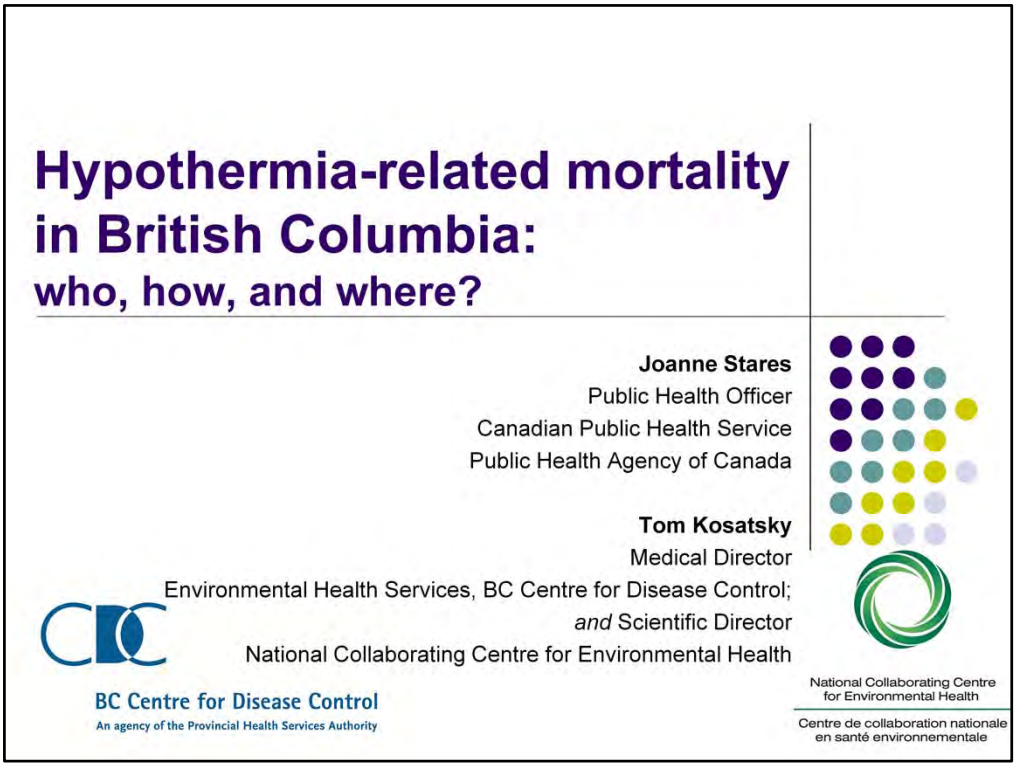
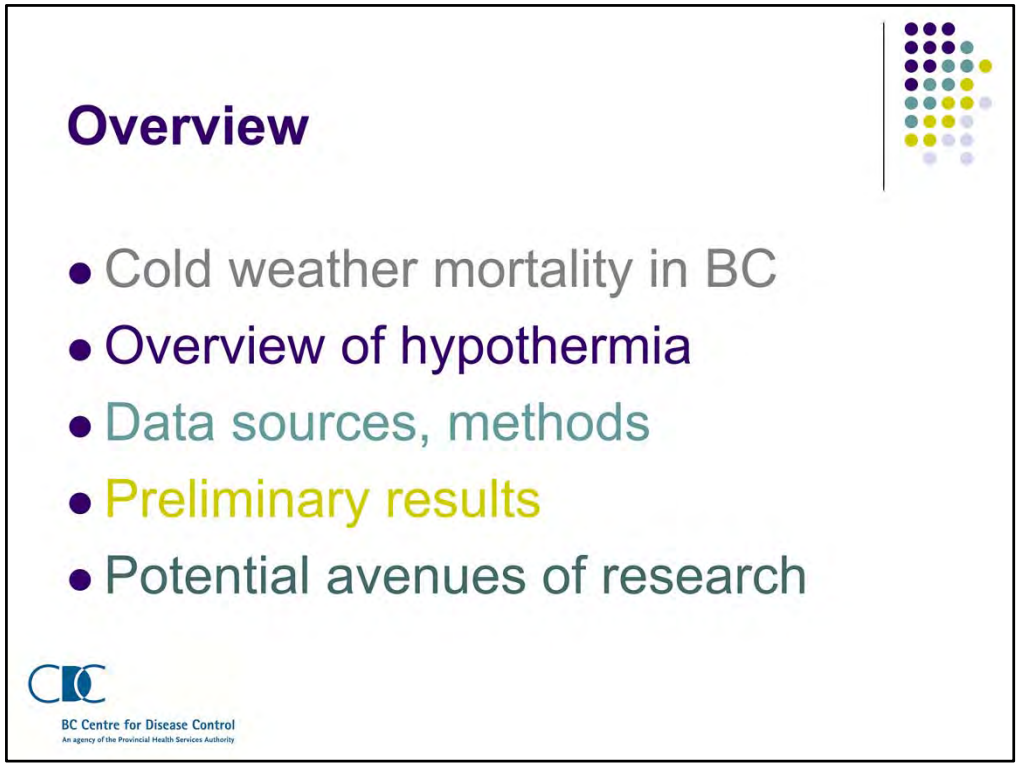


I'd like to start by thanking you all for attending my presentation today, where I will describe the "who, how, and where"s of hypothermia-related mortality in British Columbia.



First I will give a brief overview of hypothermia, after which I will briefly describe what was done, what was found, and areas of future work .

Cold weather mortality in BC

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Five BC eco-regions

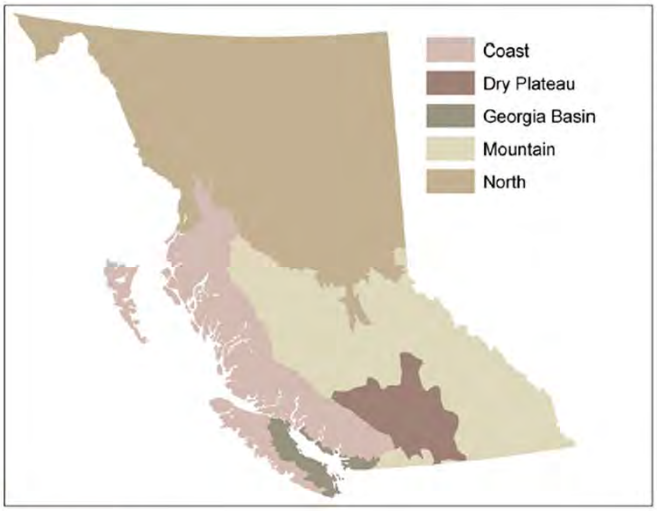


Figure 4: Five ecoregions for mortality analyses based on Level 1, 2 and 3 ecoregions in North America.

Henderson, Wan, Kosatsky, 2012

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Winter mortality by temperature: 5 BC eco-regions

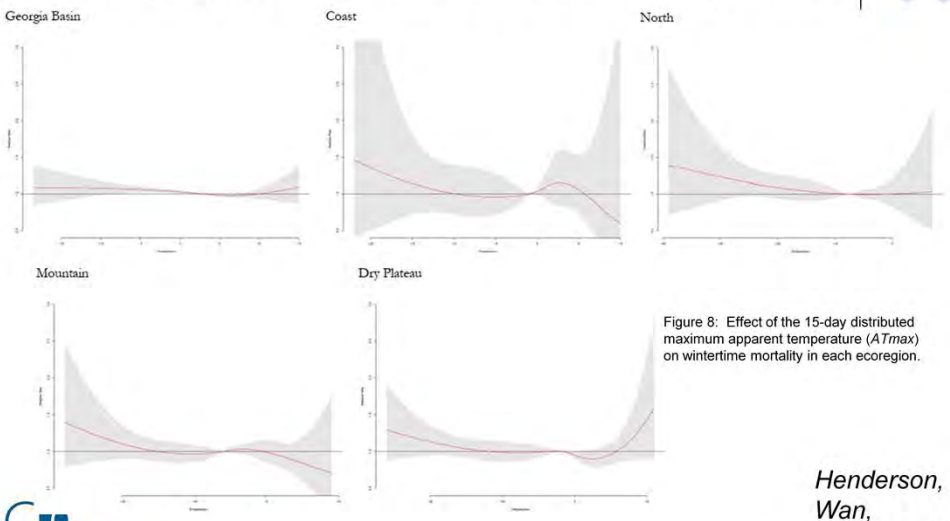


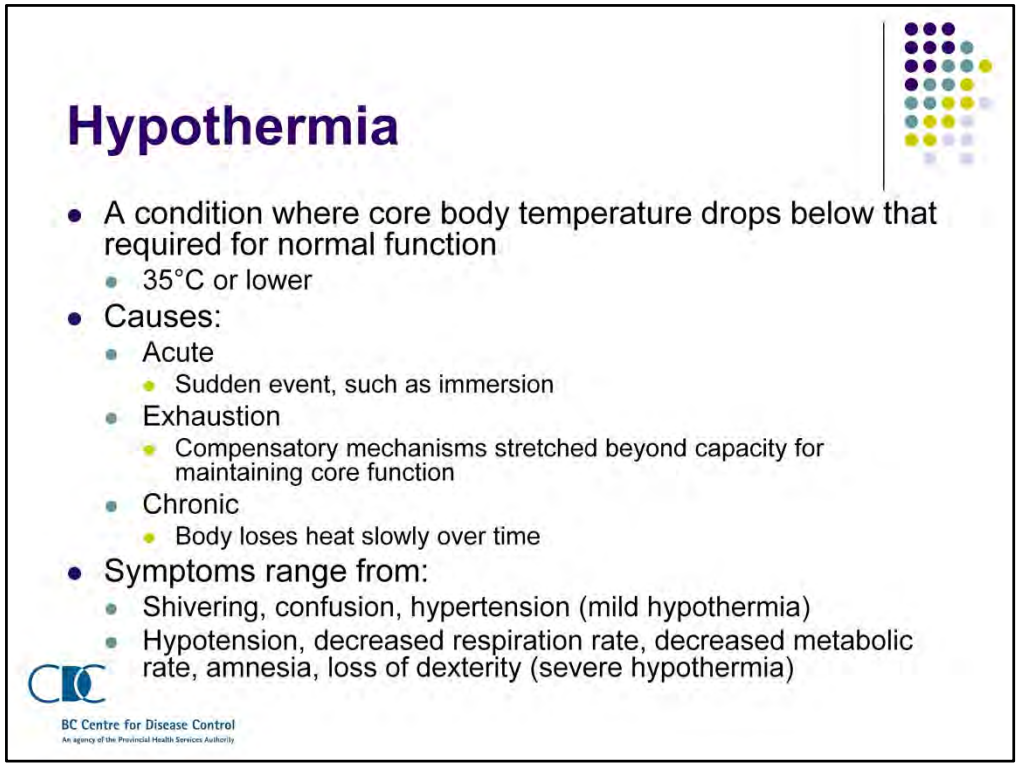
Figure 8: Effect of the 15-day distributed maximum apparent temperature (*ATmax*) on wintertime mortality in each ecoregion.

Henderson, Wan, Kosatsky 2012

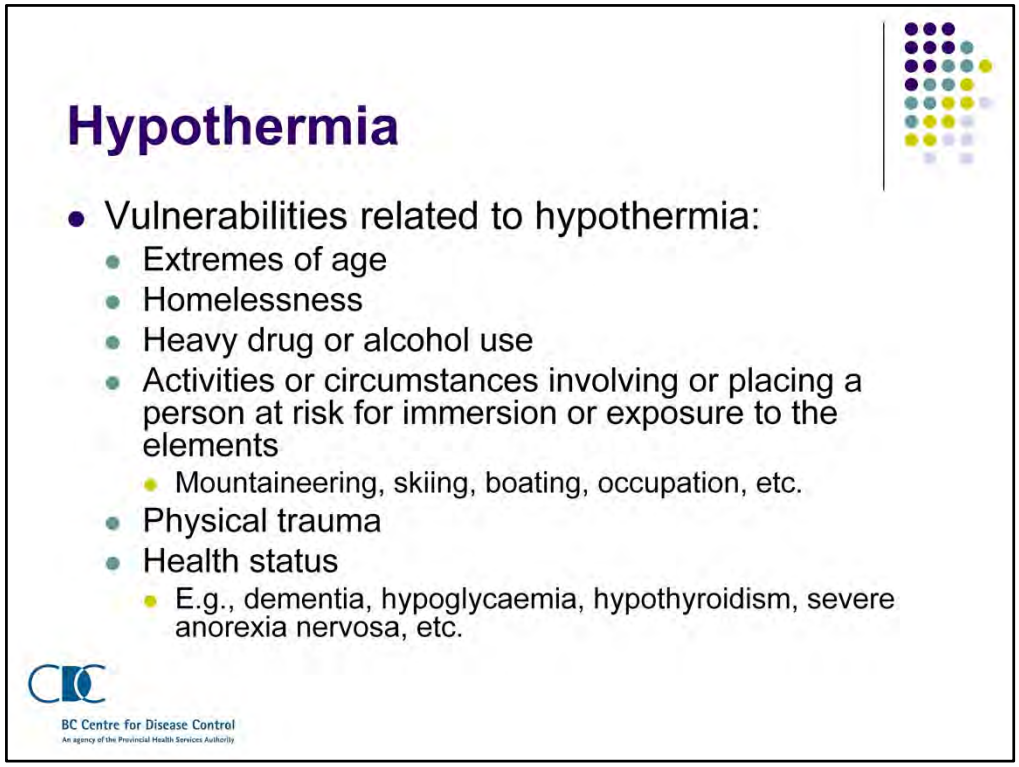
BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Hypothermia

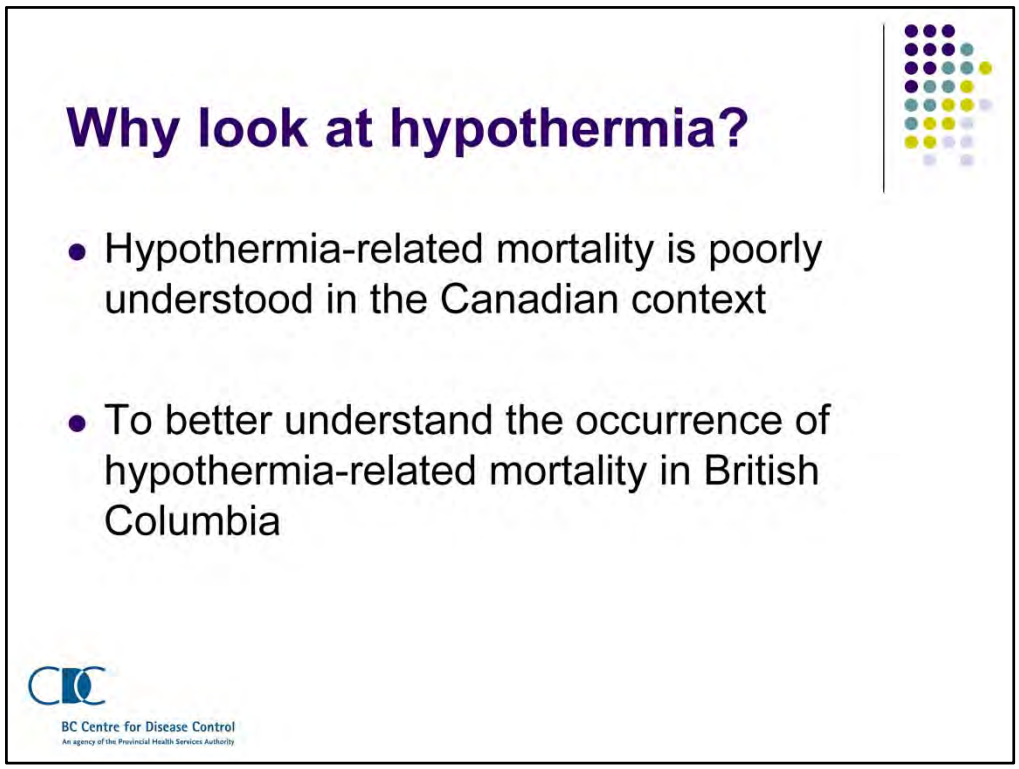
BC Centre for Disease Control
An agency of the Provincial Health Services Authority



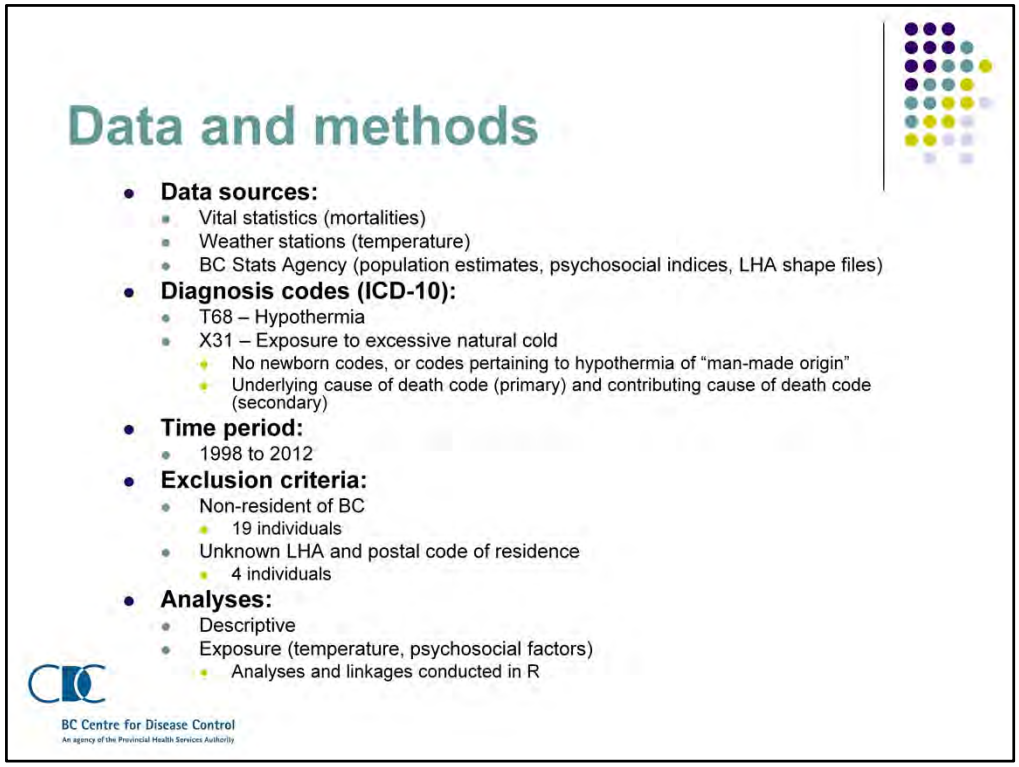
Hypothermia is a condition wherein core body temperature drops below what is required for normal functioning. Generally speaking, a state of hypothermia can be defined as a core body temperature below 35 degrees Celsius. Hypothermia can be a result of acute events, such as immersion, exhaustion where the body is worn out to the point where heat isn't generated efficiently. Hypothermia can be chronic, where the body loses heat over time, which may occur among elderly individuals living in poorly heated accommodations for instance. Hypothermia occurs on a gradient, ranging from mild hypothermia to profound states of hypothermia (where body temperature drops below 20 degrees Celsius). Symptoms range from shivering, confusion, and hypertension in cases of mild hypothermia to hypotension, decreased respiration, decreased metabolic rate, amnesia, loss of dexterity and potentially death in more severe cases.



Vulnerabilities for hypothermia are both behavioural and physiological in nature. Individuals vulnerable to hypothermia include very small children and the elderly, the homeless, individuals undertaking activities that place them at higher risk for immersion or exposure, individuals suffering from physical trauma, and individuals who have medical conditions that physiologically or behaviourally influence risk for hypothermia. In addition heavy drug or alcohol users or individuals using certain types of medications including sedatives are also at higher risk given that certain substances affect the body's ability to retain heat or may impact behaviour.



The purpose of this review is to better understand the occurrence of hypothermia-related mortality in British Columbia, given that hypothermia-related mortality is poorly understood in the Canadian context.



The BC Vital Statistics Death File was accessed to pull records for all deaths in BC that occurred between 1998-2012 that had an underlying cause of death (UCOD) or contributing cause of death (CCOD) coded for hypothermia or exposure to excessive natural cold. Individuals with a UCOD coded for hypothermia/exposure to excessive natural cold were considered cases where the primary cause of death was hypothermia. Secondary hypothermia deaths are mortalities where hypothermia or exposure to excessive natural cold were coded in additional cause of death fields on the death certificate.

Complete temperature measurements from 31 weather stations across the province were accessed. Each Local Health Area (LHA) in the province was assigned to a weather station and maximum apparent temperature on the day of death was assigned to each individual. Maximum apparent temperature was selected, based on previous work conducted at the BCCDC on cold weather mortality which found that all-cause mortality was most strongly correlated with maximum apparent temperature relative to other temperature measurements.

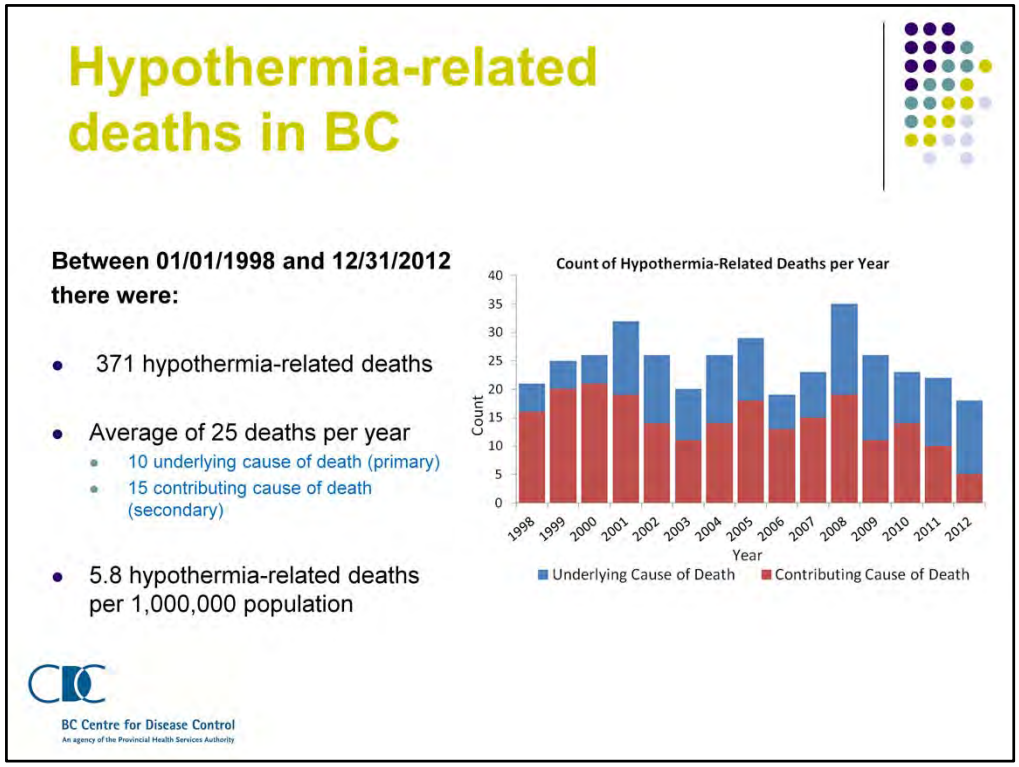
Regional socioeconomic indices, and population estimates were obtained from the BC Statistics. Agency

Individuals were included in this review if they were a resident of BC and LHA or postal code of residence was known.

Analyses were descriptive in nature, and calculations were done using R.

Preliminary Results

BC Centre for Disease Control
An agency of the Provincial Health Services Authority



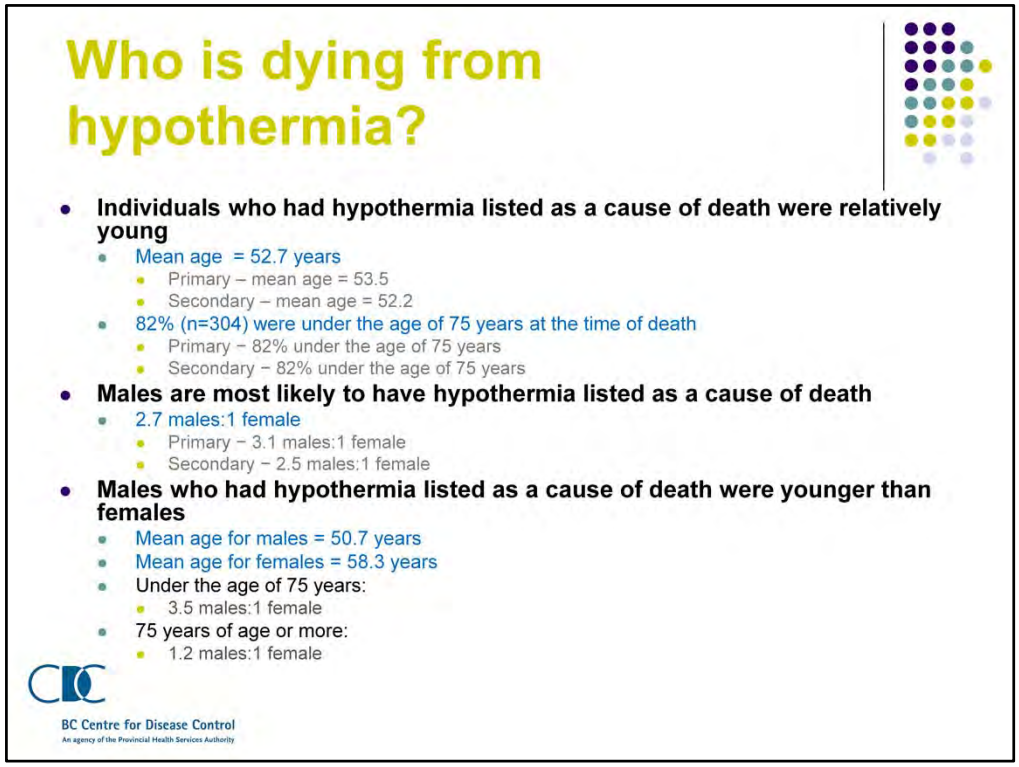
151 deaths were considered primary hypothermia deaths, averaging at 10 deaths per year.

220 deaths were considered secondary hypothermia deaths, averaging at 15 deaths per year.

There appears to be a slight shift towards primary hypothermia deaths in more recent years, whereas in the past, a larger proportion of hypothermia deaths were secondary. Examining coding practices and recommendations for coding over time may be worthwhile in determining whether or not this trend is an artefact.

Taken together, there were 371 hypothermia-related deaths, averaging at 25 deaths per year between 1998 and 2012.

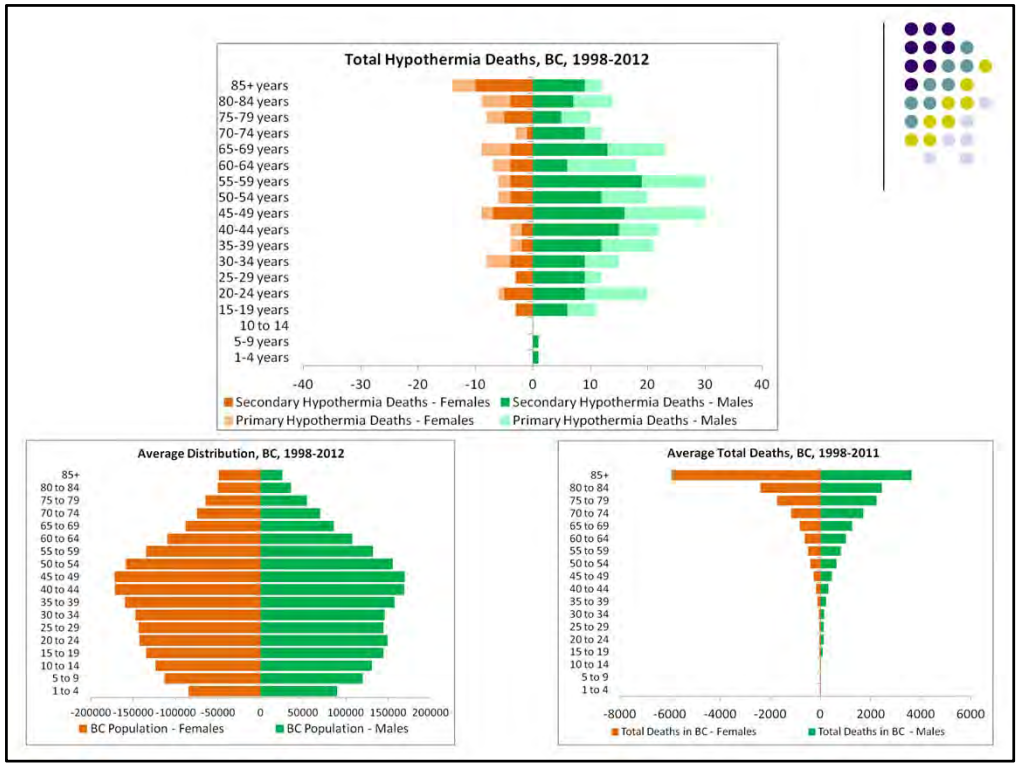
This equates to roughly 5.8 hypothermia-related deaths per 1,000,000 population per year.



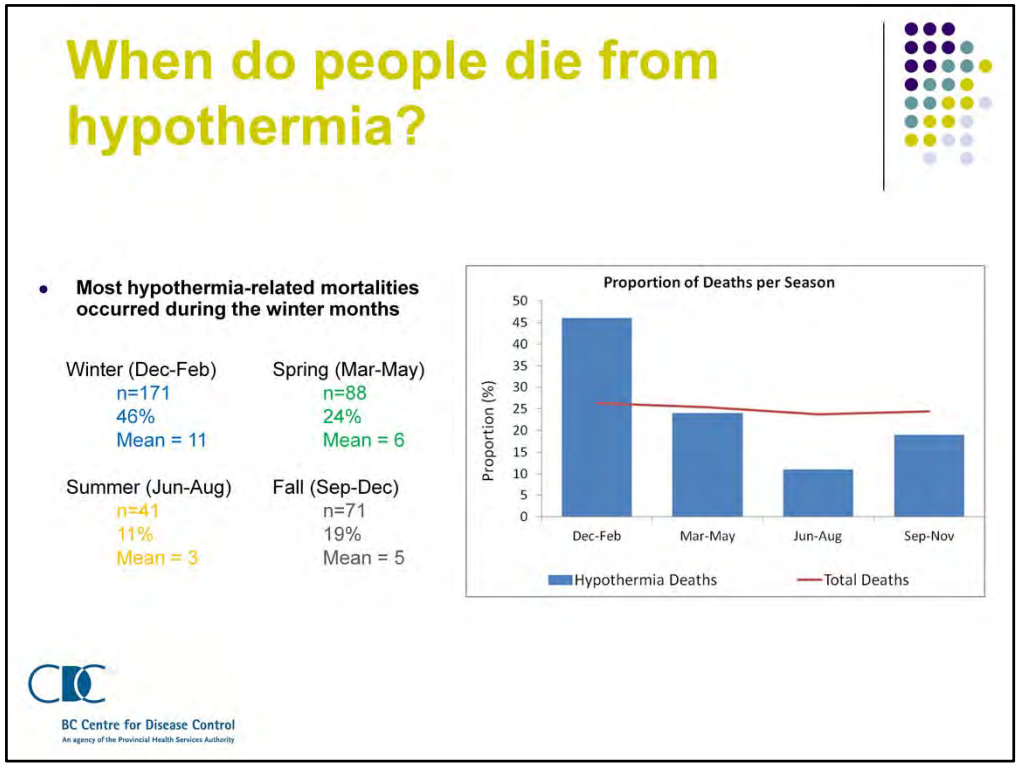
Individuals who died with hypothermia were relatively young, the mean age being 53 years. 82% of individuals were less than the age of 75 years at the time of death. There was little difference when mean age and proportion of deaths occurring in individuals less than 75 years of age were broken down by primary or secondary hypothermia deaths.

Hypothermia deaths are more likely to be identified among males relative to females. Roughly, there are 3 males who died with hypothermia for every female. There was little deviation in this trend when broken down by primary and secondary hypothermia deaths.

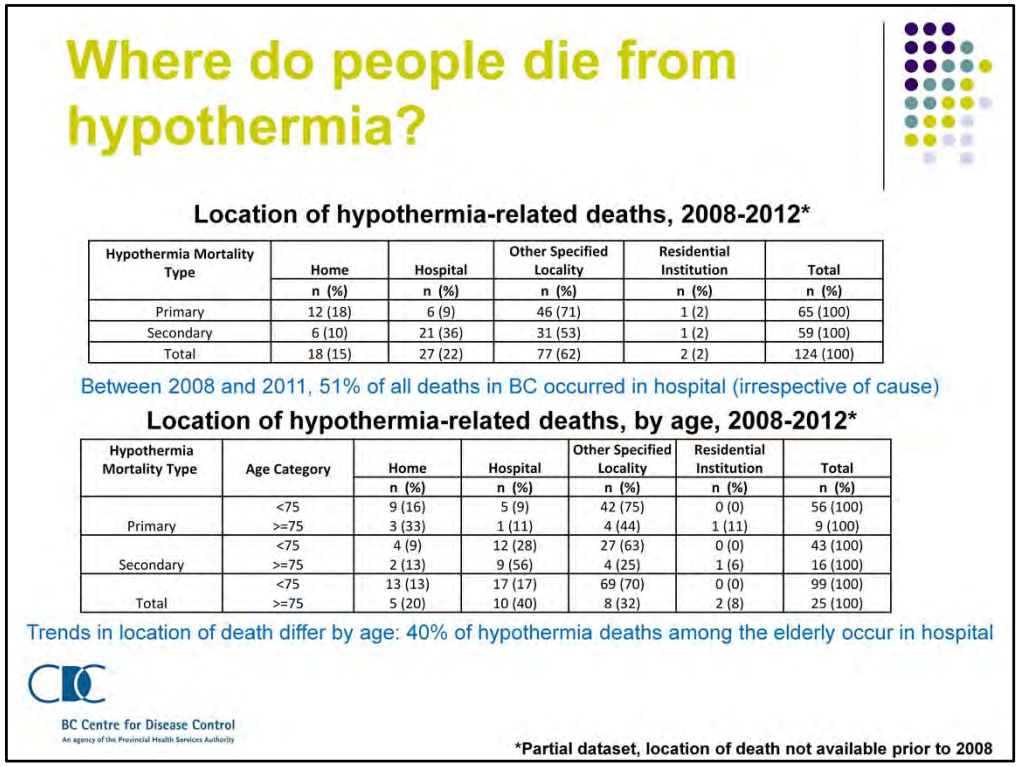
Males who had hypothermia listed as a cause of death were typically younger than females who died with hypothermia. Mean age at the time of death for males was 51 years while mean age for females was 58 years. In addition, there were nearly four male hypothermia-related deaths for every one female hypothermia-related death among individuals below the age of 75 years. After the age of 75 years, the sex ratio is roughly 1-to-1.



The top figure on this slide shows the age and sex distribution of both primary and secondary hypothermia mortalities. The bottom two figures show the age and sex distribution of the BC population and the distribution of age at the time of death and sex of the deceased for all deaths in BC. For both sexes, hypothermia deaths deviate from what is expected based on trends in overall deaths, and deviates among adults especially among seniors, from the overall population distribution.



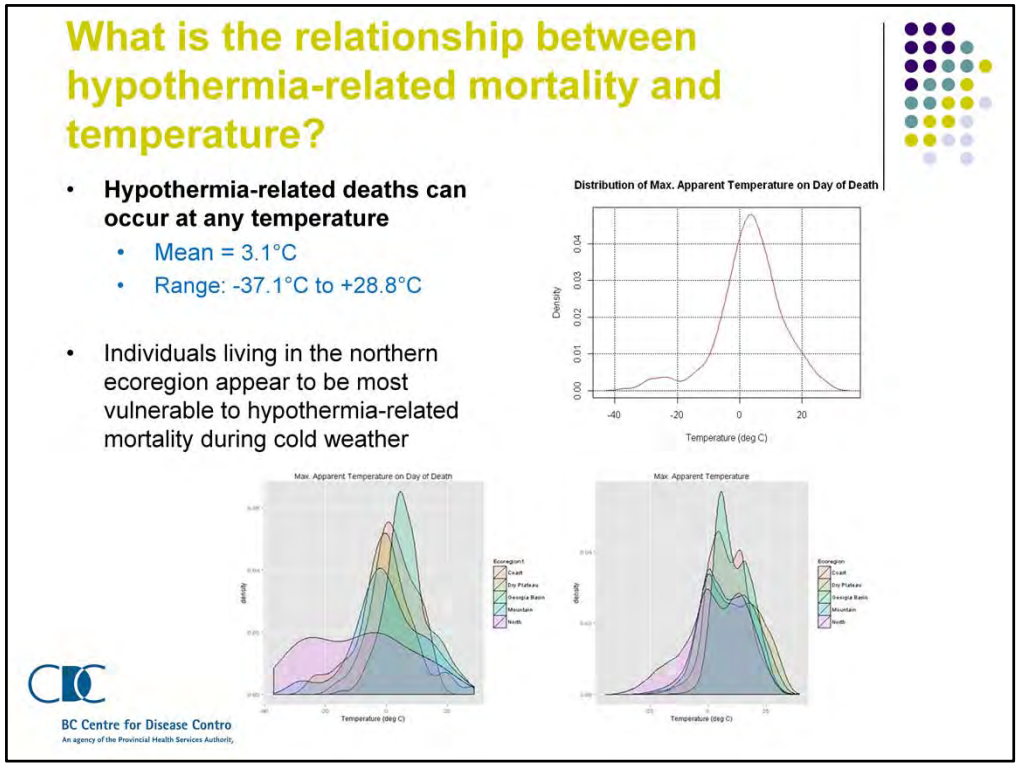
The red line in the figure to the right illustrates the proportion of total deaths that occur in BC during the winter, spring, summer, and fall months. With an exception of a slight dip in the summer months, the proportion of total deaths per season is largely consistent throughout the year. The blue bars in the figure show the proportion of hypothermia deaths across winter, spring, summer, and fall months. Nearly one-half of hypothermia-related deaths occurred during the months of December January and February, followed by spring, fall and summer months respectively.



Location of death is included in the vital statistics death file after 2008. From these data we can observe that, overall, the majority of hypothermia deaths occur at locations other than the home, hospital, or residential institution. This trend is similar among both primary and secondary hypothermia mortalities.

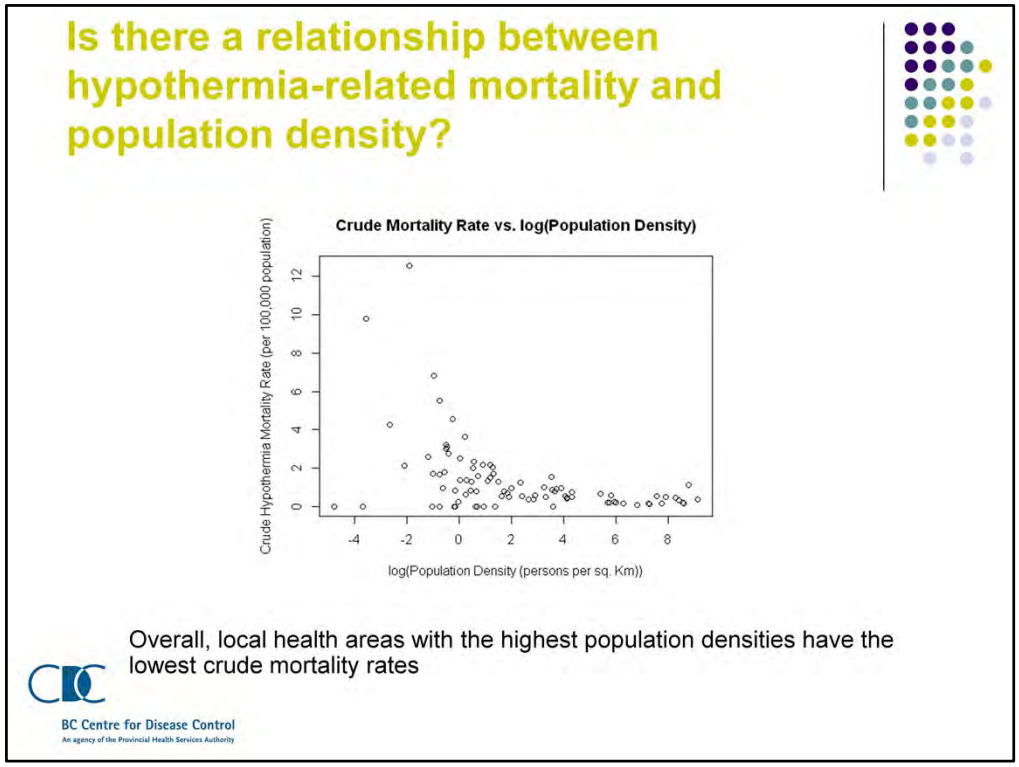
22% of hypothermia deaths overall occurred in hospital. This sharply contrasts with trends in total deaths, where 51% of total deaths occurred in hospital. This trend is slightly different among secondary and primary deaths. While the second most common location of death among secondary deaths remains hospitals at 36%, the second most common location of death among primary deaths is at home, where 18% of primary hypothermia deaths occur.

This trend is not consistent across age: it is important to note that the majority of hypothermia deaths among the elderly occur in hospital.



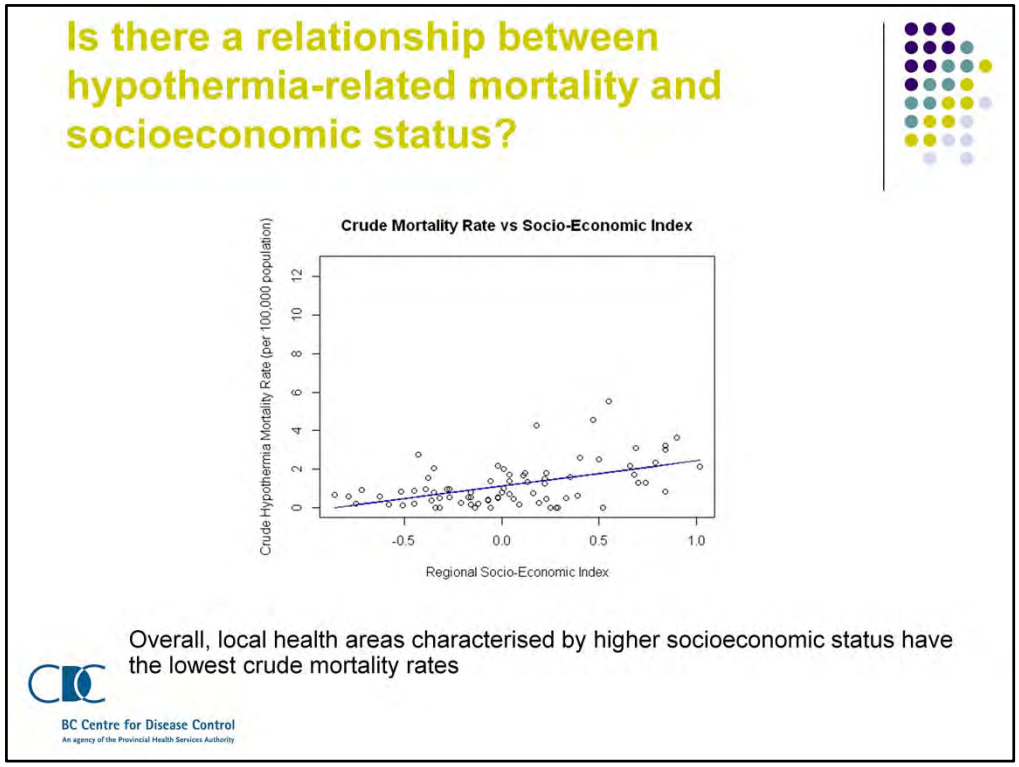
The figure at the top of the slide shows the distribution of maximum apparent temperature on the day of death for all hypothermia deaths across the province. The mean maximum apparent temperature on the day of death was approximately 3 degrees Celsius and ranged from -37 to +29 degrees Celsius, indicating that hypothermia deaths can potentially occur at any temperature.

The figure at the bottom left of the slide shows the distribution of maximum apparent temperature on the day of death for each ecoregion in the province. The figure at the bottom right of the slide shows the distribution of total maximum apparent temperatures for each ecoregion. The distribution of maximum apparent temperature on the day of death appears to be skewed towards lower temperatures in the Northern ecoregion, indicating that individuals living in the north may be most vulnerable to hypothermia-related mortality during cold weather.



This figure shows a plot of crude hypothermia mortality rates for each LHA on the y-axis against the log of population density for each LHA on the x-axis.

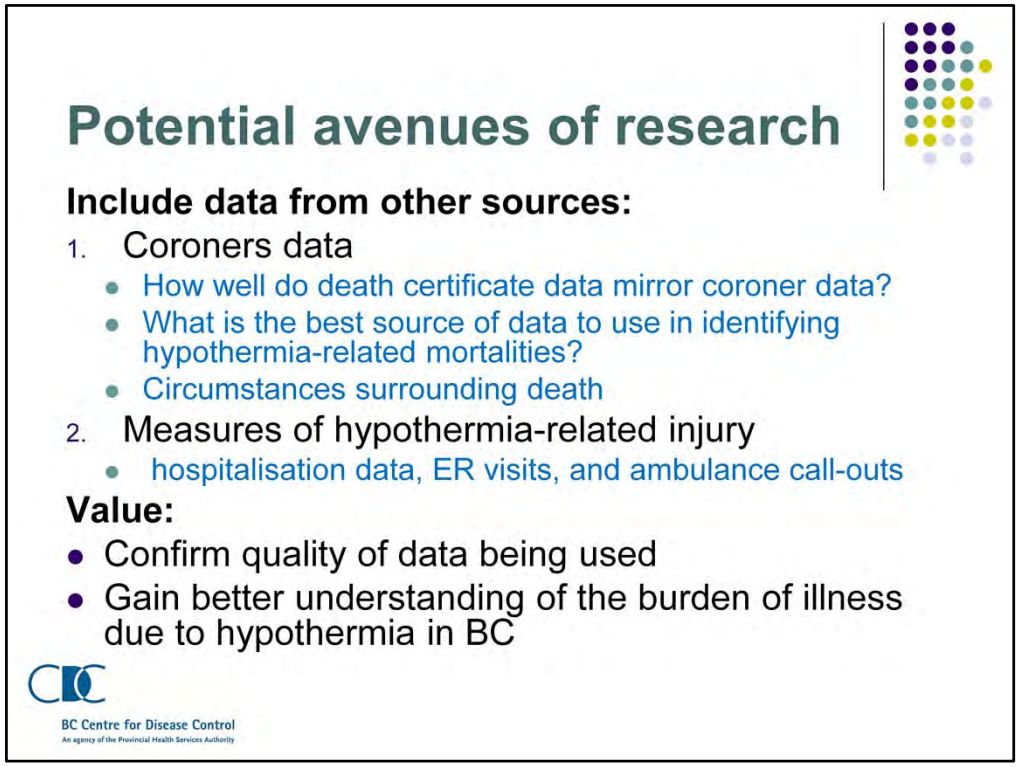
The figure illustrates that overall, local health areas with the highest population densities have the lowest crude mortality rates.



This figure is a plot of crude hypothermia mortality rates for each LHA (on the y-axis) against the BC Statistics Agency's regional-socioeconomic status index for each LHA on the x-axis.

A lower score on this index indicates higher regional socioeconomic status.

The figure illustrates that overall, local health areas characterised by higher socioeconomic status have the lowest crude mortality rates. It should be noted that for some LHAs in our data set with the highest CMRs there was no regional socioeconomic index value available.

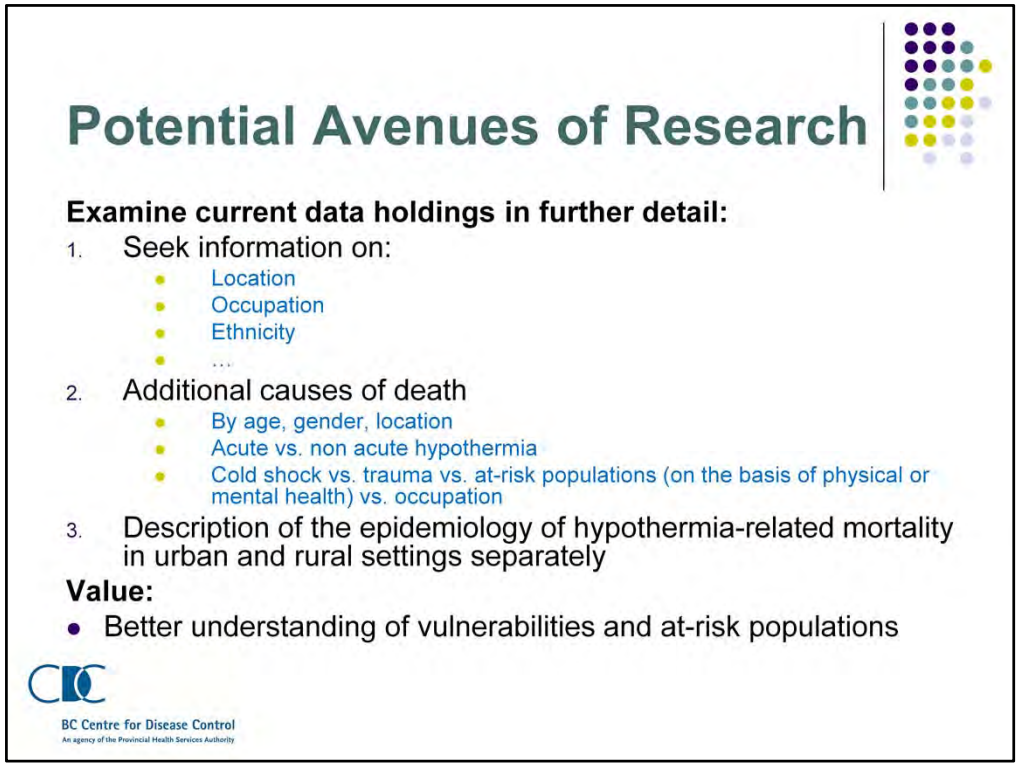


One way to move forward with this project is to include data from other sources.

In one direction, we can look to confirm the quality of the data being used and validate our processes.
The BC Coroners office investigates all sudden, unexpected, unexplained, or unattended deaths in the province. By examining data collected in a coroners report, we can:

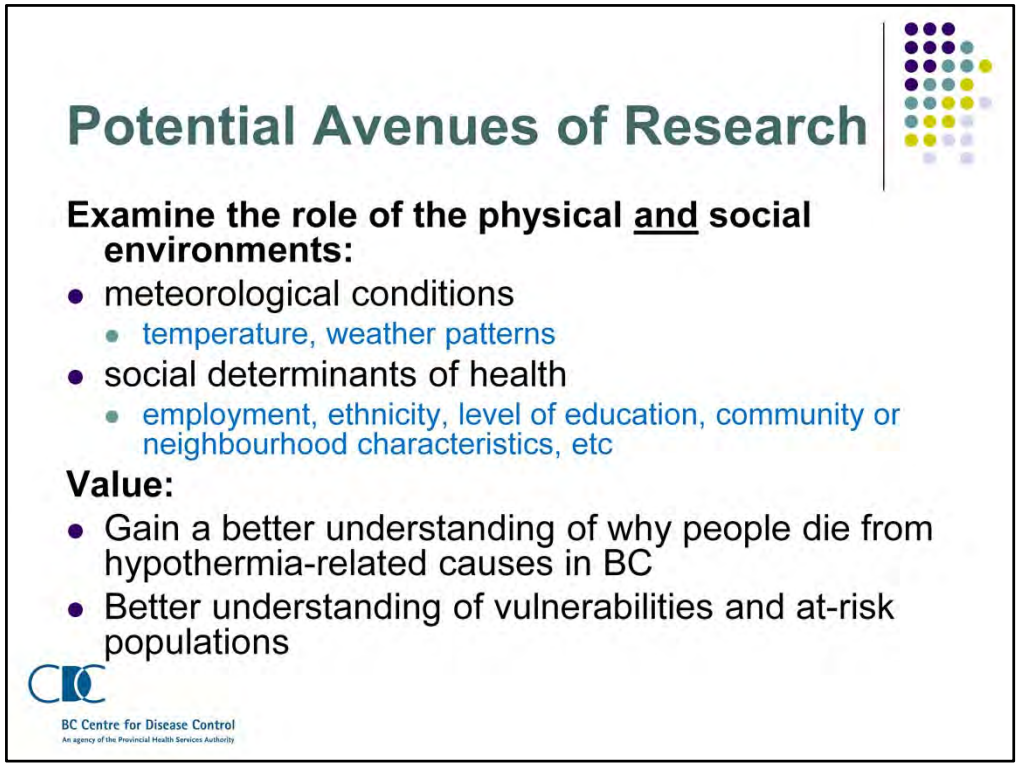
1) See how well the vital statistics death file captures deaths due to hypothermia in BC; and
2) Identify the best method to capture these occurrences.

In a second direction, we can look to describe burden of illness.
We could also request data that would capture hypothermia-related morbidity, from hospitalisations, emergency departments, and ambulance-calls. This would allow us describe the burden of illness related to hypothermia as well as allowing us to look for factors that may be associated with mortality alone.

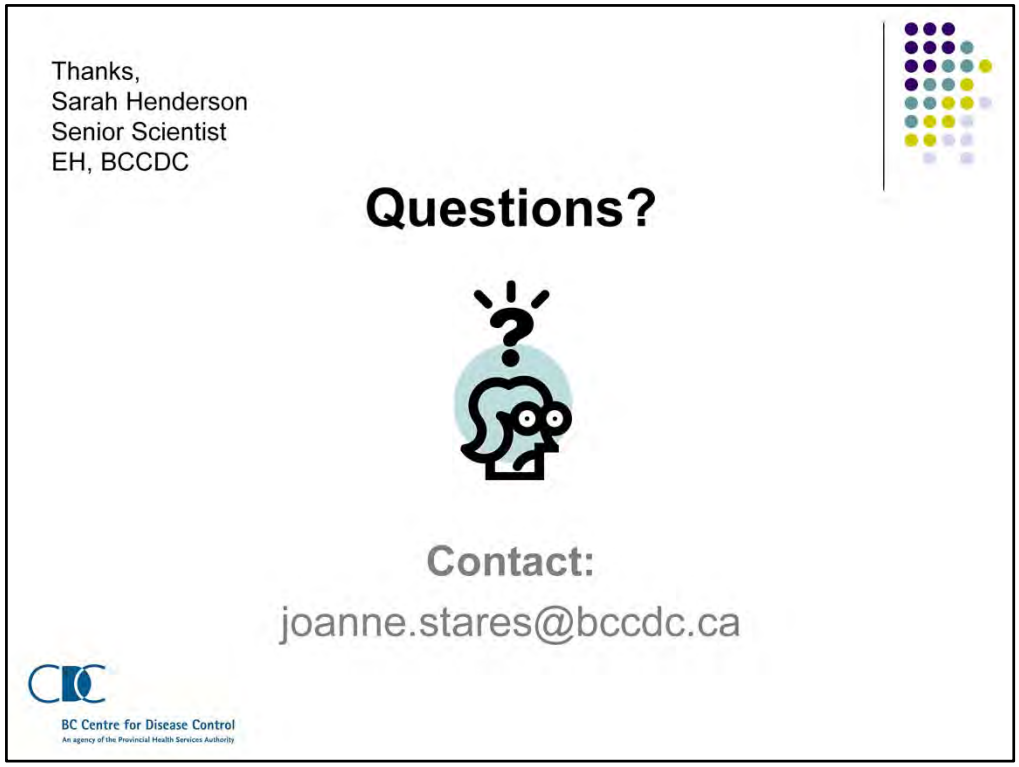


We could also examine our current data holdings in further detail so that we can better understand who the at-risk populations in BC are. As I mentioned earlier, hypothermia deaths occur in “other specified locality”. Without detail on where these deaths occured, we are unable to clearly identify areas, behaviours, and meteorological conditions that may associated with hypothermia mortality. In addition, it would be worthwhile to examine occupations of the deceased as well as ethnicity, and other such demographic risk factors to identify vulnerabilities.

All death certificates in the vital statistics death file can have upwards of nine causes of death coded. While we have started to examine this information at a high level, it would be meaningful to look at these data across age and sex, as well as looking at how these data can inform us in examining acute vs non-acute hypothermia, as well as differentiating between cases of cold shock and physical trauma, as well as hypothermia among vulnerable people and those exposure by occupation for instance.



Our preliminary work is very limited in its capacity to relate trends in hypothermia-related mortality to meteorological conditions. Going forward, it would be very important to identify what deaths may have been impacted by meteorological conditions. In addition, factors related to the social determinants of health, particularly socioeconomic status have emerged in our preliminary findings. Areas characterised by lower SES have higher CMRs for hypothermia. Examining the impact of both the social and physical environment simultaneously would be very important in identifying the most efficient way to prevent mortality as a result of hypothermia.



I believe there are a few minutes left for questions if there are any?