place of residence for individuals with a home postal code and who had an ED visit for heat or sun stroke from June 25 to July 1 (Figure 8). Quartile 1 represents the 25 per cent of Fraser DAs (excluding those with no ED visits for heat or sun stroke) with the lowest rates and quartile 4 represents the 25 per cent of Fraser Health DAs with the highest rates. The map in Figure 8 illustrates areas where relatively more visits occurred per population. Caution is needed to interpret these rate rankings. The rates used for ranking may be unstable due to the small counts of events in each DA, and these results may not be generalized to other hot weather events.

Where population density is higher, DAs may be very small. In order to better visualize clustering of ED visits in these areas, heat maps for some municipalities in the region are provided in the Appendix 2 with descriptions of the methodology and interpretation. These heat maps can identify areas with clusters of ED visits due to heat or sun stroke within municipalities. Heat maps are only provided in municipalities where there are sufficient numbers of ED visits in close enough proximity to demonstrate clustering.

3.2.3 Increased rates of emergency department visits in more deprived neighborhoods

The Canadian Multiple Index of Deprivation (CIMD) assesses levels of vulnerability across regions for four different index types, among which the residential instability index is the most relevant to social isolation, which may increase vulnerability to extreme heat. It assesses the tendency of residents in the neighbourhood to fluctuate over time, using census data on factors such as proportion of dwellings that are owned, the proportion of dwellings that are apartment buildings, the proportion of residents living alone, and the proportion of residents who moved within the past five years. A map of the index across Fraser Health DAs is provided in the appendix (Appendix 1). The index is presented as quintiles based on the distribution

in Fraser Health, with Quintile 5 representing areas that are most deprived. An increasing rate of ED visits for heat or sun stroke was observed with increasing residential instability (Figure 9). The rate of ED visits in the most deprived areas was more than two times the rate in the least deprived areas. The exact reason behind the difference is in need of further investigation. A preliminary analysis suggests that a slightly larger proportion of ED visits due to heat or sun stroke during Heat Event #1 came from residents in low-rise apartments (data not shown), but this likely does not fully explain the relationship between increased heat-related ED visits and higher residential instability index.

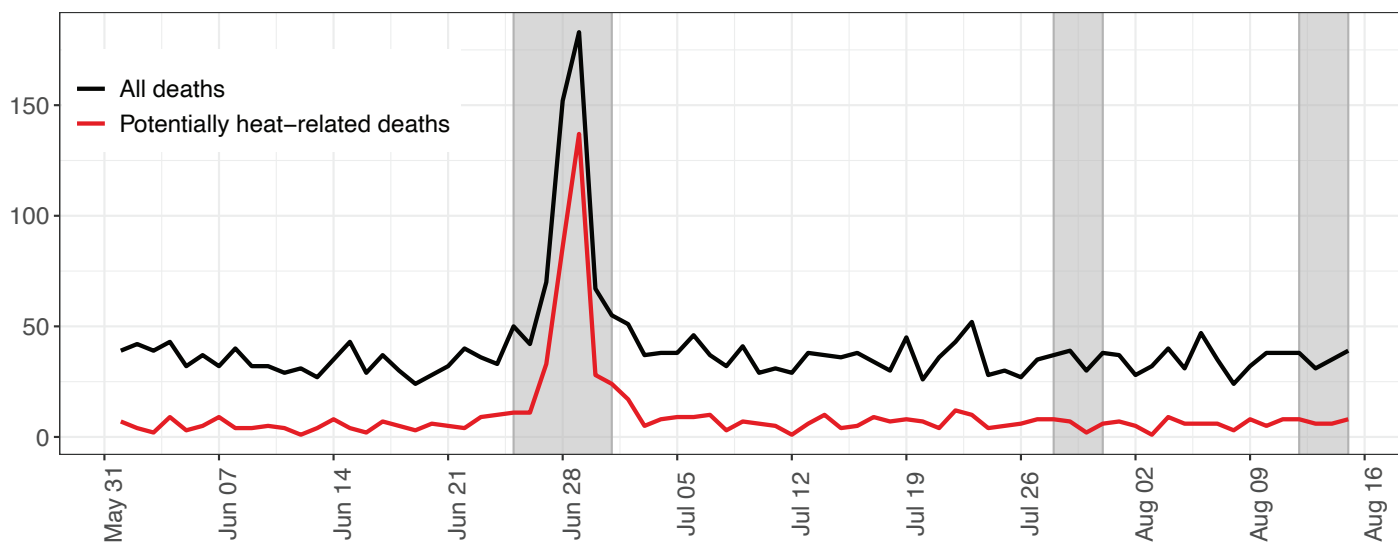
3.3 LARGE INCREASE IN DEATHS OBSERVED DURING HEAT EVENT #1

A sharp increase in all deaths as well as deaths potentially related to heat was observed on June 28 to 29, 2021 during Heat Event #1 (Figure 6), while no apparent increase was observed in Heat Events #2 and #3 in July and August. There were 183 deaths in total on June 29, which was about five times the average daily number of deaths on the days when there were no heat events from June 1 to August 15, 2021. A total of 330 deaths potentially related to heat were observed during Heat Event #1, among which 37 per cent were aged 80 or over, 55 per cent were aged 50 to 79, and 8 per cent were below age 50.

An increase in deaths potentially related to heat during Heat Event #1 was observed across the three

HSDAs in Fraser Health, with the highest cumulative rate in Fraser North (21.2 per 100,000 population), compared with 18.1 per 100,000 in Fraser East and 12.4 per 100,000 in Fraser South. The LHA of New Westminster had the highest rate of death potentially related to heat in Fraser Health (44.1 per 100,000), followed by Hope (33.8 per 100,000), Burnaby (26.6 per 100,000) and Chilliwack (25.2 per 100,000). A provincial study recently published by the BC Centre for Disease Control suggested that higher neighborhood deprivation and lower surrounding greenness were some of the factors associated with higher risk of death during Heat Event #1⁸.

FIGURE 6 Daily number of deaths for all causes and those potentially related to heat in Fraser Health, June 1 – August 15, 2021. Periods of the Heat Event #1, #2 and #3 are highlighted in gray.



4 CONCLUSIONS AND LIMITATIONS

Extreme heat events in the summer of 2021 contributed to a significant increase in heat-related ED visits and an increase in the proportion of visits with high acuity. The majority of heat-related visits were among older adults, but increased visits were seen among young adults as well. Geographically, the eastern part of the Fraser Health region was most impacted by the heat events in terms of ED visits. Areas with higher residential instability were more impacted than those with lower residential instability.

Large increases in total deaths and deaths potentially related to heat was observed during the extreme heat event in late June 2021. Adults over the age of 50 accounted for the majority of deaths, and the northern part of the Fraser Health region had the highest rate of deaths potentially related to heat.

The areas with high rates of heat-related ED visits and those with high rates of potentially heat-related deaths do not always align. Some risk factors may be shared by both of these two outcomes, such as underlying health conditions, lack of access to quality housing or social support, as well as certain built and natural elements of the neighborhood (e.g. green spaces and building design) that can improve or worsen the impact from heat events. However, there may be important differences in the degree of

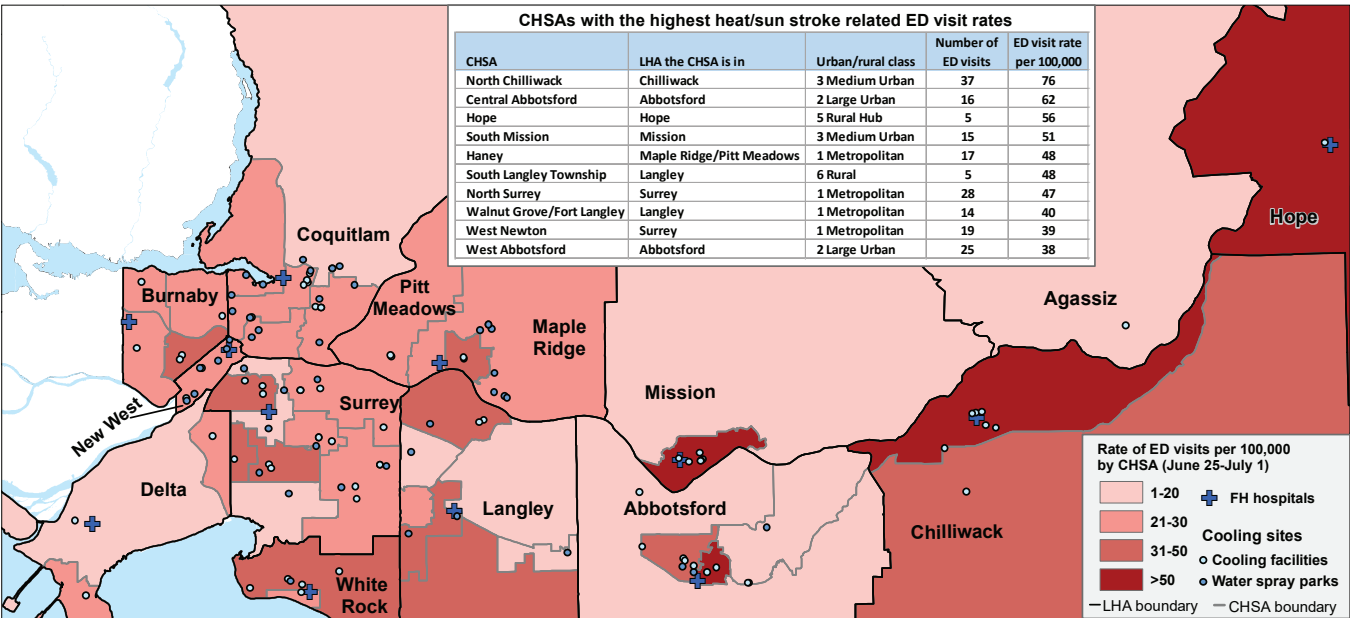
social isolation and the age of the populations, as well as activity patterns among the people presented with these two outcomes. For example, areas where outdoor workers are concentrated may see increase in ED visits due to exposure to heat among these workers, but have little impact observed in deaths as these workers are generally young and healthy. While areas with increased rates of either outcomes should be considered for heat-related interventions, different strategies may be needed to reduce the impact on the two outcomes depending on the risk factors and environmental characteristics.

There are a few known limitations to this analysis. First, the geographic assignment of individual ED visits in the maps was based on the residential postal codes of the patient. This may not reflect the location where the patient experienced heat-related illnesses. Also, the maps of ED visits did not include patients without home postal codes, thus do not reflect the impact on under-housed populations. Second, rates of ED visits and deaths were not adjusted for the different age and sex structures in different geographic regions. Third, the analysis did not consider the relationship between different factors (e.g. age and deprivation). Fourth, it is not possible to clearly define heat-related deaths due to the time required to attributing the cause of death to a heat event.

5 ACKNOWLEDGEMENT

We would like to thank the individuals and organizations that supported the collection, maintenance, sharing and analysis of the data utilized in this report, and offer our deepest condolences to those who lost their loved ones and those who were negatively impacted during the extreme heat events of 2021.

FIGURE 7 Map for rate of emergency department visits in Fraser Health due to heat or sun stroke per 100,000 population, by CHSA, June 25 to July 1, 2021



NOTE: Cooling facilities include libraries, recreation centres, museums, community centres, and a private brewery. Water spray parks were also highlighted as a way to cool down.

FIGURE 8 Quartile ranking of rate of heat or sun stroke emergency department visits in Fraser Health by Census dissemination areas (DAs), June 25-July 1, 2021

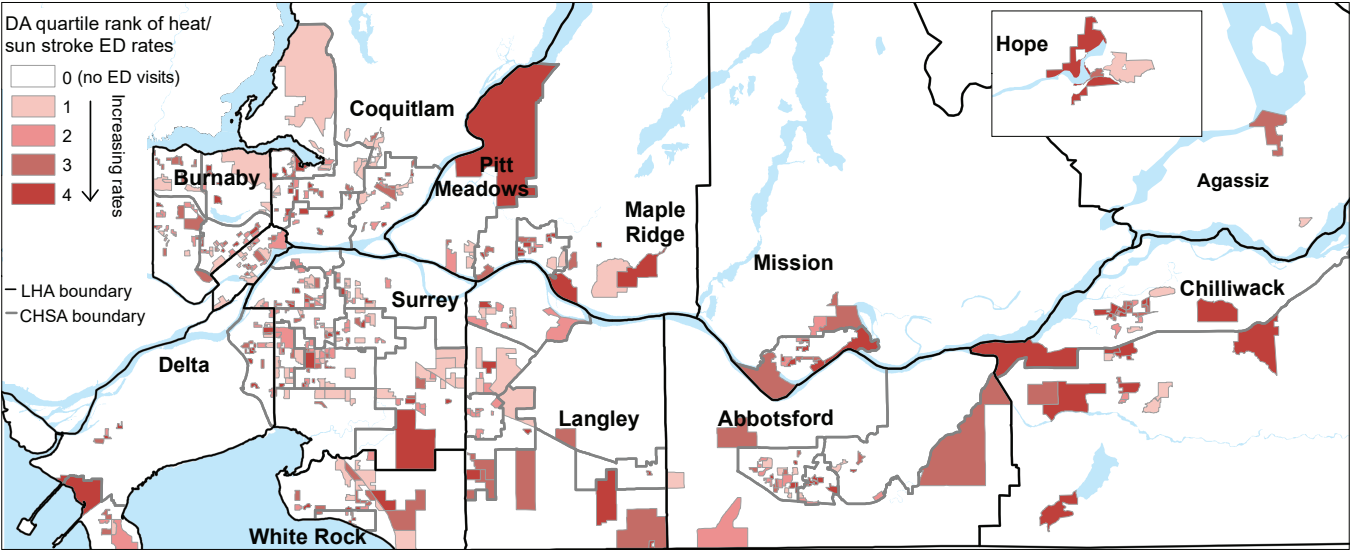
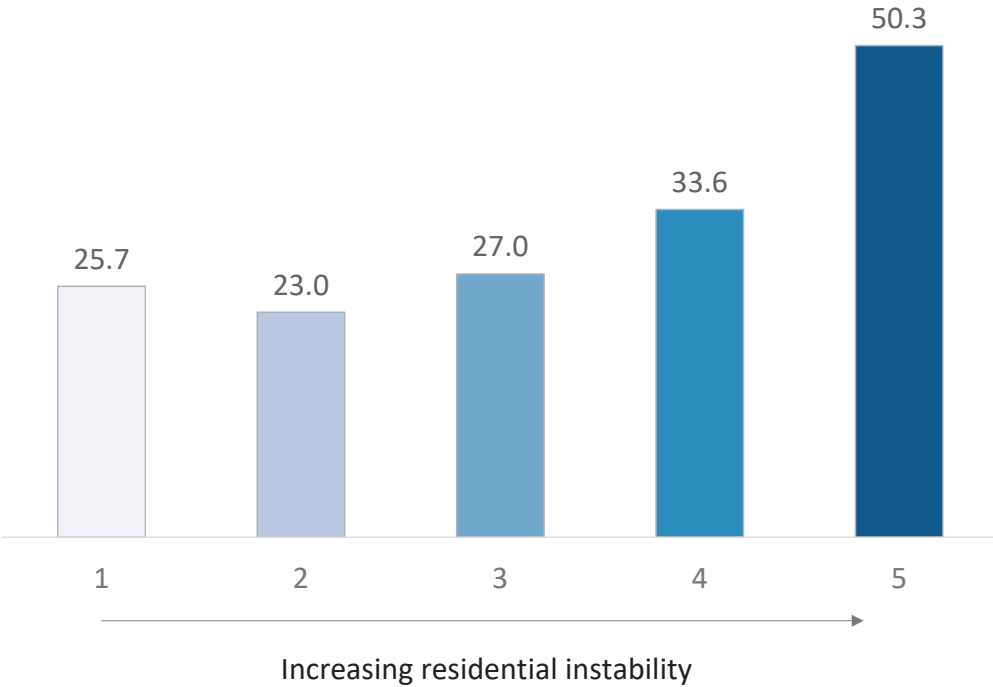


FIGURE 9 Rate of emergency department visits in Fraser Health from June 25 to July 1, 2021 for heat or sun stroke per 100,000 population by quintile of region of residential instability based on dissemination area of residence.

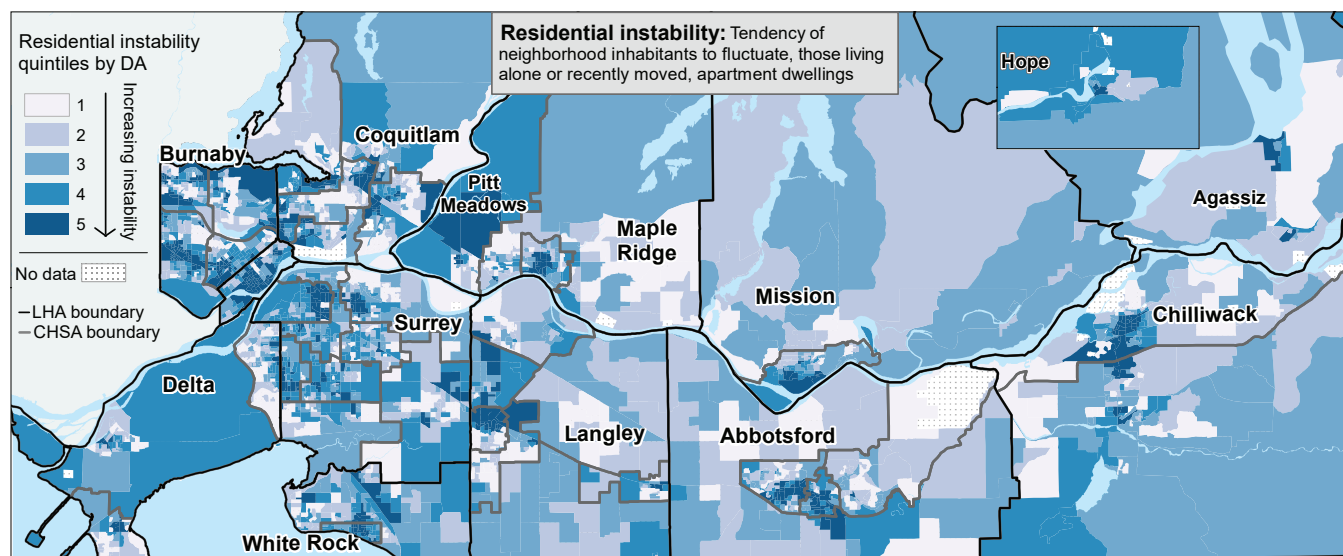


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APPENDIX 1

MAP OF THE CANADIAN MULTIPLE INDEX OF DEPRIVATION (CIMD) — RESIDENTIAL INSTABILITY IN FRASER HEALTH DISSEMINATION AREAS.



APPENDIX 2

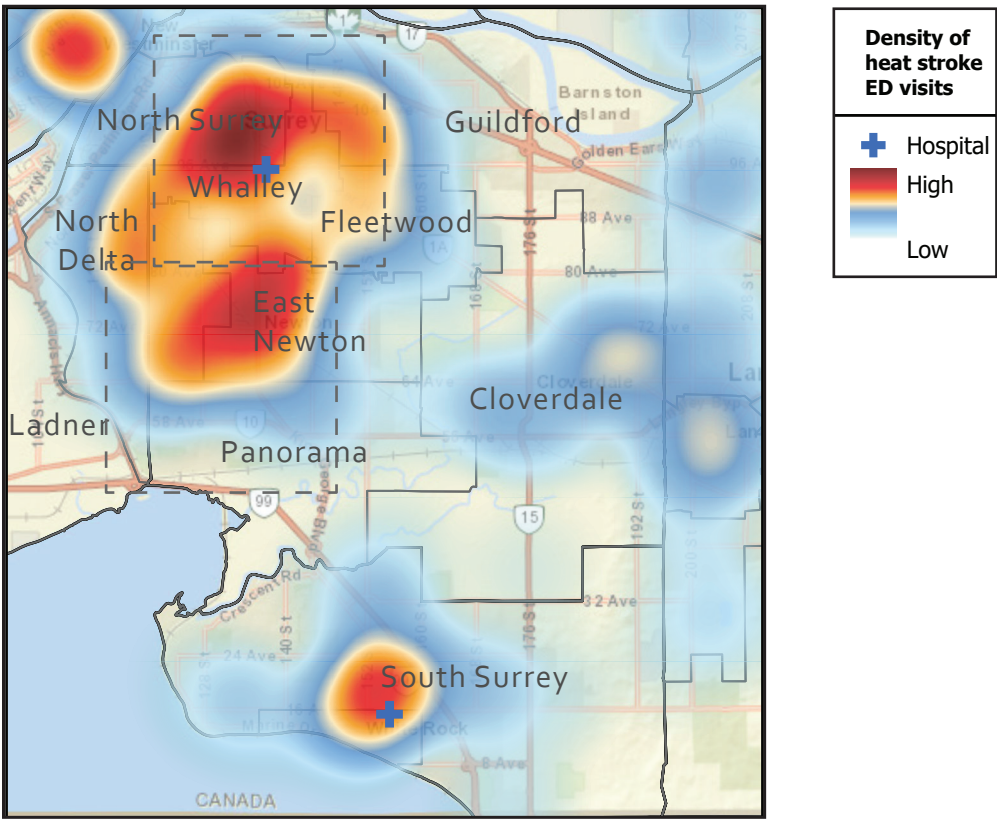
HEAT MAPS OF HEAT AND SUNSTROKE RELATED EMERGENCY DEPARTMENT (ED) VISITS

The heat maps show the density of ED visits from June 25 to July 1, 2021, by colour intensity across the area shown in each map panel. Where there are groupings of a higher number of ED visits, a more intense colour of red appears on the map.

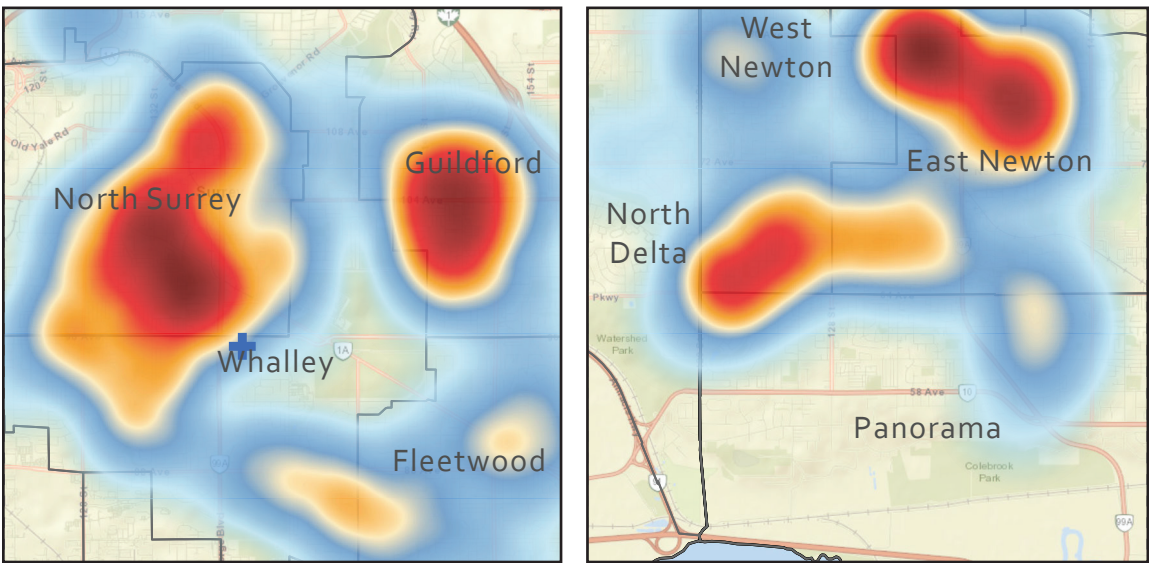
In each set of maps, the top panel presents a map at the Local Health Area (LHA) level. For selected

areas with high ED visit intensity at the LHA level map (highlighted by dashed lines in the top panel map), zoomed-in maps at the CHSA level are provided in the bottom panel. The zoom-in maps can better visualize areas of high density with higher resolution. Areas within higher densities can be viewed with reference to CHSA boundaries and major roads.

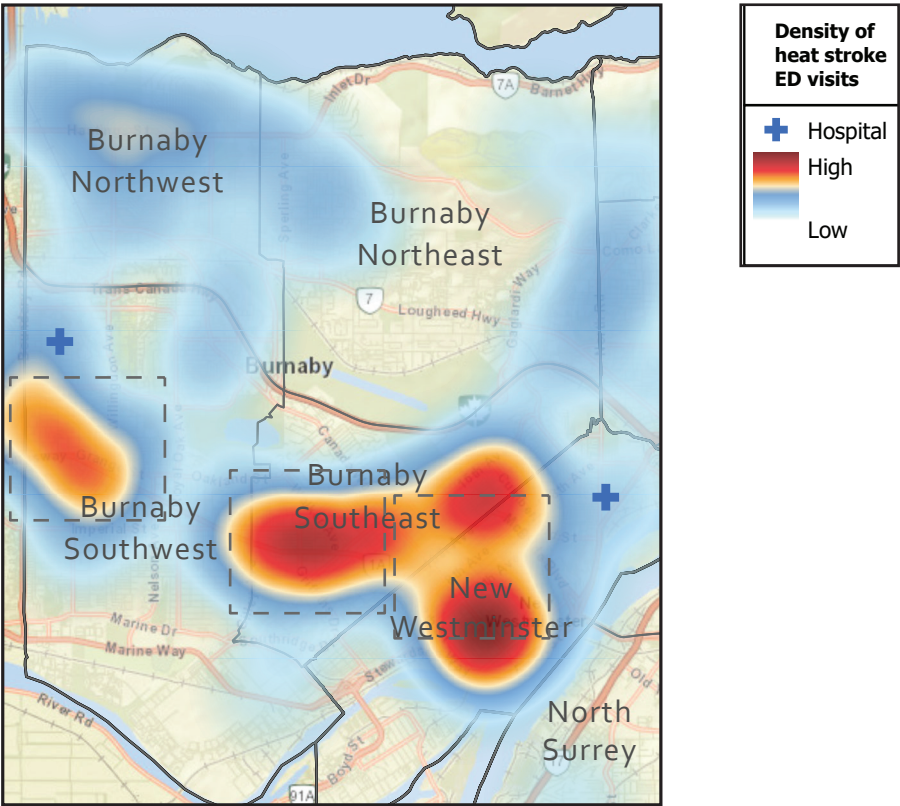
SURREY AND SOUTH SURREY



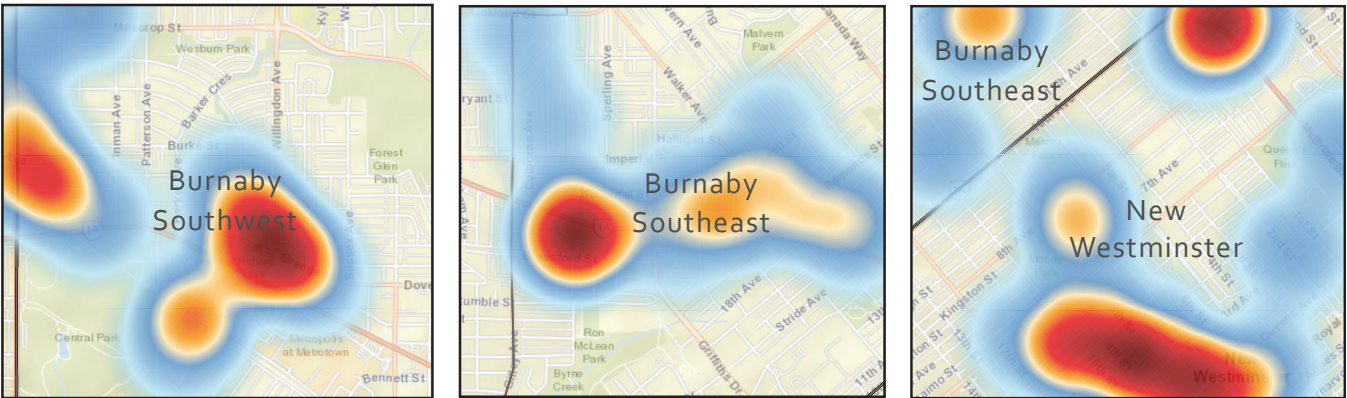
High Density Areas



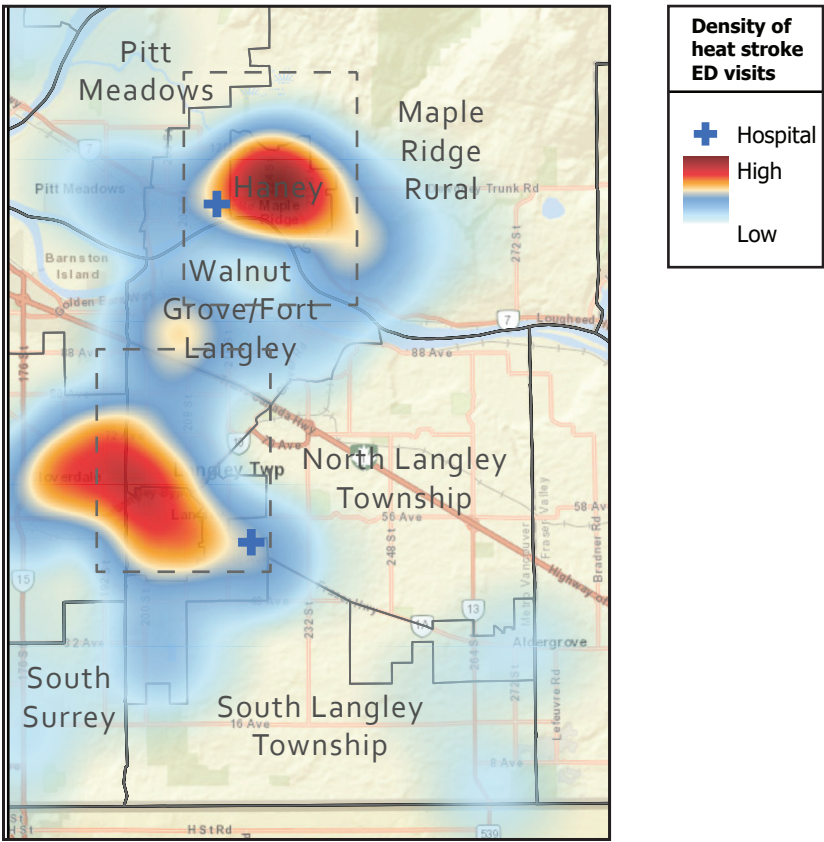
BURNABY



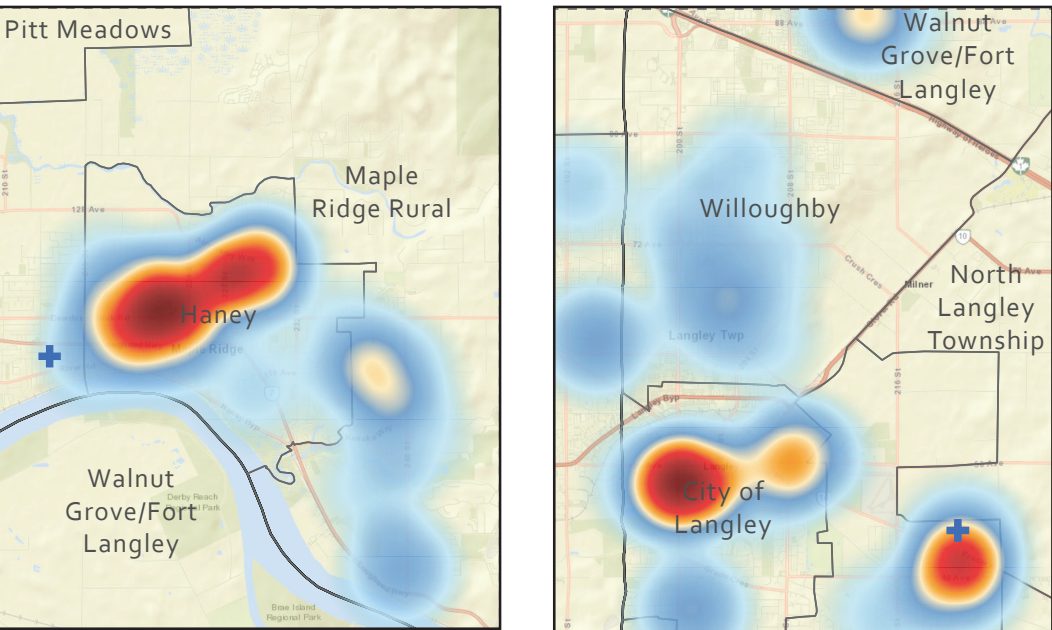
High Density Areas



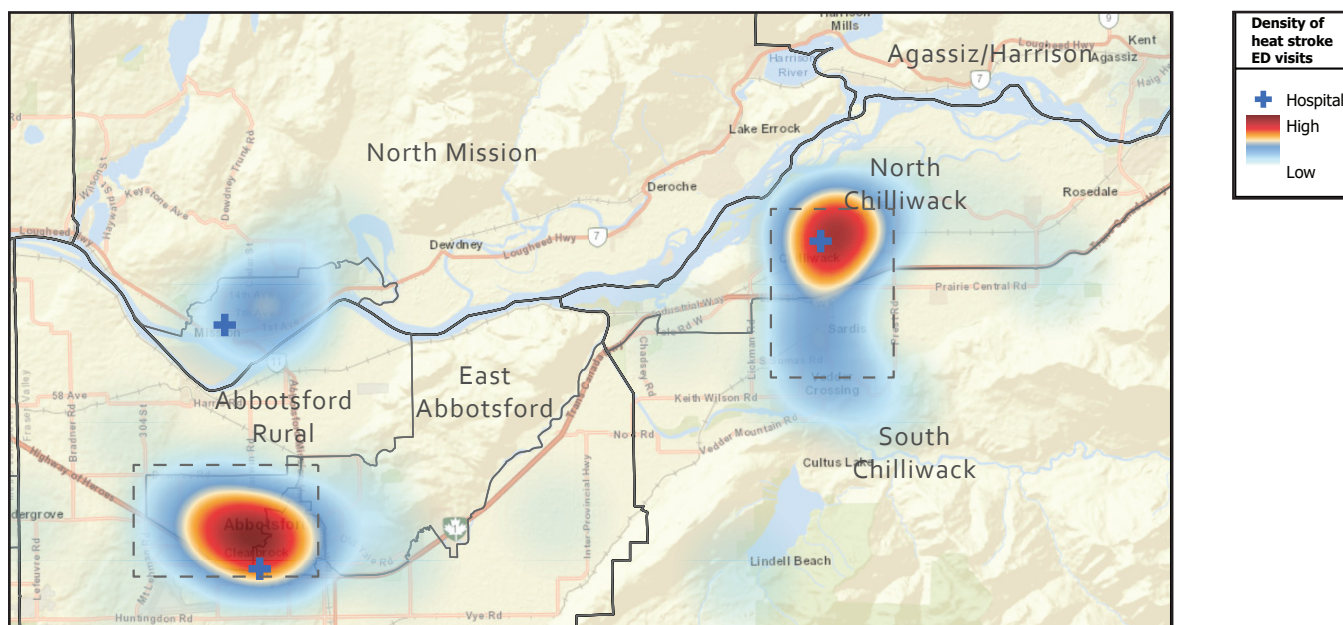
MAPLE RIDGE AND LANGLEY



High Density Areas



ABBOTSFORD



High Density Areas

