Mortality due to COVID-19 in Canadian Long-Term Care

A Comprehensive Analysis of Mortality due to COVID-19 in Long-Term Care

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Lay Abstract:

This study examined mortality due to COVID-19 from April 2020 to March 2021 in Canadian long-term care (LTC) homes by sex, age, province, and health region. Ranges of predicted values for mortality were created from mortality data from previous years and then compared with actual mortality. The number of active residents, admissions, and discharges were also examined by sex, age, and province to factor for changes in the population at risk. Overall, mortality increased in some quarters (April-June 2020 and October-December 2020) but was not always exceptional, as similar mortality rates had been observed in the four years prior to the pandemic. Also, the increase in mortality was seen mostly among younger residents (65 to 85); mortality remaining stable for the 85+. Further research is still required to better understand mortality in LTC by regional characteristics.

Abstract

The long-term care (LTC) sector in Canada has experienced high numbers of COVID-19 deaths. However, there is a paucity of data on the impact of COVID-19 in LTC by different socio-demographic variables and in LTC homes within different regions. Additionally, the question remains as to how exactly and by how much the pandemic has impacted mortality in LTC in comparison to previous years' mortality. Ranges for expected mortality by sex, province, and age, for the 2020-21 fiscal year were determined by creating forecasts and confidence intervals based on mortality trends in the preceding four fiscal years. These ranges were then compared to the actual mortality data in 2020-21. Comparisons between expected ranges and actual data were also conducted for the number of active residents, admissions, and discharges in LTC by sex, province, and age. Further, mortality ratios were created and studied by sex, province, age, and health region/authority/local health integration network. Overall, the number of deaths in LTC in Canada increased beyond the expected ranges in quarter one and three of 2020-21, and the patterns in death ratios were similar. Increases were exceptional in comparison to the peaks in deaths in previous years for specific variables, but not all variables. Most commonly, the number of active residents and admissions decreased in 2020-21 and the number of discharges from LTC did not change in quarter one and three and decreased in quarter two and four. However, importantly, these trends also varied across variables. This was the first study to comprehensively examine mortality due to COVID-19 in LTC overall, and by multiple socio-demographic variables while elucidating the complexity in the study of mortality in LTC. Further research is required to concretely understand mortality in LTC by different variables and regions.

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Background and Research Questions

Long-Term Care in Canada

In Canada, the provision of 24-hour functional support for frail individuals requiring medical assistance may be undertaken in long-term care (LTC) homes (1). The homes are interchangeably termed long-term care homes, nursing homes, continuing care facilities, or residential care homes and, in this thesis, will be called LTC homes. Due to the increasing proportion of older adults in Canada along with the subsequently increasing prevalence of chronic health conditions such as age-related dementia, the demand for LTC is projected to continue growing (2). Specifically, over the next twenty years, the population of older adults is expected to grow by 68 percent with the fastest growth in the subpopulation of those aged 75 years and older (3). LTC beds are mostly publicly financed in Canada, with residents contributing means-tested accommodation fees only.

Breakdown by the Type of Homes

In all of Canada there is a total of 2,076 LTC homes, 46% publicly owned ("municipal"), 23% private not-for-profit and 29% private for-profit (1)

Table 1. Provincial and territorial profiles of LTC homes by number of homes, LTC beds per 1000 individuals aged 65+, percentage of publicly owned homes, percentage private for-profit homes, and percentage private not for profit homes (1).

Province	**Number of Homes**	**LTC Beds per 1000 Individuals Aged 65+**	**Percentage Publicly Owned**	**Percentage Privately Owned**	
				For Profit	**Not for Profit**
Newfoundland and Labrador	40	26	98	2	
Prince Edward Island	19	39	47	47	6
Nova Scotia	84	33	14	44	42
New Brunswick	70	29		14	86
Quebec	440	24	88	12*	
Ontario	627	30	16	57	27
Manitoba	125	44	57	14	29
Saskatchewan	161	47	74	5	21
Alberta	186	26	46	27	27
British Columbia	308	28	35	37	28
Northwest Territories	9	51	100	0	0
Yukon	4	56	100	0	0
Nunavut	3	18	100	0	0

*12% of LTC homes in Quebec are privately owned. However, there is not further breakdown of privately owned homes.

Demographics of Residents in LTC

Almost all residents of LTC (94%) are older than 65 (4). Some younger residents are in facilities hosting individuals with developmental difficulties. Compared to 20 years ago, admittance of older adults to LTC facilities now occurs in later trajectories of their conditions and results in residents that are frailer. Consequently, residents of LTC facilities have increasingly complex needs (2). For instance, the proportion of older adults in LTC facilities in Canada with a mental illness is higher than the proportion of Canadians in the general population with a mental illness (5). Further, the prevalence of many mental illnesses is higher in LTC settings in comparison to older adults in the community (6). The most frequent mental illnesses in LTC include depression, anxiety, and dementia (7)(6), and dementia is a large factor influencing the admission of individuals to LTC (given the progressive course of cognitive decline caused by this condition) (6)(8). In Ontario, more than 70 percent of residents of LTC have been diagnosed with dementia (8). Additionally, according to Statistics Canada, men and women in nursing homes had significantly poorer self-perceived general health scores compared to men and women residing in private dwellings (9). Besides mental health issues, residents of LTC homes suffer from many chronic conditions: among residents of publicly funded LTC homes in Newfoundland and Labrador, Ontario, Manitoba, Alberta, British Columbia, and Yukon in the 2020-2021 fiscal year (April 2020 to March 2021), 40.5% had a endocrine/metabolic/nutritional disease diagnosis, 71.3% had a heart/circulation disease, 52.5% a musculoskeletal disease, 80.2% a neurological disease, 40.8% a psychiatric/mood disease, 17% a pulmonary disease, 21.5% a sensory disease and 54.8% some other diseases (allergies, anemia, cancer, gastrointestinal disease, liver disease, and renal failure)(4).

SARS-CoV-2 Pandemic in Canada

When the COVID-19 pandemic was first declared in Canada in March 2020, a passive response was enacted wherein there was a lack of rigorous testing and surveillance of human-to-human transmission and a late implementation of mask recommendations and mandates (10)(11). This may have been a result of the lack of laboratory supplies and logistical preparedness (10).

Although public health in Canada has municipal, provincial, and federal governance structures, healthcare is primarily in provincial and territorial jurisdiction and as such, Canadian provinces and territories had different responses and accordingly, varying numbers of cases of COVID-19 (11). The level of community cases also varied by sub-provincial region (12).

In Canada, infection control and prevention measures included recommendations on social distancing in public places, as well as non-essential business closures; limitations on private and public gatherings; recommendations against international travel; restrictions and limitations on foreign nationals entering the country; and closure of land borders with the United States (13). Polymerase chain reaction testing capacity for COVID-19, the gold standard for COVID-19 case testing, was expanded across the country and by June 2020 was accessible to many. Mask mandates were also implemented in Quebec, Nova Scotia, Alberta, and Ontario by July 2020. Provincial governments worked in collaboration with health regions and authorities to create policy responses to COVID-19 (14).

By the end of March 2020, cases had shifted from those being transmitted by international travelers from higher risk regions, to those acquired from community transmission (15). By the end of June 2020, or the first wave of the pandemic, Quebec had the highest case and death rates[1] followed by Ontario (16). While the Prairies fared better than Ontario and Quebec in the early stages of the pandemic, by the end of December 2020 and March 2021, case rates and death rates had grown considerably in these regions, surpassing Ontario. Additionally, although the Maritime provinces also fared well in the early stages of the pandemic in comparison to other regions in the country, case and death rates continued to grow over the winter of 2020 and 2021 (16). The following tables depict the case and deaths rates by province (Table 2.).

Table 2. Cases Rates and Death Rates by Province. Rates are given per 100,000 population (16)

Province		End of June 2020	End of September 2020	End of December 2020	End of March 2021
British Columbia	Case Rate	56	175	984	1919
	Death Rate	3	4	17	28
Alberta	Case Rate	182	407	2260	3339
	Death Rate	3	6	24	45
Saskatchewan	Case Rate	67	162	1285	2847
	Death Rate	1	2	13	37
Manitoba	Case Rate	23	144	1771	2465
	Death Rate	1	1	48	68
Ontario	Case Rate	237	349	1206	2360
	Death Rate	18	19	30	48
Quebec	Case Rate	645	863	2322	3615
	Death Rate	64	68	96	124
Newfoundland and Labrador	Case Rate	50	53	75	196
	Death Rate	1	1	1	1
New Brunswick	Case Rate	21	25	76	204
	Death Rate	0	0	1	4
Nova Scotia	Case Rate	107	110	149	173
	Death Rate	6	7	7	7
Prince Edward Island	Case Rate	16	36	58	97
	Death Rate	0	0	0	0
Northwest Territories	Case Rate	11	11	53	92
	Death Rate	0	0	0	0
Nunavut	Case Rate	n/a	n/a	675	1002
	Death Rate	0	0	3	10
Yukon	Case Rate	26	35	140	172
	Death Rate	0	0	2	2

All provinces and territories experienced an increase in the case rates across waves. Possibly due to a combination of high population density (in Montreal and Quebec), earlier Spring break in schools and greater exposure to international travellers than other jurisdictions,

[1] The case rate is defined as the number of cases relative to population, multiplied by 100,000 and the death rate is the number of deaths due to Covid-19 relative to the population, multiplied by 100,000. The former is also known as the case incidence.

Quebec became the province with the greatest number of COVID-19 cases early in the pandemic (14). While recognizing that the rates of COVID-19 may have been underestimated because of asymptomatic cases and the lack of systematic testing in Canada, as of December 2020, there had been 408, 921 COVID-19 cases in Canada (Waldner et al., 2021).

In April and May 2020, COVID-19 was the leading cause of death in Quebec and the mortality rate due to COVID-19 per 100,000 individuals was 71.1 in this province. Ontario had the second highest mortality rate after Quebec with a rate of 19.0 per 100,000 individuals, followed by Alberta with a rate of 4.4 and British Columbia with a rate of 4.0 (17).

Prince Edward Island, Newfoundland and Labrador, Nova Scotia, and New Brunswick experienced lower case rates per population that were maintained well into the second wave. Given the lower case rates in the Atlantic provinces, a travel bubble was established among these provinces wherein travel between these provinces was permitted while those entering the bubble had to undergo strict screening and testing. However, cases also did grow in the second wave among Atlantic provinces (Waldner et al., 2021)(11).

In regard to age and gender distribution, confirmed COVID-19 cases were similar among provinces (18). Generally, the highest incidence of cases was among 20–29-year-olds wherein this pattern decreased below this age group but drastically increased after age 80 (18). Across all provinces and territories, the burden of COVID-19 was most prevalent among older adults. Specifically, mortality was concentrated among those aged 70 years and older among both men and women, the case fatality rate[2] peaking after age 80 (18). A higher proportion of men than women, with COVID-19, were admitted to intensive care units (ICU). Specifically, in Canada, 63.2% of COVID-19 hospitalizations with ICU admission were males (19).

8,625 excess deaths (number of deaths in excess of the average number of deaths over the same period observed in past years) were recorded in Canada from the start of the pandemic to the end of June 2020 (20). In this period, those aged 65 and older comprised 85% of the excess deaths and 94% of deaths related directly to COVID-19 (20). By the end of 2020, there was an excess of 16,333 deaths (representing an increase of 4.92%), mostly among the 65+, as 87% of these excess deaths were observed among them (21).

Risk Factors for COVID-19 Complications

Although COVID-19 may have negative effects on a diversity of populations, older adults have had poorer health outcomes. Older individuals were more likely to be hospitalized, admitted to the intensive care unit, and die from COVID-19 (19)(22). Being male may be another risk factor for the same detrimental consequences (23). In Italy, the mean age of individuals who died from COVID-19 as of November 2020 was 80 years (24). Further, those who recover from infection were younger while those requiring care and complications were older (24).

Those with pre-existing health conditions, especially comorbidities, were more likely to die than those with no pre-existing or fewer pre-existing health conditions. According to Statistics Canada, by December 2020, 90% of COVID-19 related deaths occurred in the population aged 65 years and older with chronic conditions (21). Old age is associated with the prevalence of chronic comorbidities which are then associated with poorer health outcomes (25).

[2] The case fatality rate (CFR) is defined as the number of deaths to the number of cases. Of course, the denominator is the number of identified cases (through testing) and the CFR is sensitive to the testing policy of a given jurisdictions.

It is thus not surprising that being older was associated with worse outcomes such as clinical complications, mortality, and hospitalizations. Moreover, in a meta-analysis on frailty and COVID-19, frailty was determined to be associated with higher levels of mortality due to COVID-19 (26).

COVID in LTC homes

In Canadian LTC homes, COVID-19 has had a negative impact wherein there has been a high number of outbreaks and deaths due to the pandemic (27). The inability of LTC homes to control the spread and impact of COVID-19, in part due to systemic deficiencies and underfunding (and resulting understaffing as well as overcrowding) of LTC, has led to devastating consequences. By October 2020, the proportion of COVID-19 related deaths that took place in LTC homes (and not in the community) was one of the highest in Canada compared to other OECD countries, at 80% (28).

During the first wave of the pandemic, there was an outbreak in 626 or 31% of LTC homes in Canada (total of 2,039 LTC homes in Canada). Outbreaks were defined by the presence of at least one lab confirmed COVID-19 case among staff or residents. When further divided, 80% of homes had 1 outbreak, 20% had more than 1 outbreak, and 25% had outbreaks involving only staff. 49% of outbreaks in LTC homes were characterized as small (fewer than 5 cases) and these outbreaks were not particularly fatal. 94% of the total COVID-19 deaths in LTC occurred in homes that experienced large outbreaks (more than 25 cases). 30% of LTC homes had outbreaks with more than 100 resident cases (29). Percentage outbreaks and average cases can be further broken down by province

Table 4. Percentage of homes experiencing outbreaks and average cases across homes (29).[3]

Province	Percentage of Homes Experiencing Outbreaks	Average Cases
Quebec	44	38
Ontario	34	28
Alberta	17	17
British Columbia	8	15

Residents were in general more vulnerable to the virus than the population living in the community. From March 1 2020 to August 31 2020, 37% of LTC residents died with COVID-19, resulting in 6080 deaths. This accounts for 66% of the total COVID-19 deaths in the country within this time period (29). Data can be further broken down by province as depicted in Table 5.

Table 5. Deaths in LTC by province and the proportion of LTC deaths in the overall death counts by province (29).

Province	Deaths in LTC	Proportion of Overall Deaths in Province
Quebec	3950	69
Ontario	1815	64

[3] The 4 provinces with the highest percentage of homes experiencing cases are depicted in Table 4.

Alberta	143	60
British Columbia	118	57
Newfoundland and Labrador	0	0
Prince Edward Island	0	0
Nova Scotia	57	88
New Brunswick	<5	100
Manitoba	<5	21
Saskatchewan	<5	8

The pandemic exacerbated many challenges within LTC. This includes but is not limited to inadequate infection prevention measures, staffing issues (both shortages and staff working for different homes and spreading the virus), lack of quality care and feeding of residents, decreased number of physician visits during the first wave, decreased contact with family and friends, increased antipsychotic drug use, and decreased transfers to the hospital (29)(30). Physicians' visits in LTC homes dropped by 16% between March 1 and August 31, 2020, when compared to the same period in 2019 in provinces where measurements could be made, and in-person visits were seemingly not replaced by virtual visits given a similar reduction in physician care orders. Further, overall, 30% fewer resident transfers to hospitals occurred in the first wave. Additionally, there was a decrease of 40% in new admissions to LTC homes with the greatest decrease occurring among community admissions (29). In many homes, the military was deployed to attend the exacerbating situation (31). It was reported that the conditions residents and workers were experiencing compromised the basic hallmark of these residents' human rights and that the undignified and isolated conditions were a humanitarian crisis (32). A report produced by the task force convened by the Chief Science Advisor of Canada to provide direction on limiting infection and improving outcomes for LTC residents brings forward a plethora of issues in the LTC system (33). This includes the initial lack of access to personal protective equipment, inadequate staff training and numbers, a lack of policy support for the LTC sector, and inappropriate medical/protective measures. Systemic issues including minimal societal priority and attention towards LTC pre-pandemic; lack of advocacy for these vulnerable LTC residents; and fragmented continuum of care and heterogenous operational models contribute to the issue at hand (33)(31). The status of LTC homes (for-profit, non-profit, or municipal) also influenced the impact of COVID-19 outbreaks, with outbreaks being much more lethal in for-profit LTC facilities, at least in Ontario (34) Part of the issue here results from for-profit facilities being less well funded per bed than beds in municipal homes as well as from lax monitoring of the private sector.

Nonetheless, by the end of January 2021, many provinces had acquired high levels of vaccinations among LTC residents: Prince Edward Island and Alberta with 100% coverage, Quebec with 87% coverage, British Columbia with 90% coverage, but 60% only in Ontario (35). Albeit, vaccine administration and rollout have occurred in a fragmented manner across health regions in provinces and territories and across public and private long-term care homes (35).

The COVID-19 pandemic in Canada has had a disproportionate impact on LTC in Canada where this sector has experienced high numbers of outbreaks and deaths. Similar to the notion that COVID-19 has had varying effects on case and death rates across provinces and territories in the general population, COVID-19 has had varying effects on deaths in LTC across provinces and territories and the question remains as to how exactly and by how much the pandemic has impacted mortality in LTC.

Objective of the Research (Research Question): Examining Excess Mortality in LTC homes during the first year of the Covid-19 pandemic in Canada.

We measure the difference in the all-cause mortality in LTC homes during the first two waves of the pandemic relative to what should have been observed had mortality followed the trend observed in the four years pre pandemic. We also want to check whether that difference is statistically significant (as opposed to resulting from chance), whether it was stable across months during the period (excess followed by lower than expected mortality would signal that the most vulnerable individuals died) and whether excess mortality, if any, was determined by social characteristics of the region in which the LTC home is located.

Although COVID-19 infections and mortality rates among residents in LTC have been high, it is not comprehensively known by how much overall mortality was increased due to the COVID-19 pandemic. Consequently, exploration of mortality in LTC can be done using the measure of "excess mortality". The use of excess mortality as a measure can determine whether there were more deaths during a period of time than are typical.

The Canadian Institute for Health Information (CIHI) published a study of excess mortality in LTC homes during the first wave of the pandemic (March to June 2020)(29). As we explain in the methods section, our approach is different in the sense that we include the trend in mortality pre-COVID-19 whereas CIHI compares the number of deaths during the first wave to the average of the five previous years for the same infra-annual period. This matters because, if the trend in mortality in LTC homes was increasing (resp: decreasing), a number of deaths in excess (short) in the last year would not necessarily signal an increase (decrease) in mortality but simply the continuation of the previous trend. The excess mortality published by CIHI (2,273 more deaths in LTC homes from March 1 to June 30, 2020) could be an underestimate of the true shock (if the trend was decreasing) or an overestimate (in the opposite case). Also, we don't really know what to make of such data: is it exceptional, or within the range of what could be expected given what happened in LTC homes in the past? Specifically, the CIHI report indicates that the largest increase in deaths from all causes occurred in April 2020 in comparison to the average in the previous 5 years. Further broken down by province, Ontario experienced excess deaths by 28%, followed by the Maritimes at 15%, Manitoba at 9%, Newfoundland and Labrador at 5% and BC at 4%. As we detail in the methods section below, included deaths are from all causes and include residents who died in a LTC home. The CIHI report was based on the provinces that report to CIHI's Continuing Care Reporting System (Newfoundland and Labrador, Ontario, Manitoba, Alberta, and British Columbia)(29). The present analysis is also based on the same provinces.

Focus on All-Cause Mortality over Only COVID Related Mortality

In this paper, there is a focus on examining all-cause mortality over COVID-19 related mortality. There are several reasons for this including logistical limitations of data acquisition for the latter. Additionally, focusing on excess deaths from all causes reduces the potential for misclassification of deaths from COVID-19 and other causes. In turn, this allows for stronger comparisons between jurisdictions by mitigating the need to account for the potential differences in assigning cause of death and differences in testing for COVID-19. Lastly, COVID-19 killed residents directly, but also indirectly, by cancelling hospital stays for elective surgery or cancelling outpatient visits for residents.

Data and Methods:

Firstly, data on case and death rates by health region and in the general population were obtained from the publicly available Statistics Canada webpage which provides COVID-19 epidemiological updates (16). This data was examined in order to firstly gain an understanding of the case and deaths rates in the general population by health region/authority/LHIN, and secondly to compare this data with deaths in LTC by health region/authority/LHIN. Specifically, this allows for observations to be made on community case rates and their potential association with the situation in LTC. Case and death rates by health region over 2020 and early 2021 are depicted in Table 3. Case and death rates grew over 2020 and into 2021 for each health region. Case and death rates are highest in local health integration networks (LHINs) in Ontario and health regions in Alberta, followed by health authorities in British Columbia and finally by health regions in Newfoundland and Labrador.

Table 3. Case rates and death rates by health authority (British Columbia), health region (Alberta and Newfoundland and Labrador) or LHINs (Ontario). Rates are given per 100,000 population (16).

Province	Health Region		End of June 2020	End of September 2020	End of December 2020	End of March 2021
Alberta	Calgary Zone	Case Rate	320	527	2281	3384
		Death Rate	7	7	19	36
Alberta	Central Zone	Case Rate	19	139	1326	2386
		Death Rate	0	1	8	25
Alberta	Edmonton Zone	Case Rate	74	354	2958	3933
		Death Rate	1	5	38	70
Alberta	North Zone	Case Rate	70	311	1468	2989
		Death Rate	3	8	14	32
Alberta	South Zone	Case Rate	428	597	1619	2608
		Death Rate	3	8	19	34
British Columbia	Fraser Health	Case Rate	81	241	1695	2993

		Death Rate	4	6	26	41
British Columbia British Columbia	Interior Health	Case Rate	25	66	476	1037
		Death Rate	0	0	3	14
British Columbia	Island Health	Case Rate	16	24	107	382
		Death Rate	1	1	1	3
British Columbia	Northern Health	Case Rate	21	29	635	1979
		Death Rate	0	1	9	40
British Columbia	Vancouver Coastal Health	Case Rate	78	269	977	1934
		Death Rate	7	10	27	33
Newfoundland and Labrador	Central Health	Case Rate	9	14	38	50
		Death Rate	0	0	0	0
Newfoundland and Labrador	Eastern Health	Case Rate	76	79	101	291
		Death Rate	1	1	1	2
Newfoundland and Labrador	Labrador-Grenfell Health	Case Rate	17	17	19	25
		Death Rate	0	0	0	0
Newfoundland and Labrador	Western Health	Case Rate	5	5	37	50
		Death Rate	0	0	1	1
Ontario	Central East LHIN[a]	Case Rate	301	172	496	1050
		Death Rate	12	12	16	26
Ontario	Central LHIN[a]	Case Rate	256	359	1431	2823
		Death Rate	21	22	30	47
Ontario	Central West LHIN[a]	Case Rate	477	621	2567	4570
		Death Rate	20	21	29	41

Ontario	Champlain LHIN[a]	Case Rate	126	176.5	539	1062
		Death Rate	15	16	22	29
Ontario	Erie St. Clair LHIN[a]	Case Rate	247	409	938	2280
		Death Rate	12	13	18	51
Ontario	Hamilton Niagara Haldimand Brant LHIN[a]	Case Rate	186	237	770	1669
		Death Rate	13	13	22	44
Ontario	Mississauga Halton LHIN[a]	Case Rate	127	191	915	1746
		Death Rate	4	4	18	33
Ontario	North East LHIN[a]	Case Rate	33	41	129	439
		Death Rate	1	1	1	6
Ontario	North Simcoe Muskoka LHIN[a]	Case Rate	61	88	338	752
		Death Rate	3	3	6	18
Ontario	South East LHIN[a]	Case Rate	35	48	209	358
		Death Rate	3	3	3	4
Ontario	South West LHIN[a]	Case Rate	66	91	466	915
		Death Rate	5	5	10	26
Ontario	Toronto Central LHIN[a]	Case Rate	488	651	1990	3752
		Death Rate	37	10	65	94
Ontario	Waterloo Wellington LHIN[a]	Case Rate	188	249	884	1834
		Death Rate	15	16	21	37

[a] Statistics Canada provides case and death rates by regional public health units in Ontario while CIHI provides data by LHINs in Ontario. Accordingly, using a report of the Minister's Expert Panel on Public Health in Ontario (36), case and death rate data was averaged across the health regions categorized into each LHIN.
Winnipeg Regional Health and North West LHIN are not included in this data.

The remainder of the data and methods section will discuss what data was obtained to conduct the current study, how this data was used, and limitations/ considerations on how the obtained data could be used.

1. **<u>Data from CIHI</u> (here, I describe what the CIHI team did to extract the data from their data base):**

<u>Overview of Data</u>

What CIHI sent me are aggregate quarterly counts from the 2016-2017 to 2020-2021 fiscal years of active residents, discharges, admissions, and deaths in residential care facilities that submitted data. Monthly counts were provided for deaths and admissions only. I did not have access to data at the facility level, but aggregate counts were broken down by age group (one table), sex (one table), province (one table), and health region/health authority/ LHIN (one table).

<u>Database Accessed</u>

Data was prepared by the Specialized Care Data Management Team in CIHI, using raw data at the facility level from the Continuing Care Reporting System (CCRS). The Resident Assessment Instrument–Minimum Data Set (RAI-MDS 2.0) © is used to collect the data for CCRS.

<u>Time Period of Data</u>

A fiscal year is designated as April to March. For example, the 2020-2021 fiscal year was determined as April 2020 to March 2021. Quarter one is designated as April to June, quarter two is designated as July to September, quarter three is designated as October to December, and quarter four is designated as January to March of the respective fiscal year. As such, this study included data from April 2016 to March 2021.

<u>Inclusion Criteria for Variables</u>

a) Facilities: Data reflects facilities with publicly funded/subsidized beds (i.e. facilities that receive any form of funding from the province, which is the case of all LTC beds, are included). Results for Newfoundland and Labrador, Ontario, Alberta, British Columbia, and Yukon Territory are exhaustive (all publicly funded beds), reflecting full coverage in these provinces/territory. Results for Manitoba only include the Winnipeg Regional Health Authority, and as such, may not be representative of Manitoba as a whole.

b) Active Residents: For calculation of the number of active residents, all episodes that were admitted on or before March 31, 2021 and discharged on or after April 1, 2016 were first determined. Upon admission, discharge, or assessment, a resident would be counted in the number of residents for the fiscal quarter.

c) Discharges: Residents were considered discharged if for at least 2 quarters they did not have an assessment. These residents were not included in the counts for active residents.

d) Total discharges included count of residents discharged or "assumed discharged" in a specific period. Residents who died in facility were not included in the counts.

Data Variables

Age groups were classified as follows: 0-64, 65-74, 75-84, 85-94, and 95+.
Sex was classified as male or female in the data provided.
Provinces included Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Ontario and Yukon Territory
Health regions included Calgary Zone, Central Zone, Edmonton Zone, North Zone, and South Zone in Alberta. Health regions in Newfoundland and Labrador include Central Health, Eastern Health, Labrador-Grenfell Health, and Western Health.
Health authorities included Fraser Health, Interior Health, Island Health, Northern Health, and Vancouver Coastal Health in British Columbia. Winnipeg Regional Health Authority was the only health region included for Manitoba.
LHINs in Ontario included Central East LHIN, Central LHIN, Central West LHIN, Champlain LHIN, Erie St. Clair LHIN, Hamilton Niagara Haldimand Brant LHIN, Mississauga Halton LHIN, North East LHIN, North Simcoe Muskoka LHIN, North West LHIN, South East LHIN, South West LHIN, Toronto Central LHIN, and Waterloo Wellington LHIN.
There is only one health region in Yukon Territory.

Notes on Data

Where the number of admissions, deaths, active residents, or discharges was a value between 1 and 4, the real number was not provided. As such, these data elements were included as zero in the analysis.
For FY 2020-2021, CCRS has full coverage from Newfoundland and Labrador, Ontario, Alberta, British Columbia, and Yukon Territory and partial coverage in Manitoba. Participation in CCRS varies by jurisdiction and year. The issue of variations in reporting over time is examined below (note on data #2).

2. **Use of Data (here I describe what I did with the data that I received from CIHI):**

Microsoft Excel was used to conduct all analyses and to create all graphs in this study.

The goal of the analysis was to determine how the expected number of deaths, admissions, active residents and discharges (by total numbers, province, age, sex, and health region) compared with corresponding actual numbers.

To illustrate how the analysis was conducted on each variable, the steps for determining expected total deaths for each quarter of the 2020-2021 fiscal year will be provided as a starting example. The total number of deaths by quarter was calculated by summing the number of deaths in those aged 65-95+ in each quarter of each year.[4] This is because the total number of deaths,

[4] Those aged 0-64 were excluded from the analysis from total numbers. This was done because this demographic of residents differs greatly from those in the older age brackets, and where possible an analysis excluding this demographic was desired.

admissions, active residents or discharges is not provided. Instead, the number of deaths, admissions, active residents or discharges is provided by sex, age, province, and health region/health authority/ LHIN.

Step 1: Creating a Forecast for 2020-2021

Firstly, the trend in the number of deaths from 2016-2017 to 2019-2020 was established. To establish this trend, the forecast function in Microsoft Excel was used. "Forecast" predicts future values by using a linear regression of number of deaths on time in the past: using the estimated coefficients, predicted values are generated for the last four quarters (the pandemic period) and compared to the observed values. X variables were the quarters of all years (year variable) included and y variables were the death counts. Data organization to allows for this analysis is depicted in Table 6.

A) Using all y and x values in each quarter one of each year in Table 6, a forecasted value was created for quarter one of 2020-2021. For instance, the following were the y values used to create this forecast: 7723, 7721, 7918, and 8027 and the following were the x values used to create this forecast: 1, 5, 9, and 13.
B) A forecasted value for quarter two, three, and four was created using this same methodology but instead using the values corresponding to each respective quarter. For instance, the following were the y values used to create a forecasted value for quarter three of 2020-2021: 8904, 9029, 8968, and 9272 and the following were the x values used to create this forecast: 3, 7, 11, and 15.

Table 6. Example of Data Organization Before Analysis

Year	Quarter	Year Variable	Death Counts
2016-2017	Q1	1	7723
	Q2	2	7508
	Q3	3	8904
	Q4	4	9810
2017-2018	Q1	5	7721
	Q2	6	7555
	Q3	7	9029
	Q4	8	10124
2018-2019	Q1	9	7918

	Q2	10	7419
	Q3	11	8968
	Q4	12	9218
2019-2020	Q1	13	8027
	Q2	14	7607
	Q3	15	9272
	Q4	16	9377

Step 2: Creating a Trend Line for all Data

The trend line for the actual data from quarter one of 2016-2017 to quarter four of 2019-2020 and the forecasted data in quarter one to four of 2020-2021 were calculated using the trend function in excel.

Step 3: Creating Confidence Intervals Around the Trend Line

After the trend line for the data was determined, confidence intervals were created around the trend line of the actual data from quarter one of 2016-2017 to quarter four of 2019-2020 and the forecasted data for quarter one of 2020-2021 to quarter four of 2020-2021. It could then be determined if the actual data from quarter one to quarter four of 2020-2021 fit within the confidence intervals for the data.

The bounds of the confidence interval were calculated using the following formula: $Y_{sup} = Y + t_\alpha * SE * \sqrt{\frac{1}{n} + \frac{(x-x_m)^2}{ss_{xx}}}$ while the minimum confidence values were calculated using the following formula: $Y_{inf} = Y - t_\alpha * SE * \sqrt{\frac{1}{n} - \frac{(x-x_m)^2}{ss_{xx}}}$ In these formulas Y_{sup} and Y_{inf} are the bounds of the confidence interval, Y is the y value on the trend line, t_α is the t value for the 95 % confidence interval, SE is the estimated standard error of the distribution of y, n is the number of cases, X is the average for x values, X_m is the specific x value, and SS_{xx} is the explained variation.

If the actual number of deaths for a quarter in the 2020-2021 fiscal year was outside of the confidence interval of the expected values (i.e., values that fall within the confidence interval), the outcome for that quarter was said to be significantly different from expectation (either in excess or shortage). For example, if the number of total deaths in quarter one of the 2020-2021 fiscal year was below the confidence interval for total expected deaths for quarter one of this year, then the total number of deaths decreased in quarter one of the 2020-2021 fiscal year. Similarly, whether actual admissions, discharges, and active residents fell inside or outside the confidence intervals of the respective analysis allowed for an understanding of whether there was an increase or decrease in the respective variable.

<u>Step 5: Graphing Data</u>
A graph was created, using Excel, for each variable analyzed.

This exercise was conducted separately and identically for:

1. Number of deaths
    a. Total number of deaths by quarter
    b. Total number of deaths by month
    c. Number of deaths by sex (females and males) by quarter
    d. Number of deaths by sex (females and males) by month
    e. Number of deaths by province by quarter
    f. Number of deaths by province by month
    g. Number of deaths by age groups (65-74, 75-84, 85-94 and 95+) by quarter
    h. Number of deaths by age groups (65-74, 75-84, 85-94 and 95+) by month
2. Number of deaths, total by quarter, with the addition of the number of discharges to hospital for each quarter of data added to the number of deaths for each quarter of data.
3. Number of active residents, total by quarter
    a. Number of active residents by sex (females and males)
    b. Number of active residents by age groups (65-74, 75-84, 85-94 and 95+)
    c. Number of active residents by province
4. Number of admissions
    a. Total admissions by quarter
    b. Total admissions by month
    c. Number of admissions by sex (females and males) by quarter
    d. Number of admissions by sex (females and males) by month
    e. Number of admissions by age groups (65-74, 75-84, 85-94 and 95+) by quarter
    f. Number of admissions by age groups (65-74, 75-84, 85-94 and 95+) by month
    g. Number of admissions by province by quarter
    h. Number of admissions by province by month
5. Number of discharges, total by quarter
    a. Number of discharges by sex (females and males)
    b. Number of discharges by age groups (65-74, 75-84, 85-94 and 95+)
    c. Number of discharges by province
6. Discharge ratio (to number of active residents), total by quarter
2. Mortality ratio (to number of active residents), total
    a. Mortality ratio by sex (females and males)
    b. Mortality ratio by age groups (65-74, 75-84, 85-94 and 95+)
    c. Mortality ratio by province
    d. Mortality ratio by health region
3. Mortality Ratio (to number of active residents), by peer group
    a. Including British Columbia in the analysis
    b. Excluding British Columbia in the analysis
4. Mortality Ratio (to number of active residents), by socio-economic variables
    a. Mortality ratio for peer groups with high population density
    b. Mortality ratio for peer groups with middle population density
    c. Mortality ratio for peer groups low population density

d. Mortality ratio for peer groups with a high proportion of visible minority populations
e. Mortality ratio for peer groups with a middle proportion of visible minority populations
f. Mortality ratio for peer groups with a low proportion of visible minority populations
g. Mortality ratio for peer groups with high unemployment rates
h. Mortality ratio for peer groups with middle unemployment rates
i. Mortality ratio for peer groups with low unemployment rates

Step 6: Calculating Excess Deaths

Excess deaths were determined by finding the difference between the maximum or minimum confidence interval points and actual deaths, depending on whether the actual deaths fell above or below the confidence intervals, by quarter and month. If the actual value for a quarter did not fall outside the confidence interval, excess deaths were not considered to have occurred (rather, it could not be considered not to be due to chance).

Step 7: Calculating the Discharge Ratio

The discharge ratio was calculated by dividing the number of discharges (the total number of discharges was determined by summing discharges in those aged 65-95+) by the number of active residents (the total number of admissions was determined by summing admissions in those aged 65-95+). These discharge ratios were then used to create forecasts, trend lines, and confidence intervals.

Step 8: Adding Discharges to Hospital to Death Counts

In analysis 8, the number of discharges to hospital was used as a proxy for the number of deaths, under the assumption that most discharges from a LTC homes are due to death. The number of discharges to the hospital was added to the number of deaths by quarter over all years. These new values were then used to create forecasts, trend lines, and confidence intervals.

Step 9: Calculating Mortality Ratios

Given that admissions varied during the pandemic, it is possible that the number of deaths actually decreased because the population at risk itself decreased. The mortality ratio, however, corrects for this risk.

The mortality ratio, which will also be referred to as the death ratio, was calculated by dividing the number of deaths (the total number of deaths was determined by summing deaths in those aged 65-95+) by the number of active residents (the total number of admissions was determined by summing admissions in those aged 65-95+) for each respective category. For example, to determine the death ratio for males in quarter one of the 2020-2021 fiscal year, the number of male deaths in quarter one in the 2020-2021 fiscal year were divided by the total number of active residents in quarter one of the 2020-2021 fiscal year.

To examine death ratios by sex, the number of female deaths were divided by the number of female residents. This created death ratios for females from quarter one of 2016-2017 to quarter four of 2020-2021. After this, the death ratios from 2016-2017 to 2019-2020 were used to create forecasts for 2020-2021. Confidence intervals were then created for this data. The same methodology was applied to calculate male death ratios.

Death ratios by province were calculated separately for each province. To start, the number of deaths in Alberta were divided by the number of active residents in Alberta. The death ratios were then used to create forecasts and confidence intervals. This methodology was applied to obtain forecasts for British Columbia, Manitoba, Newfoundland and Labrador, and Ontario.

Death ratios were also examined for the following age groups: 65-74, 75-84, 85-94, and 95+ years using the aforementioned steps while using the number of deaths and number of residents by age group.

Death ratios were calculated for each health region using the aforementioned steps and with the substitution of data to include deaths and residents in each health region by quarter. Health regions are examined via death ratios only in this study. This is done to ensure the scope and depth of the study does not become too large.

Death ratios were calculated for peer groups (A to I) as defined by Statistics Canada.

Death ratios were calculated for nine groupings of peer groups by socioeconomic variables. More information on death ratios for peer group groups and socioeconomic groupings is in the sections that follow.

Step 10: Assigning Health Regions/ Health Authorities/ LHINs to Peer Groups

Different regions across Canada and among provinces and territories had different experiences with COVID-19 (16). This may in part be attributable to the policies implemented within those regions but also to the socio-demographic factors which influence the health and well-being of a community. As such, it is worthwhile exploring the variation in impact of COVID-19 on excess mortality in LTC homes across health regions of various types.

In this section, I describe the opportunity and methods for studying excess mortality by social characteristics of the region where homes are located. To do this, there is information on deaths by health regions/authorities/LHINs. The regions need to be matched to socio-economic background information at the regional level. Statistics Canada groups regions by similar socio-economic characteristics, such as population density, and publishes a list of regions belonging to each "peer" group (37). Statistics Canada also provides a list of each health region/authority/ LHIN that belongs to each peer group. Further, Statistics Canada then publishes which peer group has very high, high, medium, low, or very low levels of a specific characteristic (37). For example, peer group A may be designated as a group comprised of regions with mainly low population density. I used these peer groups to explore the effects of social characteristics of a region on death ratios. Table 8. (below) elucidates the characteristics of each peer group.

I now describe how I assigned health regions/authorities/LHINs (as provided in CIHI's data) to peer-groups.

Each health region/LHIN was matched to its corresponding peer group by referencing the published list of peer groups and the regions/LHINs that comprise these groups (37)(38). However, health authorities in British Columbia did not match peer groups established by Statistics Canada. Accordingly, the following decisions were made:

- Fraser Health included the following regions: Fraser East, Fraser South, and Fraser North. According to Statistics Canada, Fraser East is in peer group B, but Fraser North and Fraser South are in group H. I made the decision to assign all Fraser Health into peer group H.

- Interior Health Authority included the following regions: East Kootenay (group D), Kootenay-Boundary (group C), Okanagan (group C), and Thompson/Cariboo (gropu C). As such, this health authority was categorized into peer group C.
- Vancouver Island Health Authority included the following regions: South Vancouver Island (group B), Central Vancouver Island (group C), and North Vancouver Island (group C). As such, this health authority was categorized into peer group C.
- Northern Health Authority included the following regions: North West (group D), Northern Interior (group D), and Northeast (group A). As such, this health authority was categorized into peer group D.
- Vancouver Coastal Health Authority included the following regions: Richmond (group H), Vancouver (group G), and North Shore/Coast Garibaldi (group H). This health authority was categorized as belonging in peer group H as a result.

Health Regions were then matched to their respective peer groups as follows:

Table 7. Health Regions and their Corresponding Peer Groups.

Province	Health Region	Peer Group
AB	Calgary Zone	B
AB	Central Zone	A
AB	Edmonton Zone	B
AB	North Zone	A
AB	South Zone	D
BC	Fraser Health	H
BC	Interior Health	C
BC	Island Health	C
BC	Northern Health	D
BC	Vancouver Coastal Health	G
MB	Winnipeg Regional Health Authority	B
NL	Central Health	E
NL	Eastern Health	C
NL	Labrador–Grenfell Health	E
NL	Western Health	E
ON	Central East LHIN	B
ON	Central LHIN	H
ON	Central West LHIN	H
ON	Champlain LHIN	B
ON	Erie St. Clair LHIN	C
ON	Hamilton Niagara Haldimand Brant LHIN	A
ON	Mississauga Halton LHIN	H

ON	North East LHIN	C
ON	North Simcoe Muskoka LHIN	B
ON	North West LHIN	C
ON	South East LHIN	C
ON	South West LHIN	A
ON	Toronto Central LHIN	G
ON	Waterloo Wellington LHIN	B
YT	Yukon Territory	I

The example of how the death ratios for peer group A were found will be used to illustrate how data was analyzed by peer group. Firstly, the number of deaths for all health regions belonging to peer group A were summed separately for each quarter of 2016-2017 to 2020-2021. Secondly, the number of residents for all health regions belonging to peer group A were summed separately for each quarter of 2016-2017 to 2020-2021. The sum of deaths was then divided by the sum of residents for each respective time period to obtain the germane death ratios (e.g., sum of deaths for all health regions in peer group A in quarter one divided by the sum of active residents in health regions in peer group A in quarter one). This method of obtaining the death ratios was repeated for each peer group. The death ratios before 2020-2021 were used to create forecasts and trends and in turn, these forecasts and trends were used to create confidence intervals.

Next, given the assumptions made to group health authorities in British Columbia into peer groups, the death ratios, forecasts, trends, and confidence intervals were recalculated for each Peer Group with the exclusion of health authorities in British Columbia from the sum of deaths and residents in each peer group. This was done to examine any differences between these results and results including British Columbia.

<u>Step 11: Analyzing Socioeconomic Variables</u>

Statistics Canada provides peer group categories. Each peer group has specific socioeconomic variable values. For instance, each peer group may have a specific range for population density, proportion of visible minorities, and long-term unemployment rate. Some peer groups have similar levels of these variables e.g., high population density. As such, these peer groups were categorized together (i.e., deaths were added for each of the health regions that make up these peer groups and the same was done for the number of residents). Death ratios for each peer group grouping by quarter were made.

The following variables were chosen to be analyzed to determine if specific socioeconomic variables of the regions that LTC homes are in are associated with specific patterns in the death ratios of LTC residents: the proportion of visible minority populations, population density, and long-term unemployment.[5]

Statistics Canada provides further groupings of these variables by very high, high, medium, low, and very low based on specific percentile ranks and a breakdown of whether levels of

[5] The proportion of visible minority populations, population density, and long-term unemployment were chosen for examination while five-year internal migration and population under 20 years old was not chosen for examination. This is because the latter two were not deemed relevant for examining death ratios in LTC.

population density, visible minorities, and long-term unemployment are high, medium, or low in a specific peer group.

- Very High: X > 85th percentile
- High: 65th percentile < X ≤ 85th percentile
- Medium: 35th percentile < X ≤ 65th percentile
- Low: 15th percentile < X ≤ 35th percentile
- Very Low: X ≤ 15th percentile

Table 8: Percentile rankings for each peer group by population density, visible minority, population under 20 years of age, long-term unemployment rate, and five-year internal migration. This table is entirely obtained from Statistics Canada (37)

Peer Group	Population Density	Visible Minority	Population Under 20 Years Old	Long-term Unemployment Rate	Five-year Internal Migration
A	Very Low	High	Very High	High	High
B	High	High	Medium	Low	Low
C	Medium	Medium	Low	Medium	Medium
D	Medium	Medium	Medium	Low	High
E	Medium	Very Low	Very Low	Very High	Low
F	Very Low	Very Low	Very High	Very High	Low
G	Very High	Very High	Low	Medium	Very Low
H	Very High	Very High	Medium	Low	Medium

Peer groups with high and very high rankings were grouped together and then peer groups with low and very low rankings were grouped together. First, all peer groups with the designated high levels of population density were grouped together. The health regions that were a part of the peer groups with high levels of population density were grouped and a sum of the deaths and sum of active residents for these groups by quarter and by year was created. The sum of deaths was then divided by the sum of active residents by each quarter to obtain the mortality ratios for each grouping of health regions (and indirectly, each grouping of peer groups) by quarter for 2016-2017 to 2020-2021. Using these mortality ratios, the forecast, trends, and confidence intervals for these mortality ratios were created.

Second, all peer groups with middle levels of population density were grouped together. The same methodology was applied to finding the mortality ratios and the forecast, trends, and confidence intervals for these mortality ratios (albeit data for peer groups and health regions with middle levels of population density was used).

These steps were repeated for the following variables: low population density, high proportion of visible minority populations, middle proportion of visible minority populations, low proportion of visible minority populations, high rates long-term unemployment, middle rates long-term unemployment, land ow rates long-term unemployment.

Multiple regression was then conducted between the difference in expected and actual mortality ratios (as the y variable) and high and low levels of the proportion of visible minority populations, population density, and rates of long-term unemployment. This was done to further validate the findings on deaths ratios by high, medium, and low levels of the proportion of visible minority population, population density, and rates of unemployment, found using the methodology above. A p value of 0.1 or less was considered significant while a p value between 0.15 and 0.11 less was noted for possible significance.

3. **Notes on Data Analysis:**

Note 1: Deaths that occurred outside facilities could be not accounted for in this study due to the lack of data availability on this measure. Accordingly, deaths of residents outside residential care facilities are not added to any of the years included in the data. This is potentially a further issue when considering that the number of discharges from LTC homes in the 2020-2021 fiscal year decreased from previous years and residents that may have been discharged from homes to hospitals and would have otherwise died in hospital may have died in the residential care facility. These deaths in facilities would have been accounted for in the available data. However, in previous years, discharges to the hospital that may have resulted in death would not be accounted for in this data; potentially underestimating the deaths and death trends of previous years and inflating the differences in deaths between 2020-2021 and previous years. According to CIHI, discharges to hospital cannot necessarily be considered deaths either and as such, without verified data on deaths outside facilities, this issue remains. An analysis on total death with the addition of discharges to hospital (considered as deaths for the purposes of this specific analysis) was conducted to determine if there were any major differences in trends, nonetheless. The methodology for this is provided above. From the results of this analysis, the trends seen with and without the addition of discharges to deaths remain the same.

Note 2: During the COVID-19 pandemic, CIHI received less assessments in 2020 Q1-Q4 as compared to previous quarters, and as a result, there are variations in RAI-MDS 2.0 assessment volumes among residential care facilities. The impact varies by jurisdiction and facility. As a result, the findings in this study should be considered with caution. To elaborate, there are 2,039 homes in Canada as of May 2020 but not all homes submit data to CCRS. In 2020, less homes may have submitted data to CCRS. Further, it should be noted that participation in CCRS varies by jurisdiction and year (as variations in the amount of data sent are not unique to 2020 even though there may have indeed been less data sent in 2020). Accordingly, when comparing deaths, admissions, active residents, and discharges between years it should be noted that some levels of changes in these variables noted across years may be attributed to an increase or decrease in the number of submitting homes. It can be noted that the death ratio is somewhat protected from this bias (not entirely, though, since we cannot control the selection process and it is possible that homes with largest surges in fatality decided to withdraw from CCRS). Increases and decreases may not solely be considered as actual decreases or increases in the variables as a result.

<u>Highlights of Results:</u>

This section provides an overview of the major findings from this study and is organized by each major variable examined: deaths, active residents, admissions, discharges, and death ratios.

Deaths:

Overall, by total numbers and in the many of the sub-analysis, the number of deaths increased (was above the confidence interval) in quarter one (April-June 2020) and three (October-December 2020), decreased (was below the confidence interval) in quarter two (July-September 2020), and did not change (was within the interval) in quarter four of 2020-2021 (January-March 2021). However, in many instances, the increases and decreases in deaths were not exceptional i.e., there were either greater differences in the actual and expected deaths in previous years or peaks from previous years were higher (if excess) or lower (if less than expected).

Additionally, the comparison of data for male and female deaths shows that the excess deaths observed in the first quarter of 2020-21 (April to June 2020) resulted mostly from excess deaths among male residents. Deaths in quarter one 2020-2021 resulted mostly from Ontario while all provinces, except for British Columbia, had a decrease in deaths in quarter two. Additionally, excess death in quarter three resulted mostly from Alberta and Manitoba (British Columbia had an increase but not an exceptional increase) and all provinces, except Manitoba, did not have a change in deaths in quarter four. The comparison of graphs for deaths by age groups shows that those of the oldest age groups (groups aged 85-94 and 95+ years) were not particularly affected by the pandemic (i.e., these age groups did not experience exceptional increases in deaths in 2020-2021). Instead, the pandemic affected the younger age groups more in terms of deaths.

Active Residents:

We studied the evolution of the number of active residents during the fiscal year because the number of deaths can be affected by the population at risk.

The number of active residents decreased in all quarters of the 2020-2021 fiscal year. However, there are exceptions to this, such as the increase in active residents in Manitoba in quarter one and two and the increase in active residents in Newfoundland and Labrador in quarter three and four. There was a greater difference in actual and expected number of residents among females compared to males.

Ontario experienced the greatest difference in the actual number of active residents and the lower margin of the predicted number of residents. The greatest decrease in the number of active residents occurred in the 85-94 age group.

Admissions:

We examined whether the changes in the number of residents was due to the large number of deaths or to a decline in admissions.

Overall, the number of admissions decreased across quarters and months in 2020-2021. However, there are exceptions to this, such as the increase in female and male admissions in March 2021 or the lack of change in admissions in quarter four of 2020-2021 in Alberta. The greatest decrease in admissions occurred in May 2020 i.e., the onset of the pandemic and one month proceeding the greatest increase in total deaths across all years.

The number of female admissions was greater than the number of male admissions over all periods of time examined. However, the difference in the actual and expected admissions for females was greater than the difference in the drop in male admissions in 2020-2021 compared to previous years. The greatest decrease from expected admissions occurred in Ontario while Newfoundland and Labrador experienced an increase in admissions, British Columbia was not drastically affected (except for quarter one), Manitoba experienced exceptional decreases in the later quarters of 2020-21, and Alberta experienced decreases in quarter one (exceptional), two and three only. The greatest decrease from the number of expected admissions occurs in the 85–94-year age bracket while the lowest decrease from the number of expected admissions occurs in the 65–74-year age group, which is in contrast to the number of deaths having increased mostly among the youngest age groups but not so much among the oldest ones.

Discharges:

We studied the number of discharges for two reasons: they might explain changes in the number of residents, and they may add further context to the data on deaths recorded in the facility.

Overall, the number of discharges did not change in quarter one and three and decreased in quarter two and four. However, there are exceptions to this, such as the decrease in discharges in quarter three for those in the 65-74-year age group or the decrease in discharges in quarter three in Ontario. The number of male discharges is less than the number of female discharges in the corresponding time periods. Additionally, the difference in expected and actual discharges is greater for females than males. Ontario had the greatest difference in expected and actual discharges in quarter two and four. In Alberta and Manitoba, there was an exceptional increase in discharges in quarter three of 2020-2021. The greatest decrease in discharges occurred in the 85–94-year age group.

Death Ratios:

Overall, the trends in death ratios are similar to trends in deaths examined by total number and the variables of sex, age, and province.

The death ratio was highest for Ontario in the first quarter, among the regions examined. However, this death ratio was not exceptional compared to the death ratio of the fourth quarter of 2017-2018. There are no exceptional changes in the death ratios examined by age groups. Edmonton Zone and North Zone in Alberta experienced exceptional increases in the death ratio in quarter three of 2020-21, along with Fraser Health in British Columbia, Winnipeg Regional Health in Manitoba, and Central West LHIN in Ontario. Northern Health in British Columbia was an outlier: this health authority experienced exceptional increases in quarter three and four and was remarkably different from the trend in quarter one and two. Central East LHIN, Central LHIN, Central West LHIN, and Mississauga Halton LHIN in Ontario experienced exceptional increases in death ratios in quarter one of 2020-2021.

Analysis of the death ratios for regions grouped into peer group A, C, E, and D did not show major, significant changes in deaths throughout any quarters of 2020-2021. On the other hand, analysis of the death ratios for regions grouped into peer group B, G, and H did show increases in deaths in quarters one and three. The changes in peer group G and H were also exceptional. Notably, the regions that experienced increases had high population densities, high levels of visible minorities, and low or medium levels of long-term unemployment rates while the peer groups that did not exhibit exceptional changes were primarily comprised of rural regions. Results on the separate analysis of these variables (high population density, low long-term unemployment rates, and high proportions of visible minority populations) further showcases that there is potentially a relationship between high population density, a low rate of long-term unemployment and a high proportion of visible minority populations and an excess in observed mortality rates (relative to expectations), at least for some time periods.

Results:

This section will provide the results for all analyses conducted in this study. Section 1 will provide results on the analysis testing the existence of excess (or low) number of deaths during the first wave of the pandemic, section 2 will provide results on the analysis testing the existence of excess (or low) number of active residents during the first wave of the pandemic, section 3 will provide results on the analysis testing the existence of excess (or low) number of admissions during the first wave of the pandemic, section 4 will provide results on the analysis testing the existence of excess (low) number of discharges, and section 5 will provide results on the analysis testing the existence of excess (low) mortality ratios (deaths relative to resident population).

Each analysis was conducted for the whole population of residents, then separately by sex, province and age group. The following is an overview of what will be covered in each section of the results:

Section 1:

7. Number of deaths
    a. Total number of deaths by quarter
    b. Total number of deaths by month
    c. Number of deaths by sex (females and males) by quarter
    d. Number of deaths by sex (females and males) by month
    e. Number of deaths by province by quarter
    f. Number of deaths by province by month
    g. Number of deaths by age groups (65-74, 75-84, 85-94 and 95+) by quarter
    h. Number of deaths by age groups (65-74, 75-84, 85-94 and 95+) by month
8. Number of deaths, total by quarter, with the addition of the number of discharges to hospital for each quarter of data added to the number of deaths for each quarter of data.

Section 2:

5. Number of active residents, total by quarter
    a. Number of active residents by sex (females and males)
    b. Number of active residents by age groups (65-74, 75-84, 85-94 and 95+)
    c. Number of active residents by province

Section 3:

9. Number of admissions
    a. Total admissions by quarter
    b. Total admissions by month
    c. Number of admissions by sex (females and males) by quarter
    d. Number of admissions by sex (females and males) by month
    e. Number of admissions by age groups (65-74, 75-84, 85-94 and 95+) by quarter

   f. Number of admissions by age groups (65-74, 75-84, 85-94 and 95+) by month
   g. Number of admissions by province by quarter
   h. Number of admissions by province by month

<u>Section 4:</u>

10. Number of discharges, total by quarter
    a. Number of discharges by sex (females and males)
    b. Number of discharges by age groups (65-74, 75-84, 85-94 and 95+)
    c. Number of discharges by province
11. Discharge ratio (to number of active residents), total by quarter

<u>Section 5:</u>

6. Mortality ratio (to number of active residents), total
   a. Mortality ratio by sex (females and males)
   b. Mortality ratio by age groups (65-74, 75-84, 85-94 and 95+)
   c. Mortality ratio by province
   d. Mortality ratio by health region
7. Mortality Ratio (to number of active residents), by peer group
   a. Including British Columbia in the analysis
   b. Excluding British Columbia in the analysis
8. Mortality Ratio (to number of active residents), by socio-economic variables
   a. Mortality ratio for peer groups with high population density
   b. Mortality ratio for peer groups with middle population density
   c. Mortality ratio for peer groups low population density
   d. Mortality ratio for peer groups with a high proportion of visible minority populations
   e. Mortality ratio for peer groups with a middle proportion of visible minority populations
   f. Mortality ratio for peer groups with a low proportion of visible minority populations
   g. Mortality ratio for peer groups with high unemployment rates
   h. Mortality ratio for peer groups with high unemployment rates
   i. Mortality ratio for peer groups with low unemployment rates

Results are presented in graphical format to help visualize the trend, confidence interval and whether the numbers observed during the first wave of the pandemic are outside of the expected range or not. Graphs for results by month are included in the appendix. The actual number of the variable under study (deaths, admissions, discharges, and active residents) or death ratio by quarter or month for 2016-2017 to 2019-2020 and the forecasted values for 2020-2021 is represented by an orange line. The actual data in 2020-2021 by quarter or month is depicted in green. The trend line of the actual data from 2016-2017 and the forecasted data from 2020-2021 is depicted in gray. The upper bound of the confidence interval created around the trend line is depicted in yellow while the lower bound is depicted in blue.

Section 1. Deaths

Overall, by total numbers and in the many of the sub-analysis, the number of deaths increased (was above the confidence interval) in quarter one and three, decreased in quarter two (was below the confidence interval), and did not change in quarter four (was within the interval) of 2020-2021.

a) Analysis of quarters: The total number of deaths increased in quarter one of the 2020-2021 fiscal year (the data point on the green curve for that quarter is outside, specifically above, the confidence interval for predicted values). The total number of deaths decreased in quarter two of 2020-2021 (the data point on the green curve for quarter two is outside, specifically below, the confidence interval for predicted values) while the total number of deaths increased in quarter three of 2020-2021(the data point on the green curve for that quarter is outside, specifically above, the confidence interval for predicted values). The total number of deaths did not significantly differ from the trend in quarter four of 2020-2021, however (the data point on the green curve for that quarter is inside the confidence interval for predicted values).
In quarter one there were 1,032 excess deaths and in quarter three there were 713 excess deaths. In quarter two there were 580 less deaths than forecasted.
It should be noted that the excess mortality observed in 2020-21 is not necessarily exceptional: fourth quarters (winter) of FY 2016-17 and 2017-18 were already out of the confidence interval and at peaks similar to the peaks in 2020-21. Further, the number of excess deaths in quarter four of 2017-2018 (the difference in the actual number of deaths and the upper margin of the confidence interval) was 1220 i.e., a value similar to the number of excess deaths in quarter one of 2020-2021 and higher than the excess deaths in quarter three of 2020-2021.

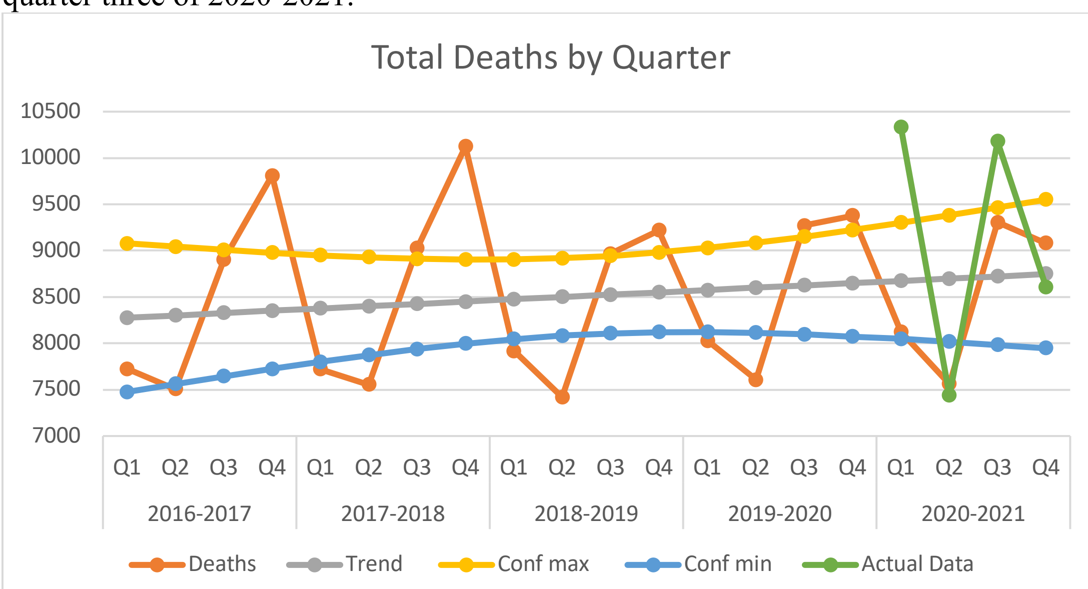

Figure 1: Total Deaths by Quarter

b) Analysis by month: The total number of deaths increased in April, May, November, December, and January, decreased in June, July, August, and September, February, and

March, and did not significantly change in October of the 2020-2021 fiscal year. In April there were 1,382 excess deaths, 311 in May, 242 in November, 839 in December, and 440 in January. In June there were 408 less deaths than forecasted, 361 in July, 358 in August, 273 in September, 182 in February, and 402 in March.
It is now clear that April 2020 stood out, but the excess number of deaths observed in October, November and December 2020 had already been observed in the same months in 2016-17 and 2017-18. Refer to figure 1a in the appendix.

c) By quarter, for female residents: The number of deaths among female residents increased in quarter one and quarter three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. There were 372 and 230 excess female deaths in quarter one and three, respectively. There were 491 less deaths than forecasted in quarter two of 2020-2021. This follows the trend seen with total number of deaths among quarters of the 2020-2021 fiscal year. Excess deaths were not exceptional in comparison to previous years. Notably, there are more female deaths than male deaths throughout all years.

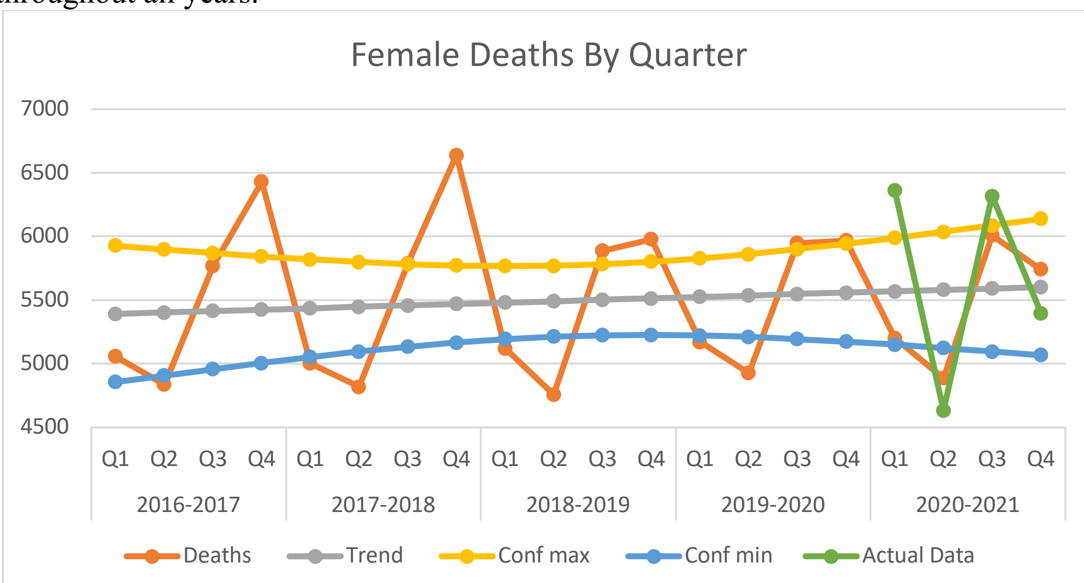

Figure 2: Female Deaths by Quarter

d) By quarter, for male residents: The number of deaths among male residents increased in quarter one and quarter three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. This follows the trend seen with total number of deaths among quarters of the 2020-2021 fiscal year. There were 442 and 265 excess male deaths in quarter one and three, respectively and there were 270 less deaths than forecasted in quarter two. The pattern of male deaths from 2016-2017 to 2020-2021 is also similar to the pattern for females in this time period (i.e., increases and decreases relative to established confidence intervals). However, the number of male deaths in quarter one and three of 2020-2021 were the highest in any year studied i.e., deaths were exceptional in these quarters while they were not for females.

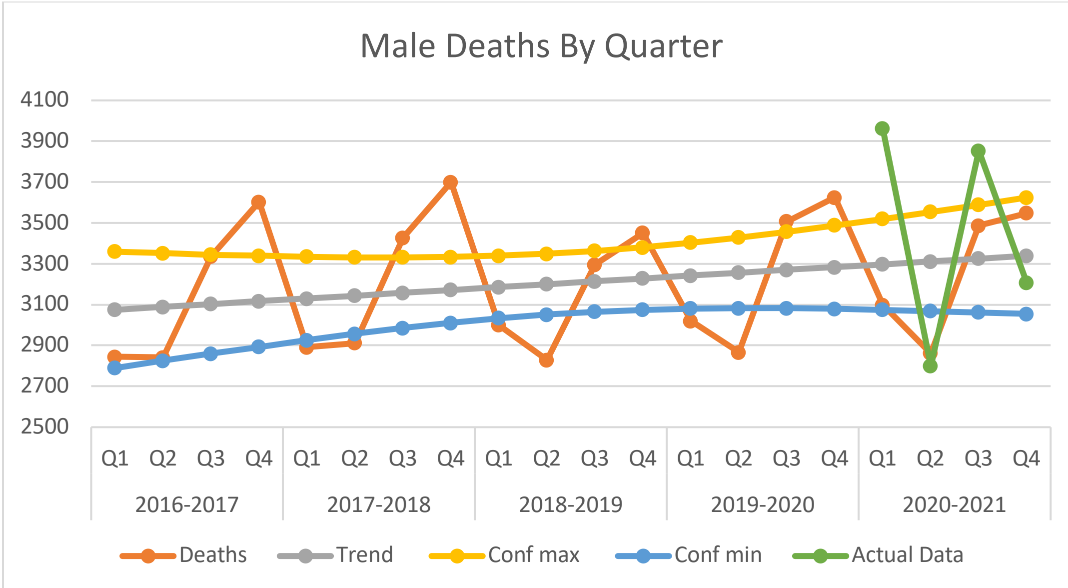

Figure 3: Male Deaths by Quarter

e) By month, for female residents: The number of deaths among female residents increased in April and May, November, December, and January, decreased in June, July, August, September, February and March, and did not significantly change in October of the 2020-2021 fiscal year. This follows the trend seen with total number of deaths among quarters of the 2020-2021 fiscal year. There were 837 excess deaths in April, 181 in May, 101 in November, 497 in December, and 289 in January. In June there were 307 less deaths than forecasted, 241 in July, 250 in August, 166 in September, 129 in February, and 245 in March. Although the number of excess deaths in April of 2020-2021 were exceptional compared to previous years, this is not necessarily the case for the increase seen in November, December, and January of 2020-2021. The first quarter of 2020-21 was not exceptional for female residents, mostly because the excess number of deaths of April was more than compensated by lower number of deaths as soon as June of the same year. Refer to Figure 2a in the appendix.

f) By month, male residents: The number of deaths among male residents increased in April, May, November, December, and January, decreased in June, July, August, September, February and March, and did not significantly change in October of the 2020-2021 fiscal year. All months except for October follow the trend observed in the total number of deaths (October otherwise did not significantly change in the total number comparisons). There were 581 excess deaths in April, 144 in May, 134 in November, 360 in December, and 167 in January. There were 101 less deaths than forecasted in June, 131 in July, 116 in August, 110 in September, 19 in October, 70 in February, and 163 in March. Among male residents, the peak of April 2020 was much higher than among female residents, and the compensation in June was not as strong, explaining that the excess number of deaths for male residents in the first quarter of the pandemic was more significant for men than for women. Refer to Figure 3a in the appendix.

The comparison of graphs for males and females shows that the excess deaths observed in the first quarter of fiscal year 2020-21 (April to June 2020) resulted mostly from excess deaths among male residents. The number of deaths among female residents in that quarter was above the trend but still lower than the winters of 2017 and 2018.

g) By quarter, for Ontario: The number of deaths increased in quarter one, decreased in quarter two, and did not significantly change in quarter three and four in 2020-2021 in Ontario. This does not follow the trend seen with the total number of deaths in 2020-2021 among quarter three. There were 1028 excess deaths in Ontario in quarter one while there were 656 less deaths than forecasted in quarter two. However, what can be noted is that deaths in quarter one of 2020-2021 were exceptionally higher than previous years.

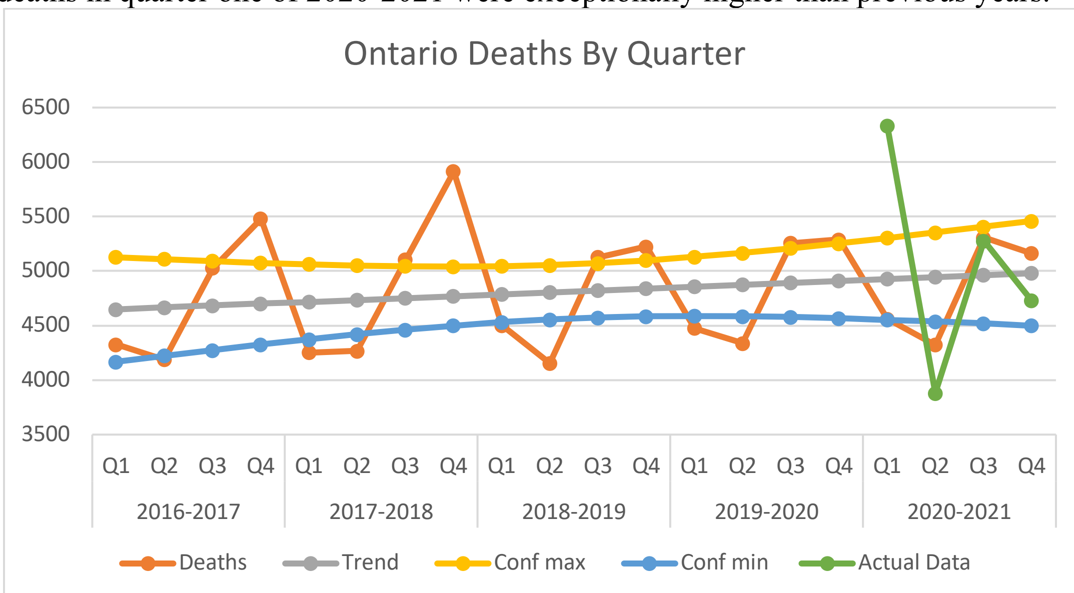

Figure 4: Deaths in Ontario by Quarter.

h) By quarter, for Alberta: The number of deaths did not significantly change in quarter one and four, decreased in quarter two, and exceptionally increased in quarter three in Alberta. This does not follow the trend seen with the total number of deaths in 2020-2021 among quarters. There were 281 excess deaths in quarter three and 116 less deaths than forecasted in quarter two.

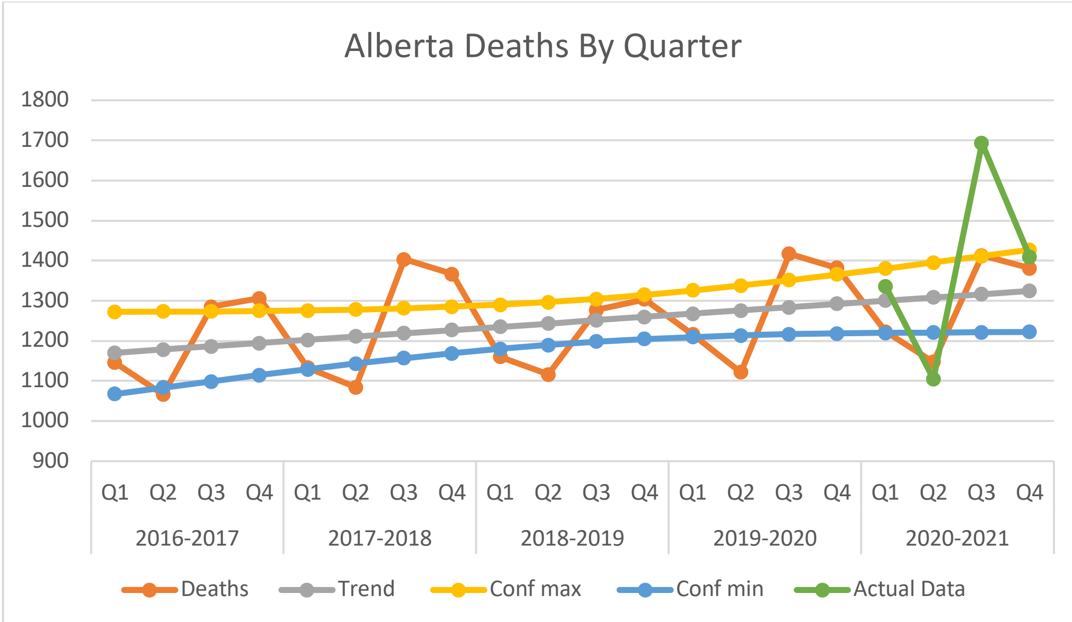

Figure 5: Deaths in Alberta by Quarter

i) By quarter, for British Columbia: The number of deaths did not significantly change in quarter one, two, and four, and increased in quarter three in 2020-2021. This does not follow the trend seen with the total number of deaths in 2020-2021 among quarters. There were 194 excess deaths in quarter three. The increases in deaths were not exceptional in comparison to previous years wherein an increase in quarter four of 2016-2017 was greater than the increase in deaths in 2020-2021. Additionally, it seems there was a steady decrease in deaths over time (2016-2017 to 2019-2020) that was interrupted by an increase in deaths in 2020-2021.

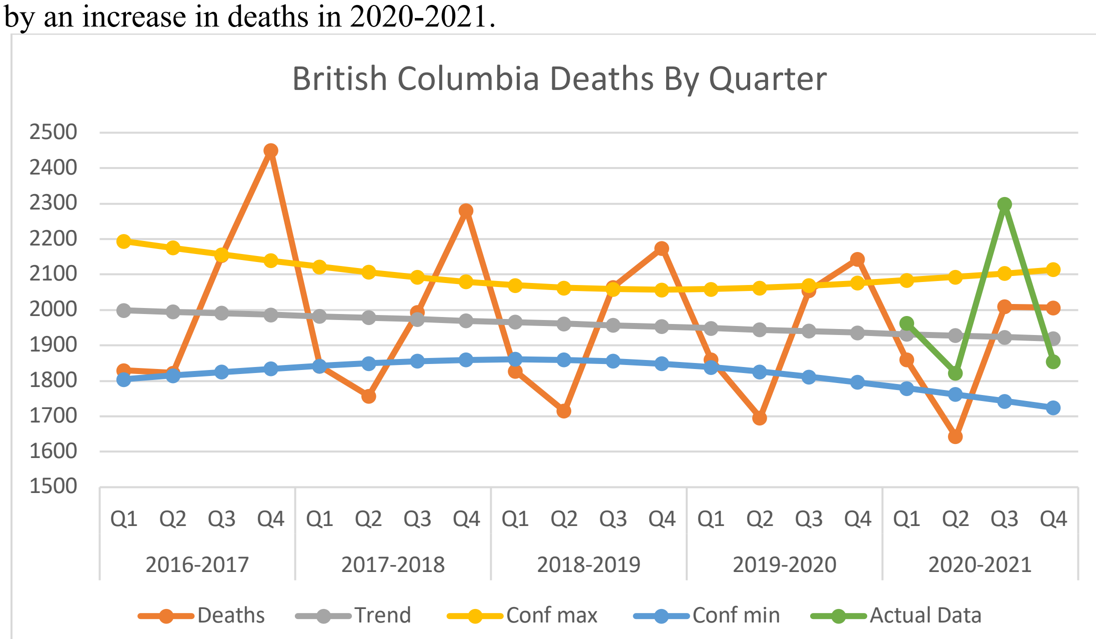

Figure 6: Deaths in British Columbia by Quarter.

j) By quarter, for Manitoba: The number of deaths did not significantly change in quarter one, decreased in quarter two and four, and exceptionally increased in quarter three in 2020-2021 in Manitoba. This does not follow the trend seen with the total number of deaths in 2020-2021 among quarters. There were 124 excess deaths in quarter three while there were 20 less deaths than forecasted in quarter two and 53 less deaths in quarter four.

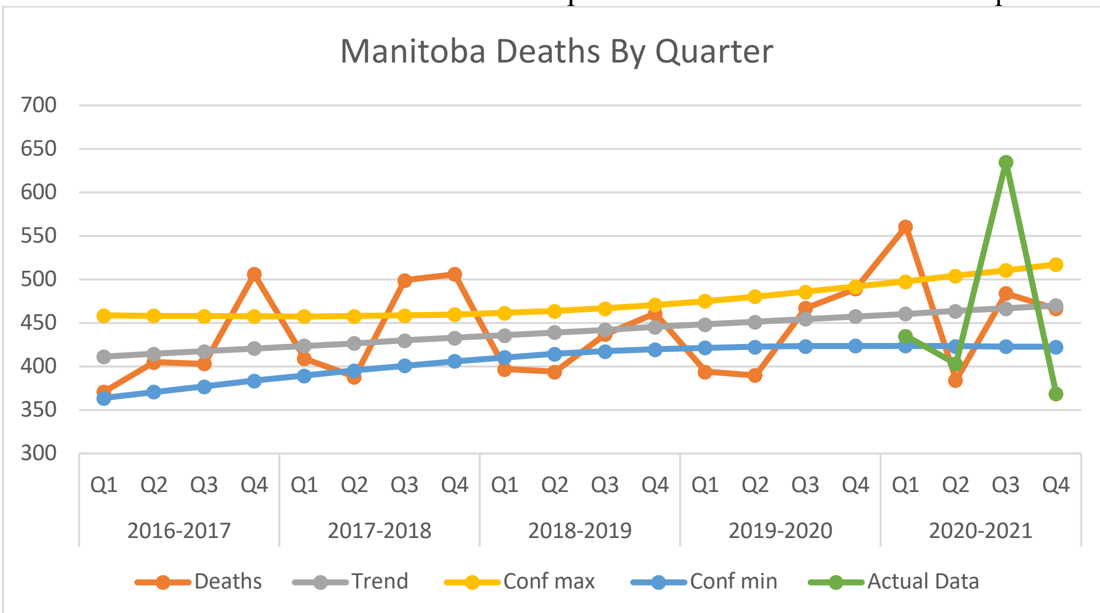

Figure 7: Deaths in Manitoba by Quarter

k) By quarter, for Newfoundland and Labrador: The number of deaths did not significantly change in quarter one, three and four, and decreased in quarter two in 2020-2021 in Newfoundland and Labrador. This does not follow the trend seen with the total number of deaths in 2020-2021 among quarters. In quarter two there were 26 less deaths than forecasted.

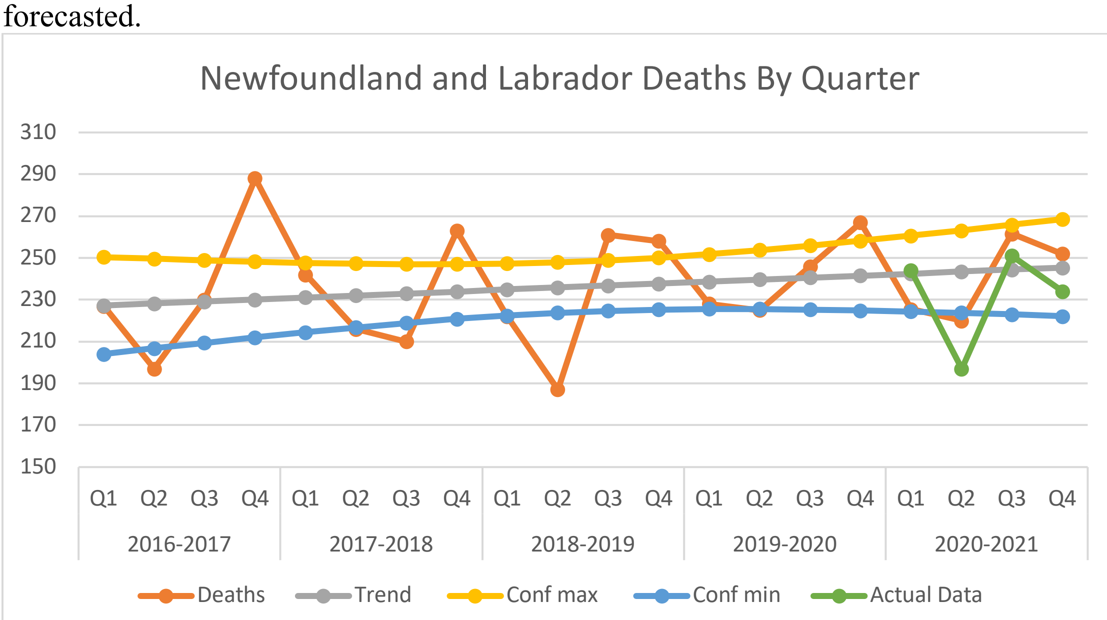

Figure 8: Deaths in Newfoundland and Labrador by Quarter.

From these graphs, it can be seen that excess deaths in quarter one 2020-2021 resulted mostly from Ontario while all provinces, except for British Columbia, had a decrease in deaths in quarter two. Additionally, excess death in quarter three resulted mostly from Alberta and Manitoba (British Columbia had an increase but not an exceptional increase) and all provinces, except Manitoba, did not have a change in deaths in quarter four.

l) By month, for Ontario: The number of deaths increased in April, May, December, and January, decreased in June, July, August, September, October, February, and March, and did not significantly change in November in 2020-2021 in Ontario. All months follow the trend with the total number of deaths except for November (should have increased) and October (should have not significantly changed). There were 1179 excess deaths in April (wherein this increase seems exceptional in comparison to previous years), 567 in June, 243 in December, and 269 in January while there was 260 less deaths than expected in June, 294 in July, 290 in August, 228 in September 19 in October, 141 in February, and 274 in March. Although an increase in April was exceptionally higher than increases in previous years, this does not seem to be the case for the increases seen in November and December. Refer to figure 4a in the appendix.
As such, the exceptional increase seen quarter one in Ontario, is a result of the exceptional increase in deaths in the month of April.

m) By month, for Alberta: The number of deaths increased in April, November, December (the increase in this month is exceptionally higher than previous increases), January (the increase in this month is exceptionally higher than previous increases), did not significantly change in May and October, and decreased in June, July, August, September, and February in 2020-2021 in Alberta. This does not follow the trend with the total number of deaths (outliers are May which should have increased and March which should have decreased). There were 99 excess deaths in April, 77 in November, 246 in December, and 108 in January. There were 45 less deaths than forecasted in June, 21 in July, 70 in August, and 47 in September. Refer to figure 5a in the appendix.
As such, the exceptional increase in deaths in quarter three in Alberta is greatly attributable to the exceptional increase in December.

n) By month, for British Columbia: The number of deaths increased in April, November, December, and January, did not significantly change in May, August, and September, and decreased in June, July, October, February, and March. This does not follow the trend of the total number of deaths in 2020-2021 in British Columbia. This does not follow the trend for the total number of admissions in 2020-2021 among all quarters (outliers are May should have increased, August which should have decreased, September which should have decreased, and October which should not have significantly changed). There were 88 excess deaths in April, 87 in November, 258 in December, and 98 in January. There were 58 less deaths than forecasted in June, 14 in July, 22 in February, and 94 in March. Increases in deaths were not exceptional in comparison to previous years. Refer to figure 6a in the appendix.

o) By month, for Manitoba: The number of deaths increased in April, November (exceptionally higher), and December (exceptionally higher), decreased in May, June, July, August, February, and March, and did not significantly change in September, October, and January in 2020-2021 in Manitoba. This does not follow the trend for the total number of deaths in 2020-2021 among all quarters (outliers are May which should have increased, September which should have decreased, and January which should have increased). There were 28 excess deaths in April, 69 in November, and 100 in December while there were 22 less deaths than forecasted in June 19 in July, and 33 in March. Therefore, the exceptional increase in quarter three in this province is mostly attributable to the exceptional increase in November and December 2020-21. Refer to figure 7a in the appendix.

p) By month, for Newfoundland and Labrador: The number of deaths increased in April, did not significantly change in May, October, November, December, January, February, and March, and decreased in June, July, August, and September in 2020-2021 in Newfoundland and Labrador. This does not follow the general trend for the total number of deaths in 2020-2021 among all quarters. There were 18 excess deaths in April while there were 13 less deaths than forecasted in June, 13 in July, and 12 in August. The increase of deaths in April was not exceptional in comparison to previous years. Refer to figure 8a in the appendix.

q) By quarter, for the 65-74 age bracket: The number of deaths increased exceptionally in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those age 65-74. This follows the trend for the total number of deaths in 2020-2021 among all quarters. There were 158 excess deaths in quarter one and 46 excess deaths in quarter three while there was 14 less deaths in quarter two than forecasted.

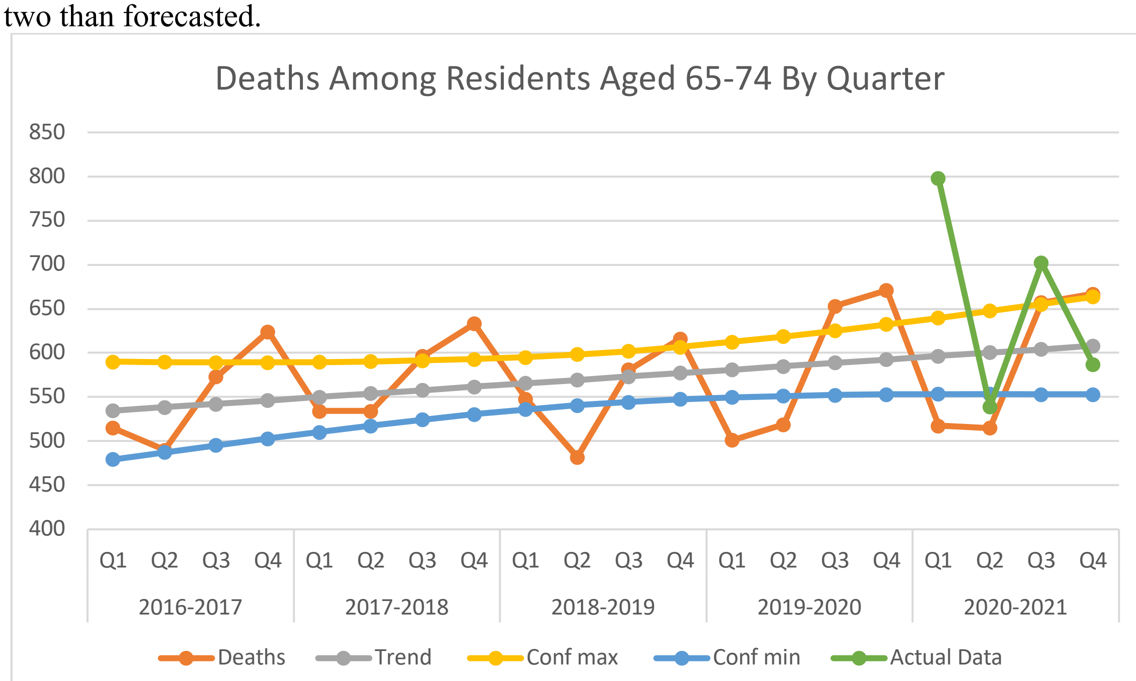

Figure 9: Deaths among Residents Aged 65-74 by Quarter

r) By quarter, for the 75-84 age bracket: The number of deaths increased exceptionally in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those age 75-84. This follows the trend for the total number of deaths in 2020-2021 among all quarters. There were 230 excess deaths in quarter one and 200 excess deaths in quarter three while there was 145 less deaths in quarter two than forecasted.

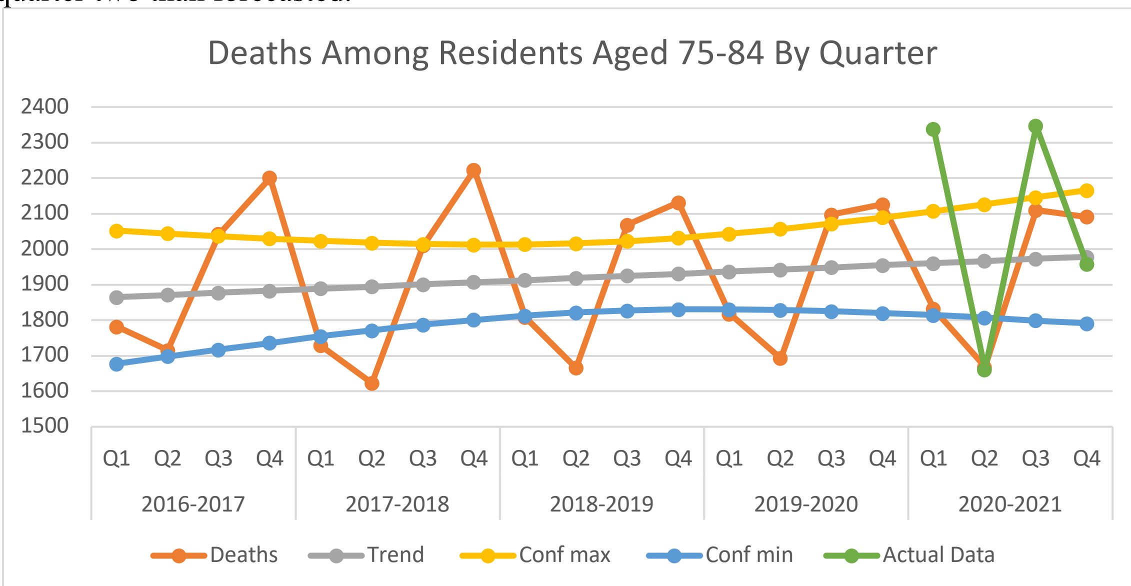

Figure 10: Deaths among Residents Aged 75-84 by Quarter

s) By quarter, for the 85-94 age bracket: The number of deaths increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those age 85-94. This follows the trend for the total number of deaths in 2020-2021 among all quarters. There were 321 excess deaths in quarter one and 218 excess deaths in quarter three while there was 364 less deaths in quarter two than forecasted. The change in the number of deaths was not exceptional for this age group in comparison to previous years.

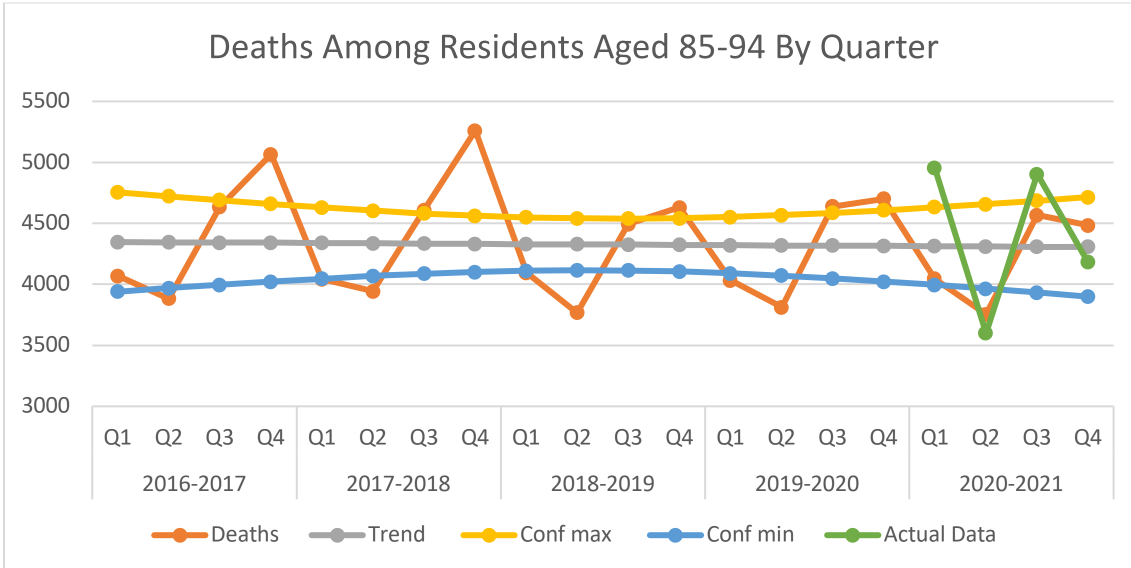

Figure 11: Deaths Among Residents Aged 85-94 by Quarter.

a) By quarter, for the 95+ age bracket: The number of deaths increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those age 95+. This follows the trend for the total number of deaths in 2020-2021 among all quarters. There were 53 excess deaths in quarter one and 20 excess deaths in quarter three while there was 202 less deaths in quarter two than forecasted. The change in the number of deaths was not exceptional for this age group in comparison to previous years, especially when considering the steadily increasing trend over time.

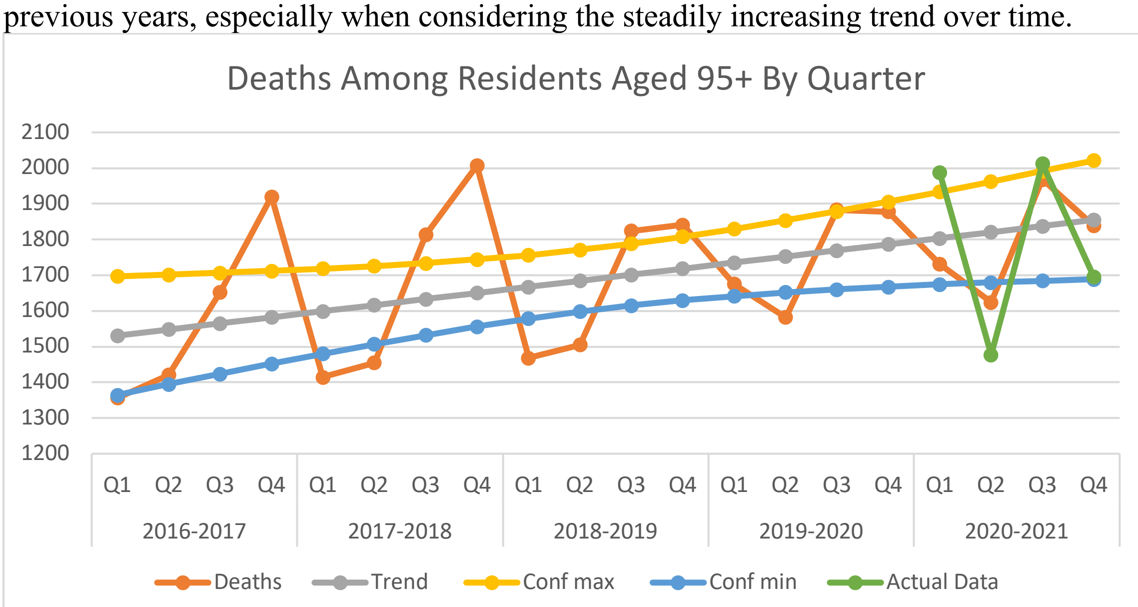

Figure 12: Deaths Among Residents Aged 95+ by Quarter.

The comparison of graphs for deaths by age groups shows that the those of the oldest age groups (aged groups of 85-94 and 95+ years) were not particularly affected by the pandemic (i.e., these age groups did not experience exceptional increases in deaths in 2020-2021). Instead, the pandemic affected the younger age groups more in terms of deaths.

b) By month, for the 65-74 age bracket: The number of deaths increased in April (exceptionally), May (exceptionally), December (exceptionally), and January, did not significantly change in June, August, and October, and decreased in July and September in 2020-2021 among those aged 65-74. This does not follow the trend for total number of deaths in 2020-2021 wherein July and August should have decreased. There was 107 excess deaths in April, 83 in May, 82 in December, and 24 in January. There were 29 less deaths than forecasted in July, 12 in February, and 21 in March.
Accordingly, the exceptional increase seen in quarter one for this age group is mainly attributable to the increase in deaths in April and May and not in June. Additionally, the exceptional increase in quarter three is attributable to the increase in December as there was no change in November and no exceptional increase in January. Refer to figure 9a in the appendix.

c) By month, for the 75-84 age bracket: The number of deaths increased in April (exceptionally), May, and December (exceptionally) decreased in June July, August, September, February, and March, and did not significantly change in October in 2020-2021 among those aged 75-84. This follows the trend in total number of deaths in 2020-2021. There were 349 excess deaths in April, 64 in May, 91 in November, 233 in December, and 102 in January. There were 67 less deaths than forecasted in June, 78 in July, 66 in August, 57 in September, 36 in February, and 44 in March.
Accordingly, the increase in deaths in those aged 75-84 in quarter one resulted from the increase which occurred in April and the increase in quarter three is mainly attributable to the increase in December 2020-21. Refer to figure 10a in the appendix.

d) By month, for the 85-94 age bracket: The number of deaths increased in April (exceptionally), May, November, December, and January decreased in June July, August, September, February, and March, and did not significantly change in October in 2020-2021 among those aged 85-94. This follows the trend in total number of deaths in 2020-2021. There were 688 excess deaths in April, 137, in May, 102 in November, 416 in December, and 251 in January while there were 244 less deaths than forecasted in June, 171 in July, 193 in August, 128 in September, 94 in February, and 189 in March.
Although there was an exceptional increase in deaths in April 2020, the non-exceptional and decreased number of deaths in May and June, respectively resulted in a non-exceptional increase in deaths in quarter one. Refer to figure 11a in the appendix.

By month, for the 95+ age bracket: The number of deaths increased in April, May, November, December, and January and decreased in June July, August, September, February, and March, and did not significantly change in October in 2020-2021 among those aged 95+. This follows the trend in total number of deaths in 2020-2021. There were 231 excess deaths in April, 19 in May, 38 in November, 99 in December, and 53 in January. There were 91 less deaths than forecasted in June, 75 in July, 92 in August, 78 in September, 30 in February, and 138 in March. Again, although there was an exceptional increase in deaths in April 2020, the non-exceptional and decreased number of deaths in May and June, respectively resulted in a non-exceptional increase in deaths in quarter one for those aged 95+. Refer to figure 12a in the appendix.

2. a) Next, under the assumption that the number of discharges to hospital could be used as a proxy for deaths, the number of discharges to hospital were added to the number of deaths. This was done to see if there were any major differences in the trends without addition of this variable. When discharges to the hospital, which may be assumed to be deaths, were added to the total number of deaths, the same pattern once again emerged: there was an increase in deaths in quarter one and three, decrease in quarter two, and no significant change in quarter four in the 2020-2021 fiscal year. However, the increase in deaths in quarter one and three was not exceptional compared to previous years.
In the analysis with only deaths, there were 1032 excess deaths in quarter one and 713 excess deaths in quarter three while in the analysis with deaths and discharges there were 577 excess deaths in quarter one and 388 excess deaths in quarter three. In quarter three of the analysis with only deaths there were 580 less deaths than expected and 1066 less deaths than expected for the same period in the analysis with deaths and discharges. It can be said that while quantitatively there is a difference in patterns between analysis with and without hospital discharges, qualitatively there is no difference i.e., we still observe the same major patterns in increases and decreases.

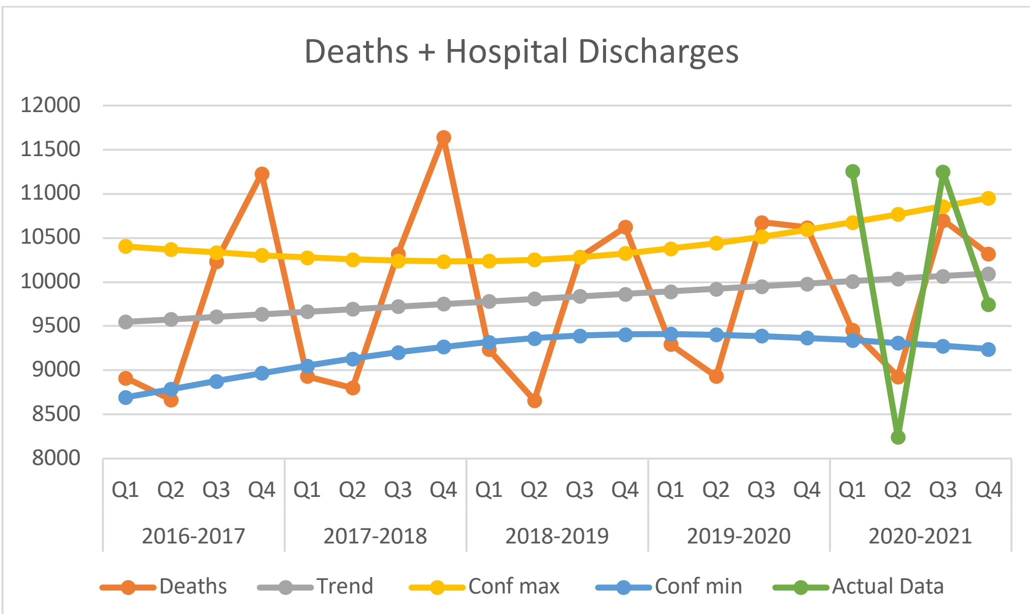

Figure 13: Deaths and Hospital Discharges Added Together.

<u>Section 2. Active Residents</u>

Next, the number of active residents is examined. In consideration of how the number of deaths may have decreased due to a lower number of at-risk populations, it is important to also examine the number of active residents across different variables.

Most commonly, the number of active residents decreased in all quarters of the 2020-2021 fiscal year. However, there are exceptions to this, and the following section will describe where changes occurred to the number of active residents and whether these changes were exceptional. Patterns in the number of admissions, discharges, and death may explain the levels of active residents. Conversely, trends in the number of active residents can also elucidate the reason for trends in deaths.

Total Active Residents:

a) The total number of active residents decreased in all quarters of the 2020-2021 fiscal year. The decrease in the number of residents in this period is in contrast to the steadily increasing numbers of active residents over time. Notably, the difference in actual active residents in 2020-2021 and the lower margin of the expected number of active residents is greater than differences in these variables in other years. Specifically, the difference in the actual number of residents in 2020-2021 and the lower margin of the predicted trend for this period is 1859 for quarter one, 4459 for quarter two, 4668 for quarter three, and 6324 for quarter four while the differences for 2018-2019 (the only other year with decreases beyond the predicted margins) is 1117 for quarter one, 1737 for quarter two, and 490 for quarter four.

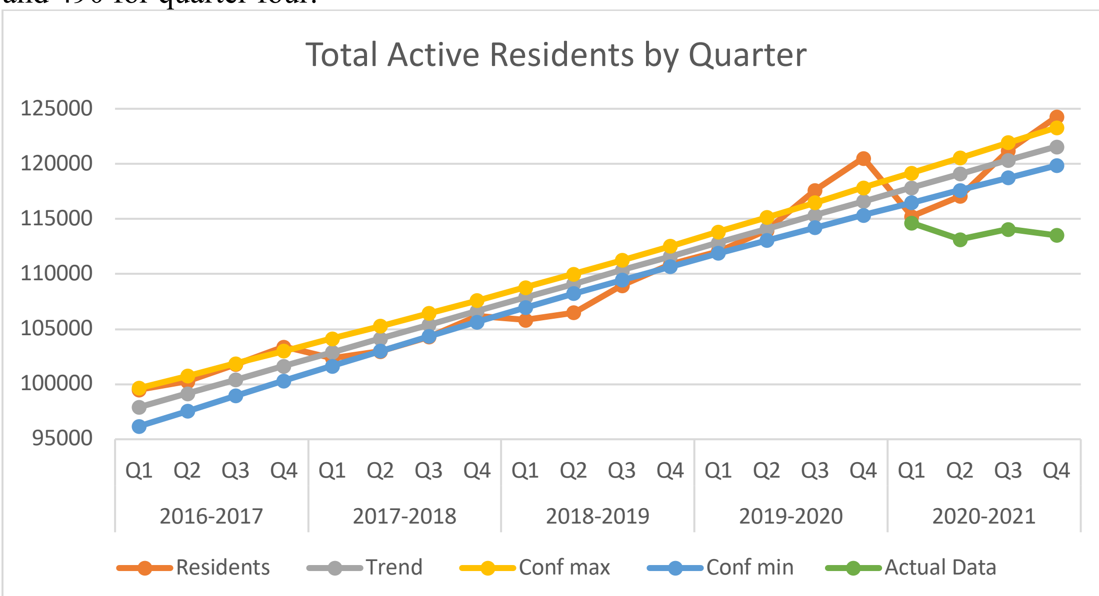

Figure 14: Total Active Residents by Quarter.

b) The number of female residents decreased in all quarters of the 2020-2021 fiscal year. This follows the trend among total active residents in all quarters of the 2020-2021 fiscal year. The differences between the actual number of residents and the lower margin of the predicted number of residents is 1695 for quarter one, 3560 for quarter two, 3774 for quarter three, and 4901 for quarter four.

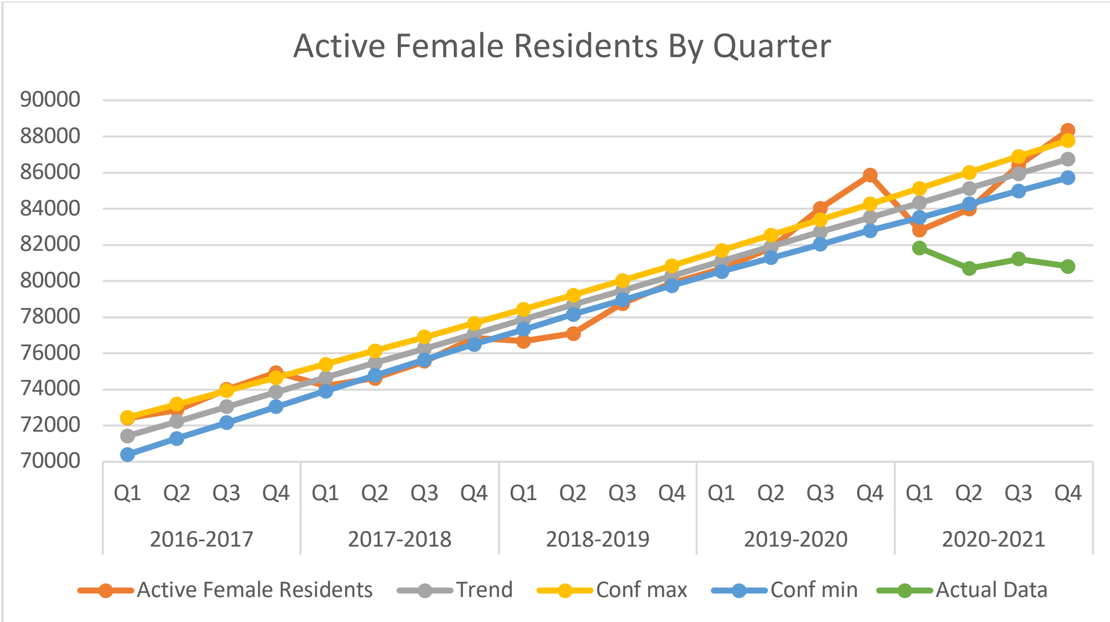

Figure 15: Active Female Residents by Quarter.

c) The number of male residents decreased in all quarters of the 2020-2021 fiscal year. This follows the trend among total active residents in all quarters of the 2020-2021 fiscal year. However, the difference between the actual number of residents and the lower margin of the predicted number of residents (difference in quarter one is 218, 1015 in quarter three, 962 in quarter three and 1306 in quarter four) is less than the difference seen for females; the decrease in residents in 2020-2021 is greater for females than males.

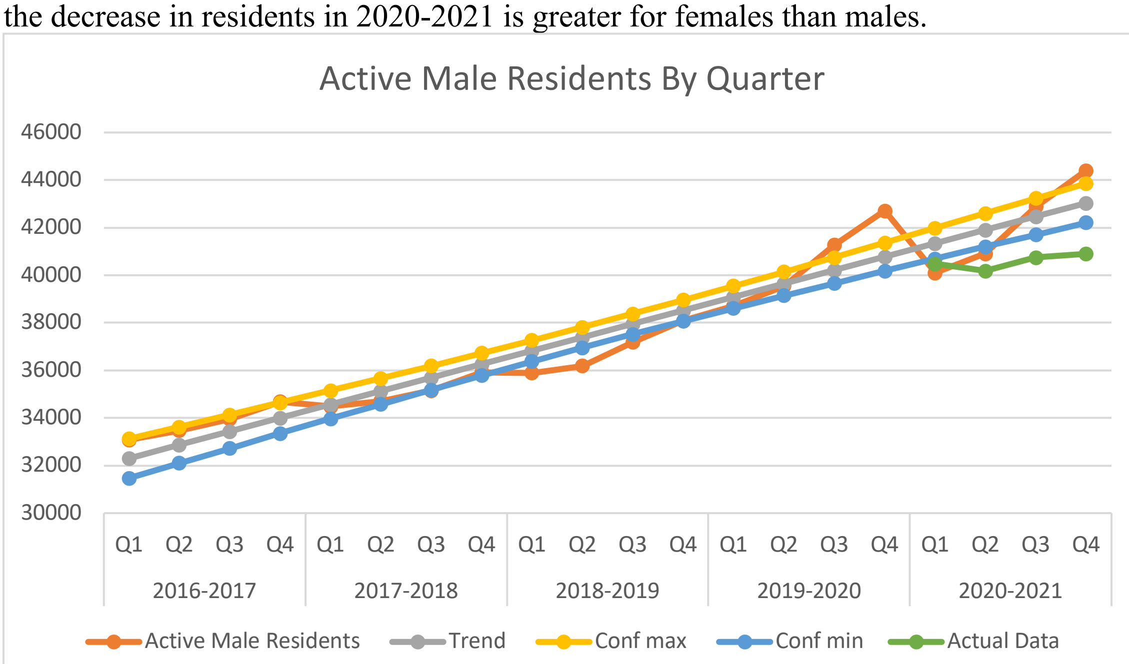

Figure 16: Active Male Residents By Quarter

d) The number of active residents decreased in all quarters of the 2020-2021 fiscal year in Ontario. This follows the trend among total active residents in all quarters of the 2020-

2021 fiscal year. Notably, the number of active residents in quarter one of 2020-2021 was very similar to the forecasted number for this period. Ontario experienced the greatest difference in the actual number of active residents and the lower margin of the predicted number of residents (greatest number of decreases compared to previous years). Specifically, there was a decrease of 1323 residents in quarter one, 4149 residents in quarter two, 3995 residents in quarter three, and 4485 residents in quarter four. The decrease in 2020-2021 was exceptional compared to previous years.

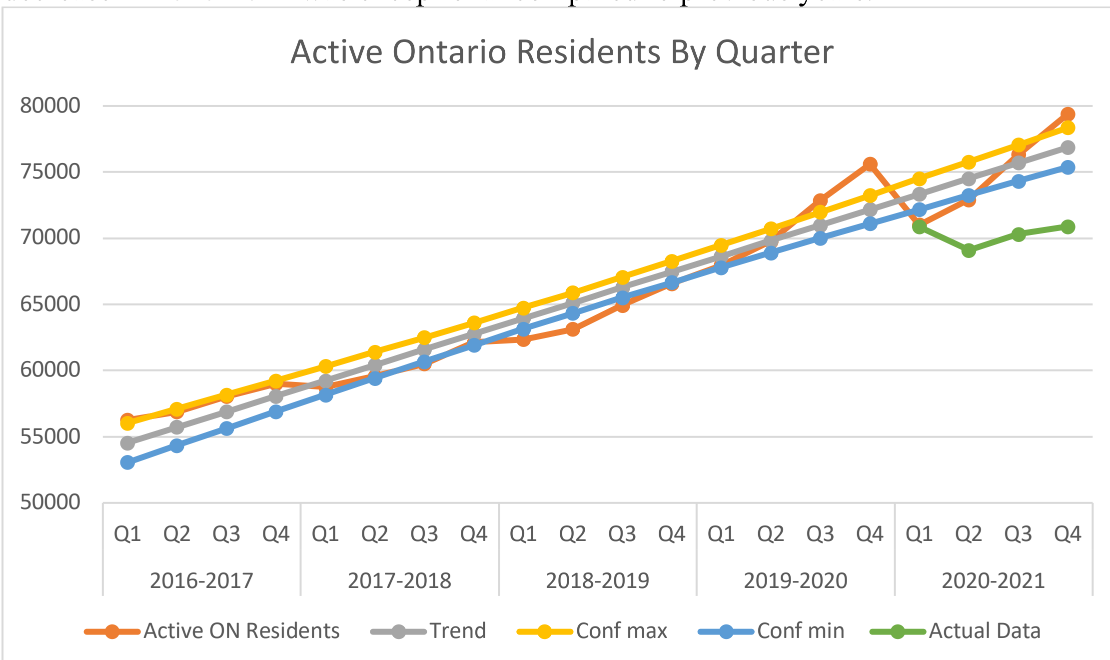

Figure 17: Active Ontario Residents by Quarter.

e) The number of active residents decreased in all quarters of the 2020-2021 fiscal year in Alberta. This follows the trend among total active residents in all quarters of the 2020-2021 fiscal year. The number of residents was lower in years previous to 2020-2021 but there was a seemingly similar decrease in 2018-2019 quarter one and two and this prompted a comparison between the differences in expected and actual residents between these time periods. In 2020-2021 and in quarter one the difference between the lower margin of expected and actual is 235 and in quarter two is 348. In 2018-2019, the difference between expected and actual is 254 in quarter one and 262 in quarter two. As such, the decrease in the number of residents is only exceptional in quarter two, three, and four of 2020-2021.

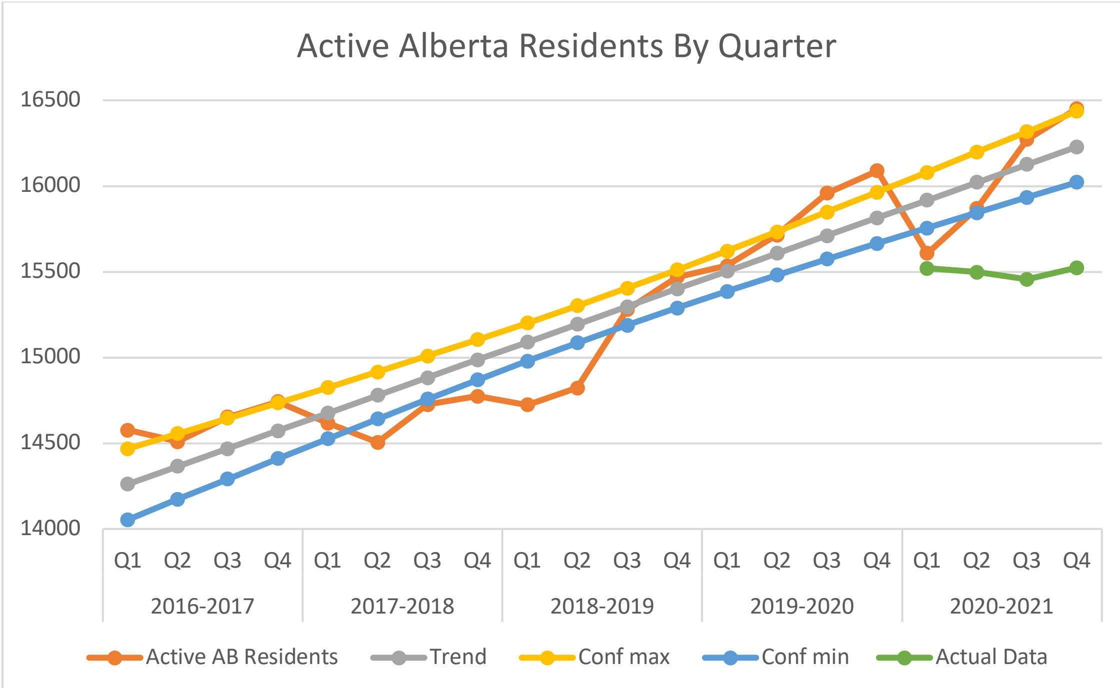

Figure 18: Active Alberta Residents by Quarter.

f) The number of active residents decreased in all quarters of the 2020-2021 fiscal year in British Columbia. This follows the trend among total active residents in all quarters of the 2020-2021 fiscal year. The actual number of active residents decreased the most in quarter four of 2020-2021 while the number of residents remained stagnant across quarter one and two of 2020-2021. The decrease in active residents is exceptional in 2020-2021. The number of admissions remained stagnant in this period as well and may in part explain the pattern for active residents.

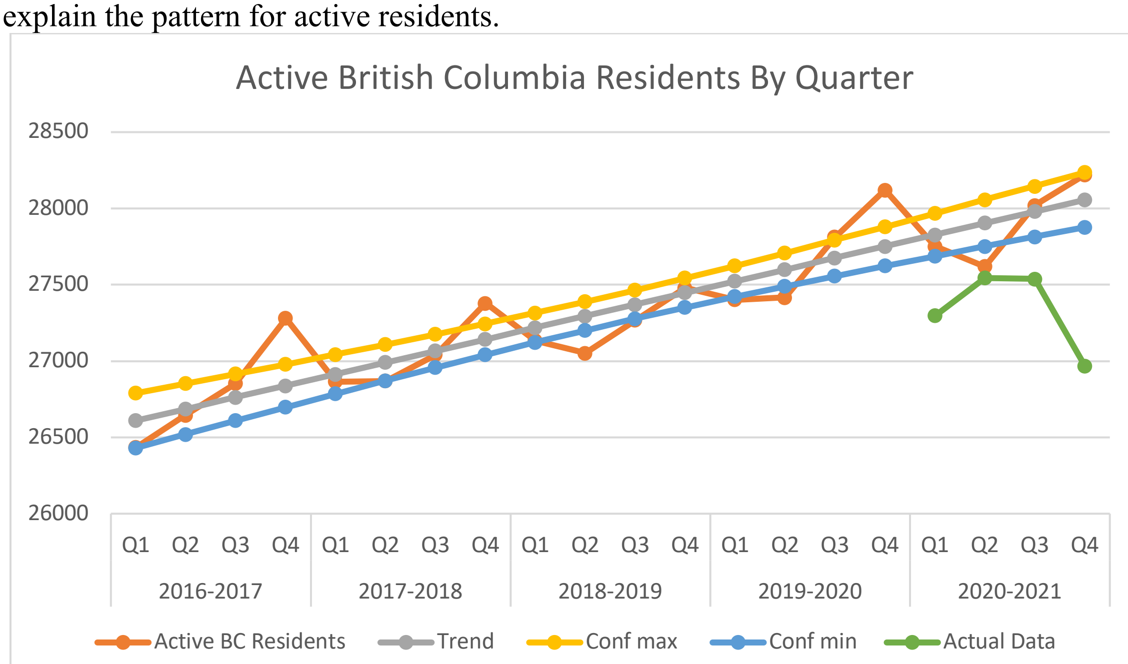

Figure 19: Active British Columbia Residents by Quarter.

g) The number of active residents increased in quarter one and two and exceptionally decreased in quarter three and four of the 2020-2021 fiscal year in Manitoba. This does not follow the trend among total active residents in all quarters of the 2020-2021 fiscal year. The number of admissions also remained relatively stagnant between quarter one and two and also may in part explain the lack of substantial change between quarter one and two of 2020-2021 for the number of active residents. Nonetheless, this little change between the two quarters is not unique to 2020-2021 as the same pattern is observed in quarter three and four of 2019-2020 (before the pandemic).

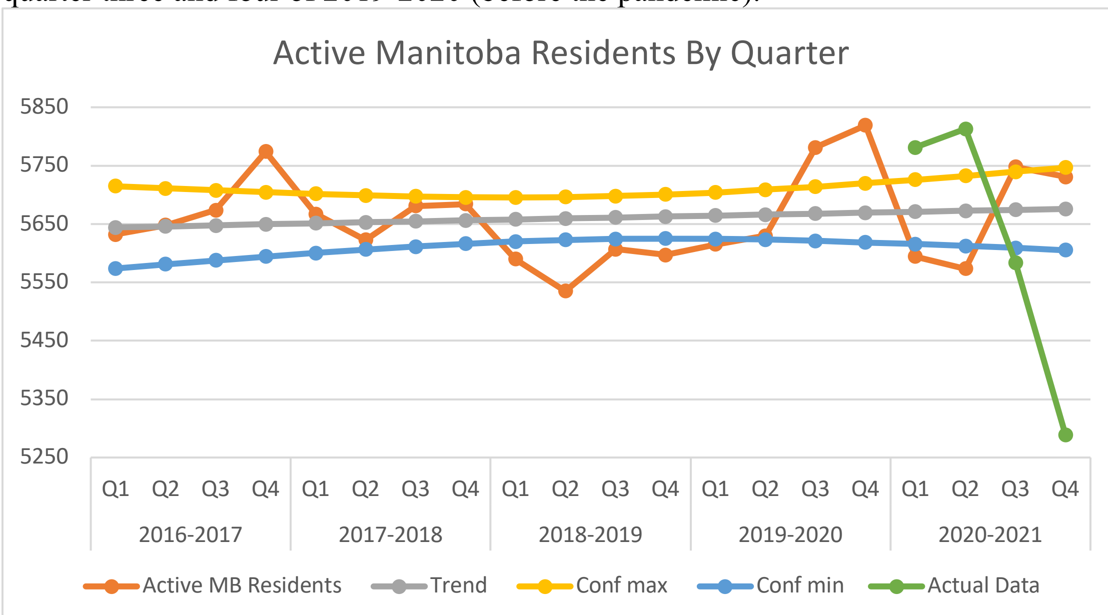

Figure 20: Active Manitoba Residents by Quarter.

h) The number of active residents decreased in quarter one and two, increased in quarter three, and did not significantly change in quarter four of the 2020-2021 fiscal year in Newfoundland and Labrador. This does not follow the trend among total active residents in all quarters of the 2020-2021 fiscal year.

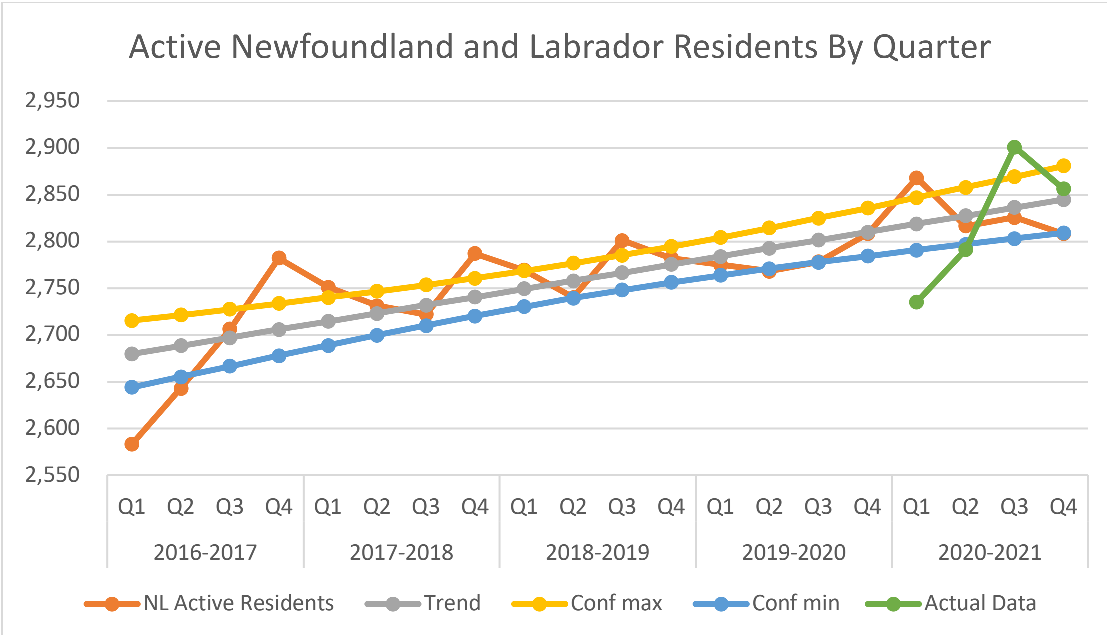

Figure 21: Active Newfoundland and Labrador Residents by Quarter.

i) The number of active residents did not significantly change in any quarter in 2020-2021 among residents aged 65-74. This does not follow the trend for the total number of active residents in 2020-2021 (which otherwise decreased in all quarters). There is seemingly a lack of change in the number of residents in this age group, overall.

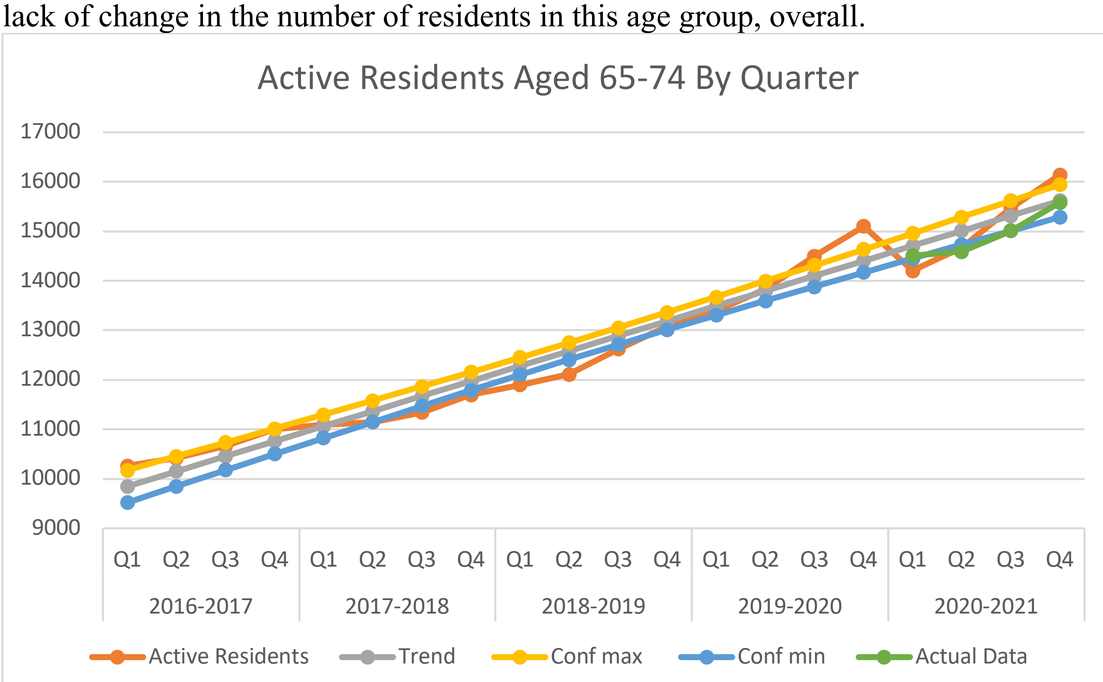

Figure 22: Active Residents Aged 65-74 by Quarter.

j) The number of active residents exceptionally decreased in all quarters in 2020-2021 among those aged 75-84. This follows the trend for the total number of active residents in

2020-2021. This mirrors the decrease in admissions in this time period and may be in part explained by a decrease in admissions.

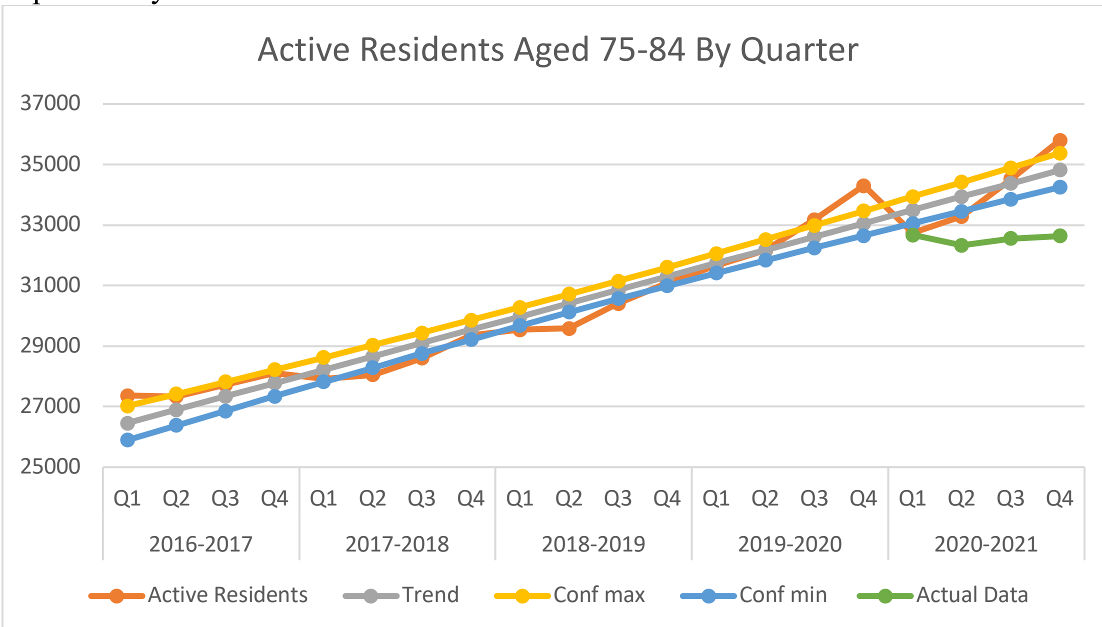

Figure 23: Active Residents Aged 75-84 by Quarter.

k) The number of active residents exceptionally decreased in all quarters in 2020-2021 among those aged 85-94. This follows the trend for the total number of active residents in 2020-2021. This mirrors the decrease in admissions in this time period which may in part explain the trend for active residents.

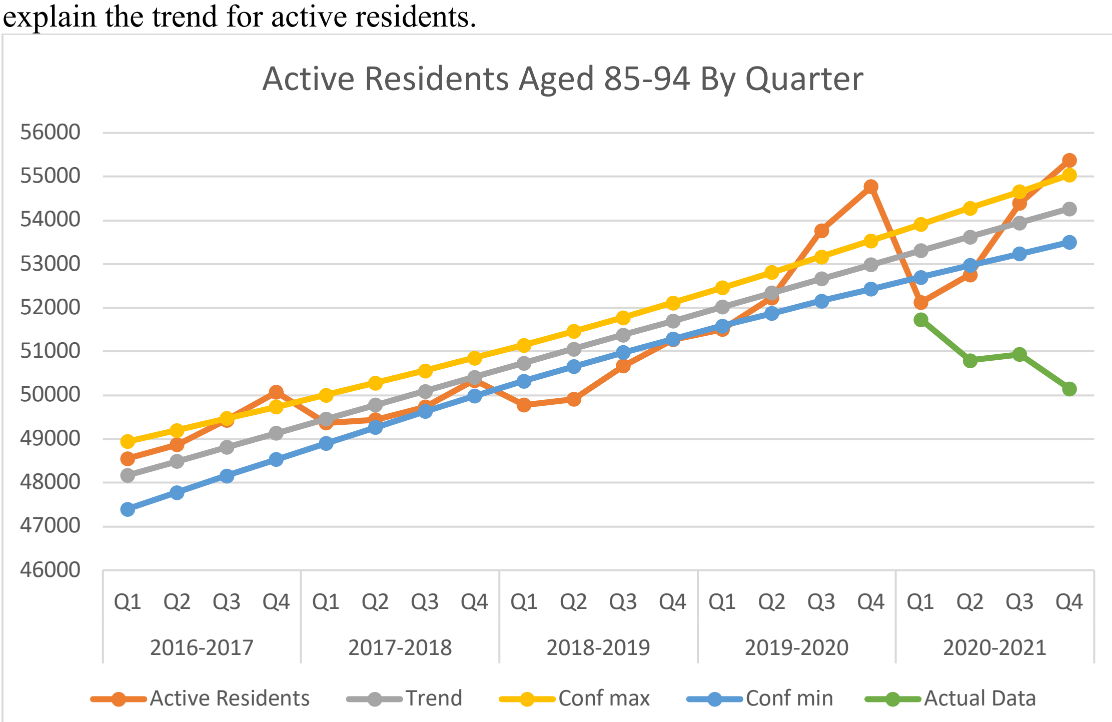

Figure 24: Active Residents Aged 85-94 by Quarter.

l) The number of active residents exceptionally decreased in all quarters in 2020-2021 among those aged 95+. This follows the trend for the total number of active residents in 2020-2021. This mirrors the decrease in admissions in this time period which may in part explain the trend for active residents.

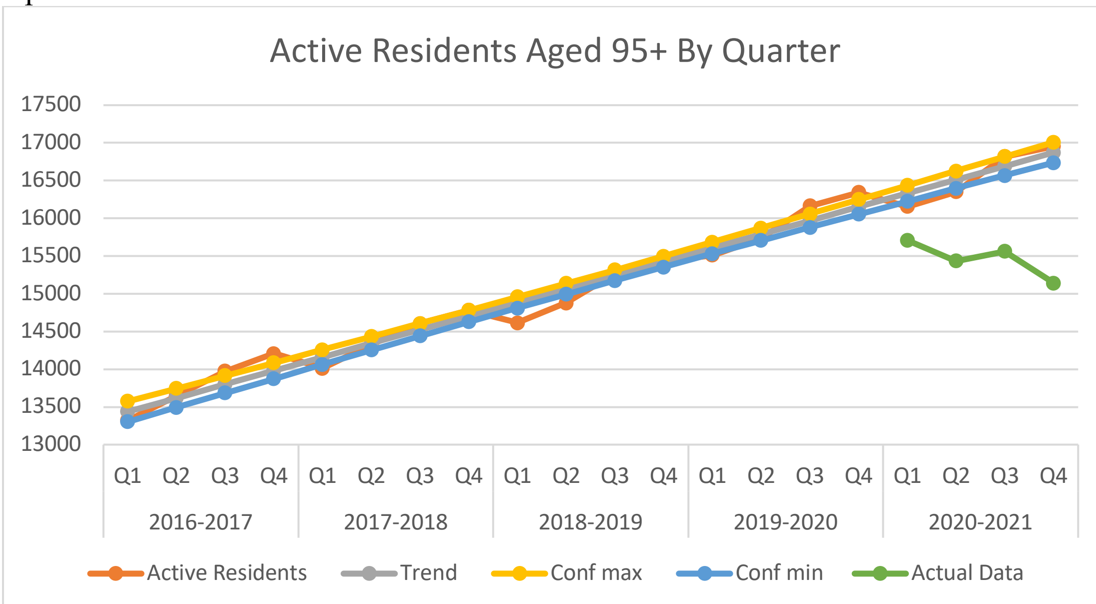

Figure 25: Active Residents Aged 95+ by Quarter.

<u>Section 3. Admissions:</u>

Overall, the number of admissions decreased across quarters and months in 2020-2021 and across data by sex, age, and province. However, the exceptions to this will be discussed below. Examination of admissions can contribute to a greater understanding of the patterns in the number of residents in LTC homes which in turn then could affect the number of deaths in 2020-21. The patterns seen in this section, further validates the importance of the analysis on the mortality ratio. Due to the drop in admissions, the study of the mortality ratio (excess deaths relative to the population at risk) is pertinent as there could have been fewer deaths than expected given there were fewer residents.

a) Analysis by quarter: The total number of admissions exceptionally decreased in all quarters of the 2020-2021 fiscal year. The greatest decrease in admissions occurred in quarter one of 2020-2021. This is also the quarter where the highest number of deaths was recorded across 2020-2021 when examining the total numbers.

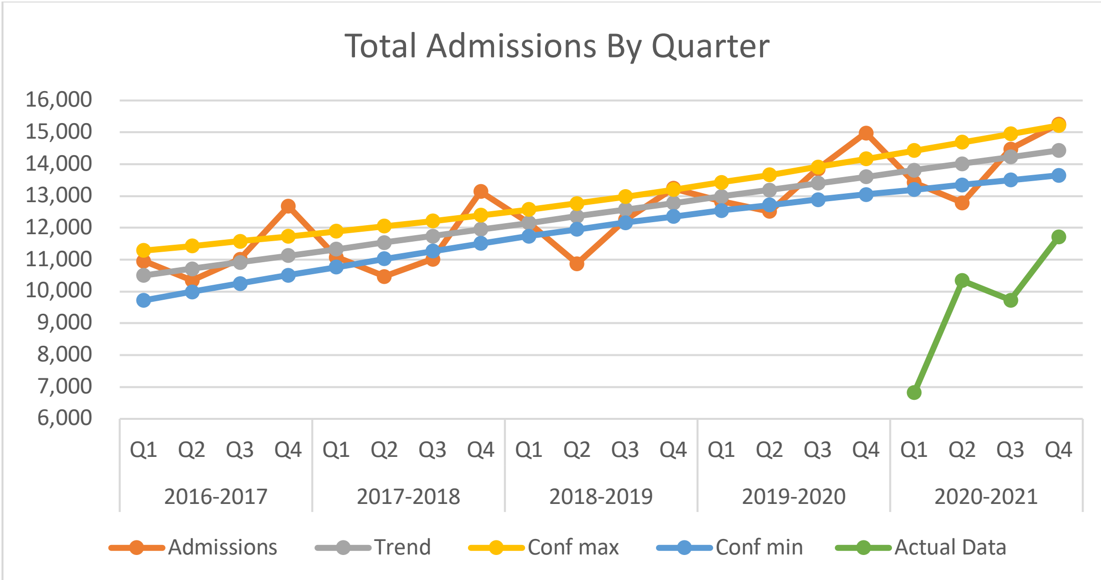

Figure 26: Total admissions by quarter

b) Analysis by month: The total number of admissions decreased in all months, except for March where there was an increase. Although admissions increased in March 2021, this increase is not substantially different than the trends established for changes in total admissions over time. The greatest decrease in admissions occurred in May 2020 i.e., the onset of the pandemic and one month proceeding the greatest increase in total deaths across all years.
The subsequent upward trend in admissions from the first quarter occurs across the summer when cases and deaths were lower (this upward trend still does not put the number of admissions above or even in the expected range). However, the following subsequent decrease of admissions in the fall occurs when the number of cases and deaths across Canada and LTC were rising again. By March 2021, the number of admissions had increased again. Refer to figure 13a in the appendix.

c) By quarter, for females: The number of admissions for female residents decreased in all quarters of the 2020-2021 fiscal year. This follows the trend seen with total number of admissions among all quarters of the 2020-2021 fiscal year. Despite, the decrease in admissions in 2020-2021, the number of female admissions was greater than the number of male admissions over all periods of time examined.

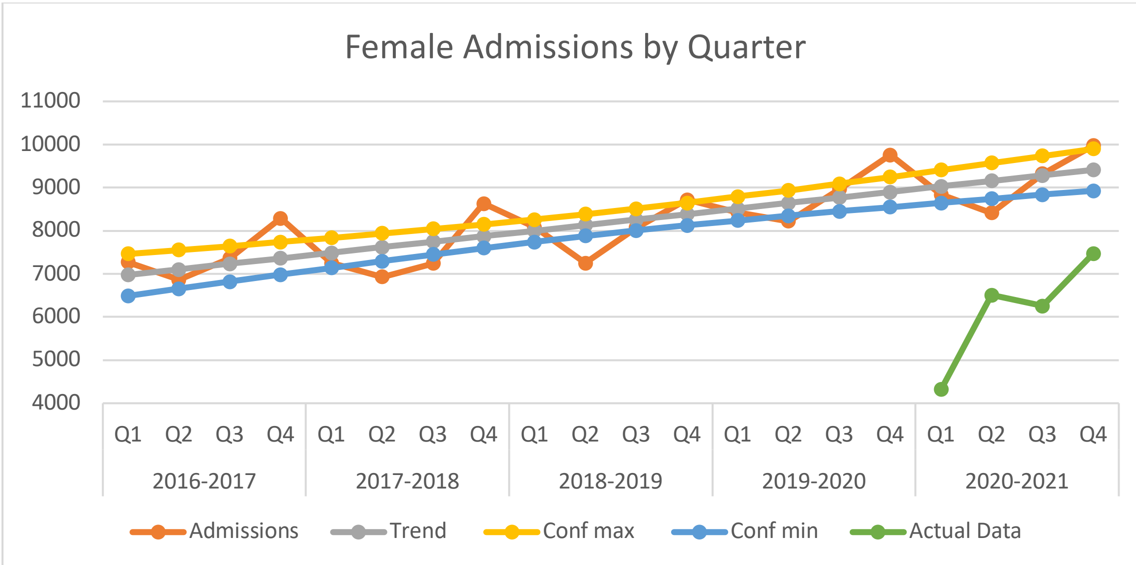

Figure 27: Female Admissions by Quarter.

d) By quarter, for males: The number of admissions for male residents decreased in all quarters of the 2020-2021 fiscal year. This follows the trend seen with total number of admissions among all quarters of the 2020-2021 fiscal year. There was a greater decrease in the number of female admissions when comparing the actual data to the lower margin of the predicted data. Specifically, there was a difference of 4332 admissions in quarter one, 2232 in quarter two, 2578 in quarter three, and 1451 in quarter four of 2020-2021 for females while there was a difference of 2463 admissions in quarter one, 969 in quarter two, 1457 in quarter three, and 524 in quarter four of 2020-2021 for males. Nonetheless, a greater number of females were still being admitted to LTC during 2020-2021.

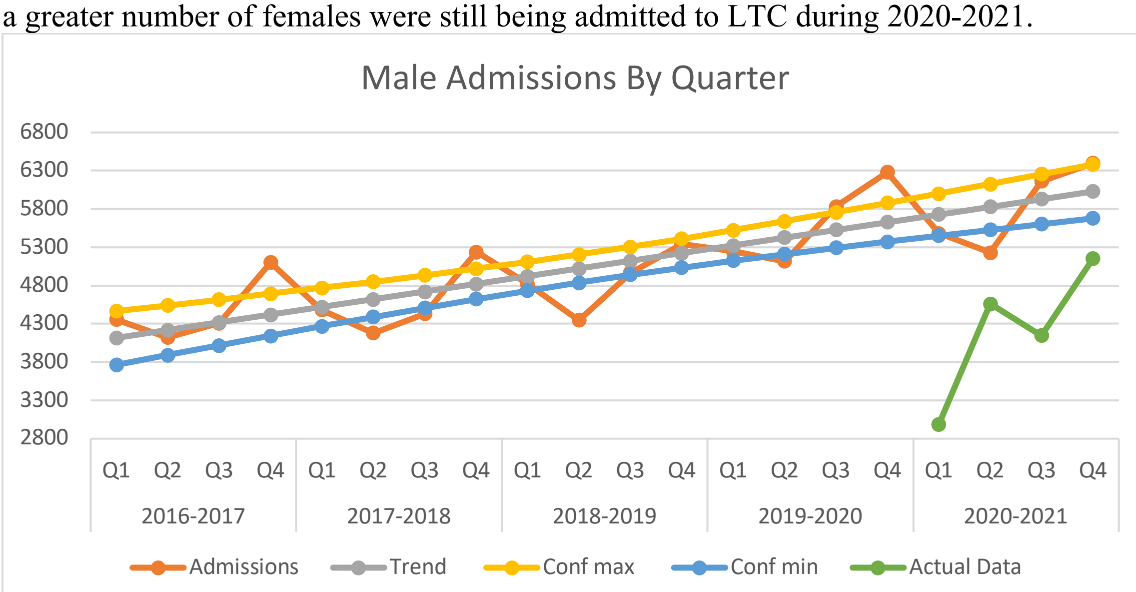

Figure 28: Male Admissions by Quarter.

As seen from these graphs, the number of admissions was lower than expected for both females and males but lower for females than males compared to preceding years even though more females were admitted.

e) By month, for females: The number of admissions for female residents decreased in all months except for March in the 2020-2021 fiscal year where they did not significantly change. As such, all months follow the trend with the total number of admissions except for March. Refer to figure 14a in the appendix.

f) By month, for males: The number of admissions for male residents decreased in all months except for March of the 2020-2021 fiscal year where they increased. This follows the trend for the total number of admissions in 2020-2021 among all quarters with March as an outlier. Refer to figure 15a in the appendix.

g) By quarter, for Ontario: The number of admissions exceptionally decreased in all quarters in 2020-2021 in Ontario. This follows the trend with total number of admissions in 2020-2021 among all quarters. The greatest decrease in admissions compared to the trend across 2020-2021 occurred in Ontario. Specifically, the difference between the actual number of admissions and the lower margin of the predicted number of admissions is 5822 in quarter one, 3060 in quarter two, 3307 in quarter three, and 2374 in quarter four of 2020-2021. It can be seen the greatest decrease in admissions occurred in quarter one.

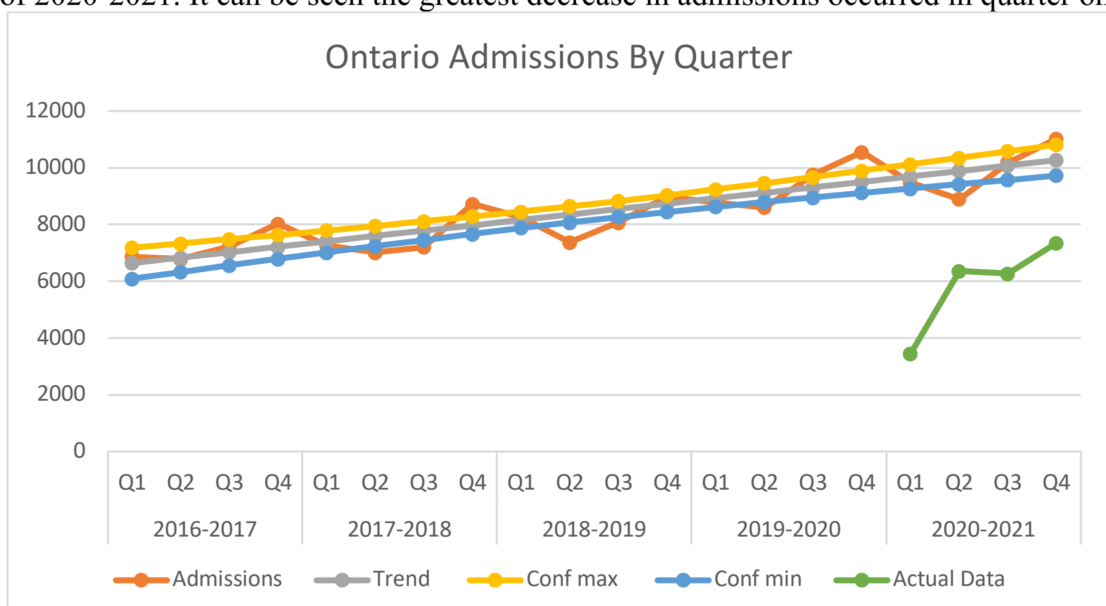

Figure 29: Ontario Admissions by Quarter.

h) By quarter, for Alberta: The number of admissions exceptionally decreased in quarter one, two, and three, and did not significantly change in quarter four in 2020-2021. This does not follow the trend for the total number of admissions in 2020-2021 among all quarters. There was 587 less deaths than expected in quarter one, 196 in quarter two, and 485 in quarter three of 2020-21.

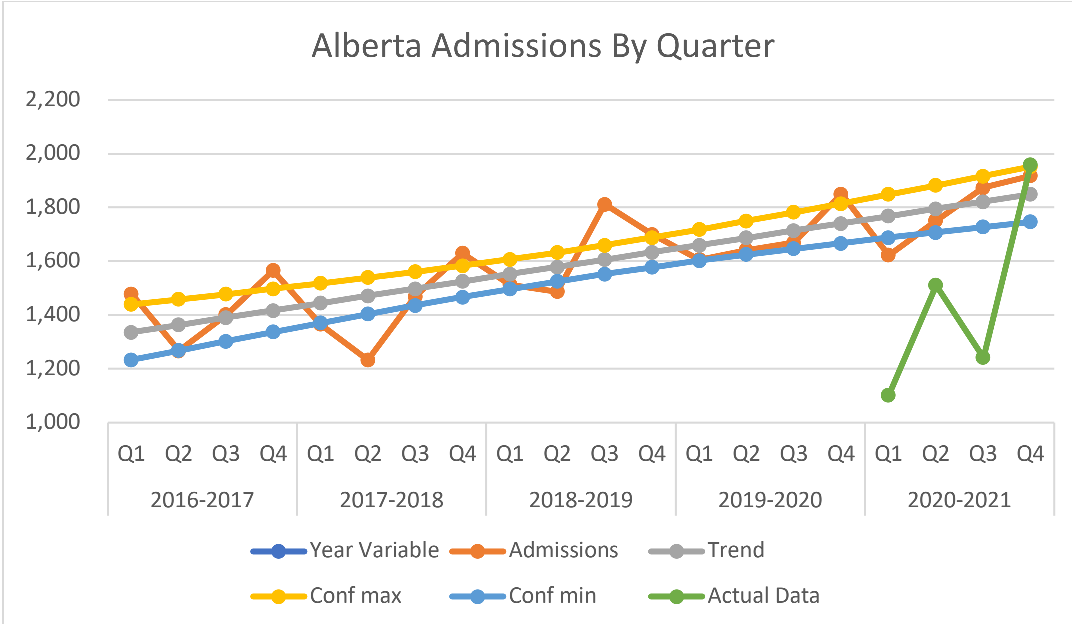

Figure 30: Alberta Admissions by Quarter.

i) By quarter, for British Columbia: The number of admissions decreased in quarter one (exceptionally) and three (not exceptionally) and did not significantly change in quarter two and four in 2020-2021 in British Columbia. Specifically, the number of admissions is 320 less than expected in quarter one and 32 in quarter three of 2020-21. This does not follow the trend for the total number of admissions in 2020-2021. The number of admissions does not change very much between quarter two and quarter three. The lack of substantial change in admissions between two quarters is not unique to 2020-2021 however; there is not much change in admissions between quarter two and three of 2016-2017 either.

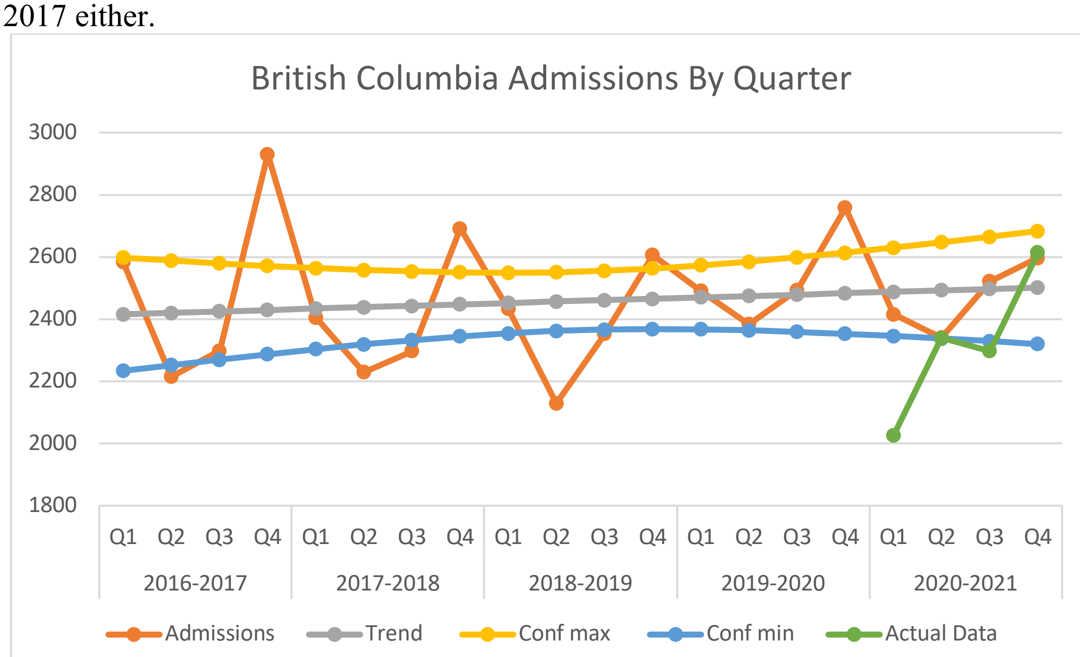

Figure 31: British Columbia Admissions by Quarter.

j) By quarter, for Manitoba: The number of admissions did not significantly change in quarter one and two and decreased in quarter three (exceptionally) and four (not exceptionally) in 2020-2021. Specifically, there is 265 less admissions than expected in quarter three and 65 less in quarter four of 2020-21. This does not follow the trend for the total number of admissions in 2020-2021. The lack of change in admissions in quarter one and two are followed by a steep decline in admissions in quarter three and a subsequent upward trend in quarter four (however, the number of admissions remains below the confidence interval in quarter four). The little levels of change in admissions are not necessarily unique to 2020-2021, however; there is little change between admissions in quarter one and two of 2016-2017 as well. Interestingly, admissions do not change when the number of cases and deaths are relatively lower than other jurisdictions and decrease drastically when there is a drastic increase in cases and deaths in Manitoba.

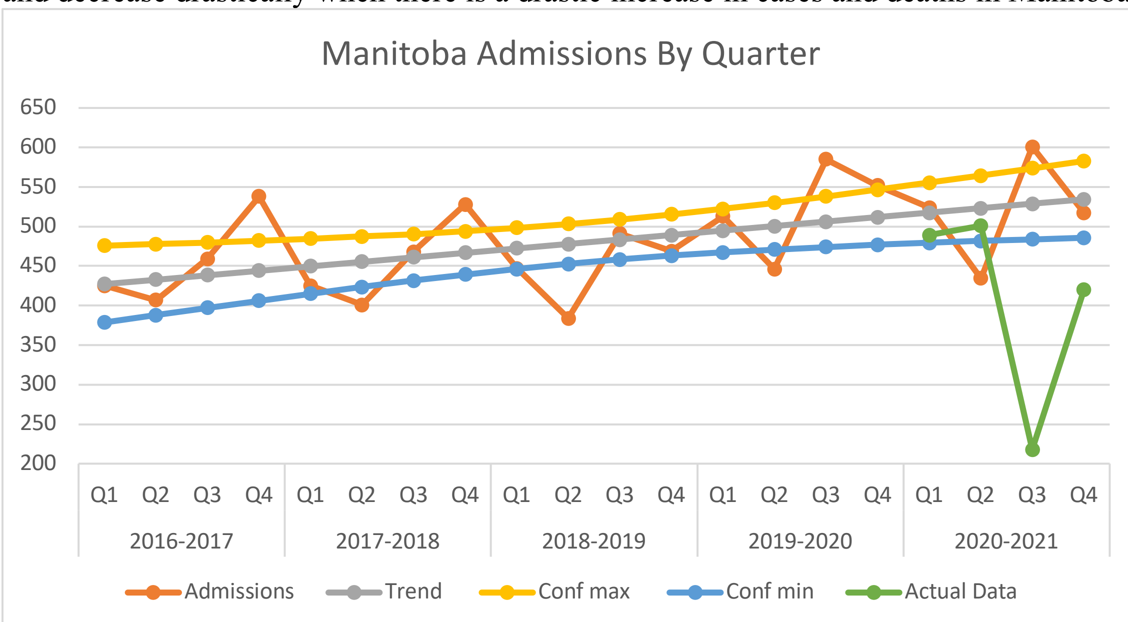

Figure 32: Manitoba Admissions by Quarter.

k) By quarter, for Newfoundland and Labrador: The number of admissions, increased in quarter two and three (exceptionally), and did not significantly change in quarter one[6] and four in 2020-2021. There are 56 and 65 more admissions than expected in quarter two and three. This does not follow the trend for the total number of admissions in 2020-2021 among all quarters. There is a lack of substantial admissions between quarter two and three and this occurs at a time when there is a greater increase in cases and deaths in the region than compared to the increase between quarter one and two. This lack of change in admissions between two quarters is not necessarily unique to Manitoba either, wherein there is not much change in admissions between quarter three and four in 2018 to 2019 and quarter two and three of 2017-2018. Interestingly, the increase in admissions in quarter two and three in 2020-2021 is exceptional compared to previous years i.e., there was an increase in admissions despite the pandemic.

[6] While there is seemingly a significant decrease in admissions in quarter one of 2020-2021 when looking at the data graphically, the decrease is only of 6. This change is more apparent for the graph for admissions in Newfoundland and Labrador because the number of admissions is lower to begin with.

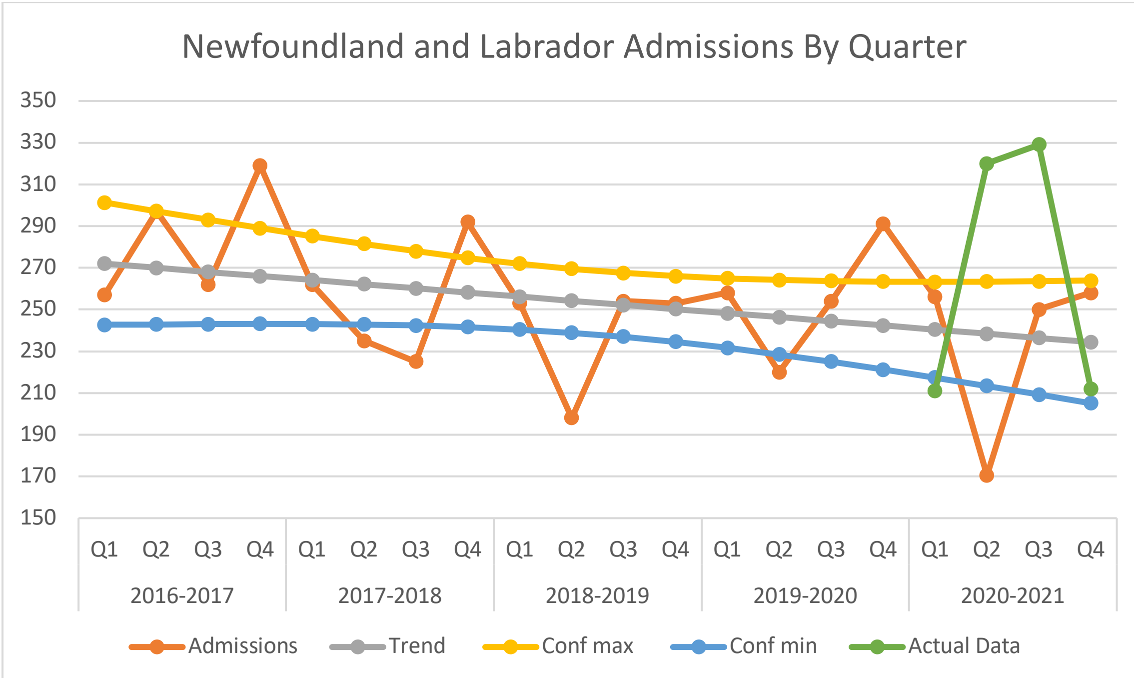

Figure 33: Newfoundland and Labrador Admissions by Quarter.

From these graphs, the greatest decrease from expected admissions occurred in Ontario while Newfoundland and Labrador actually experienced an increase in admissions, British Columbia was not drastically affected (except for quarter one), Manitoba experienced exceptional decreases in the later quarters of 2020-21, and Alberta experienced decreases in quarter one (exceptional), two and three only.

a) By month, for Ontario: Admissions decreased in all months except for March where there was no significant change. This follows the trend for total number of admissions in 2020-2021 among all months except for March where the number of admissions had otherwise increased. Admissions decreased the most in May while they did not decrease significantly in March. Refer to figure 16a in the appendix.

b) By month, for Alberta: Admissions decreased in April, May, June, July, August, September, October, November, December, and January, did not significantly change in February, and increased in March in 2020-2021. This follows the trend for total number of admissions in 2020-2021 among all months except for February which had otherwise decreased. Admissions decreased most in April and May 2020. Additionally, although admissions did not change in quarter four, they increased exceptionally in March 2021. Refer to figure 17a in the appendix.

c) By month, for British Columbia: Admissions decreased in April, May, June, August, October, November, December, and January, did not significantly change in July and August, and increased in February and March in 2020-2021. This follows the trend for total number of admissions in 2020-2021 among all months except for July, September, and February which should have decreased. Admissions decreased the most in April 2020. Refer to figure 18a in the appendix.

d) By month, for Manitoba: Admissions decreased in April, October, November, December, January, and February, did not significantly change in May, June, July, August, and September, and increased in March in 2020-2021 in Manitoba. This does not generally follow the trend for total number of admissions in 2020-2021. Admissions decreased the most in December but there is still a substantial decrease in November and January. Refer to figure 19a in the appendix.

e) By month, for Newfoundland and Labrador: Admissions decreased in April, May, August, and February, increased in June, July, September, October, November, December, and January, and did not significantly change in March in 2020-2021.This does not generally follow the trend for total number of admissions in 2020-2021. Broken down by month, no month alone shows an exceptional increase in quarter two and three and there is actually a decrease in admissions in August (part of quarter two). This is interesting because there is otherwise an exceptional increase in admissions in quarter two and three. The effects of increases in all other months of these quarters create an overall exceptional increase in these quarters. Notably, admissions start to decrease (not yet significantly) as soon as December. Refer to figure 20a in the appendix.

f) By quarter, for the 65-74 age bracket: The number of admissions decreased in all quarters in 2020-2021. This follows the trend for the total number of admissions in 2020-2021. The greatest decrease occurs in quarter one for this age group while the number of admissions does not substantially change between quarter two and three. Specifically, there are 842, 373, 412, and 57 less admissions than expected in quarter one, two, three, and four, respectively in 2020-21. Changes are exceptional for quarter one to three in comparison to previous years.

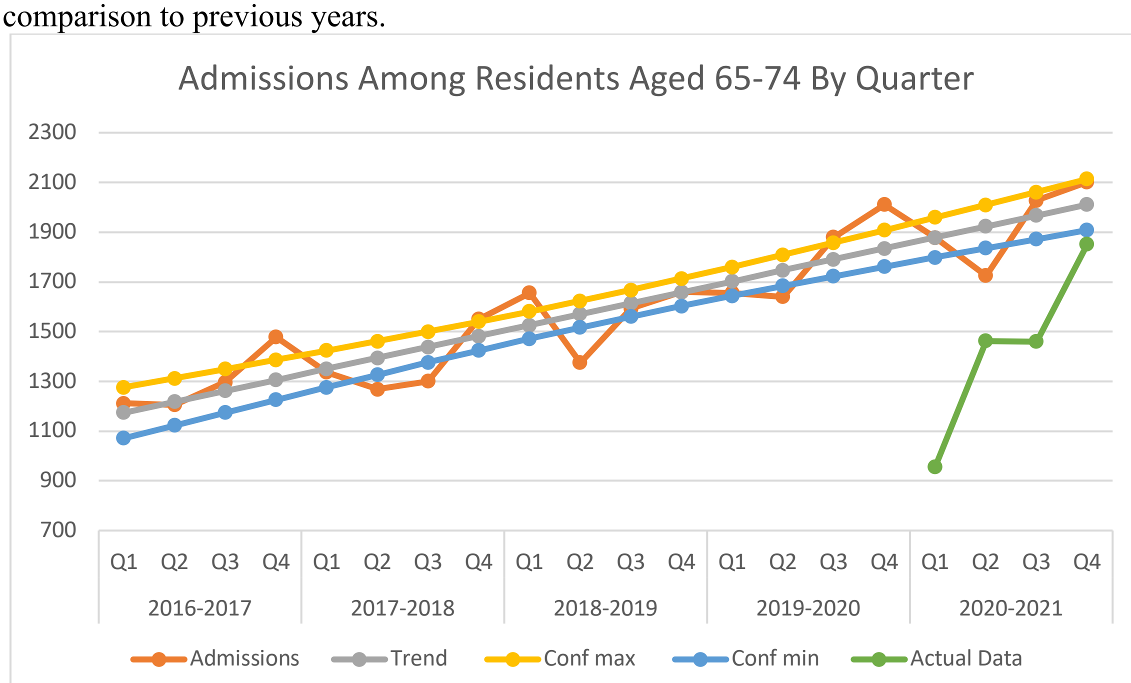

Figure 34: Admissions Among Residents Aged 65-74 by Quarter.

g) By quarter, for the 75-84 age bracket: The number of admissions exceptionally decreased in all quarters in 2020-2021. Specifically, there are 1903, 922, 1192, and 450 less admissions than expected in quarter one, two, three, and four, respectively in 2020-21. This follows the trend for the total number of admissions in 2020-2021.

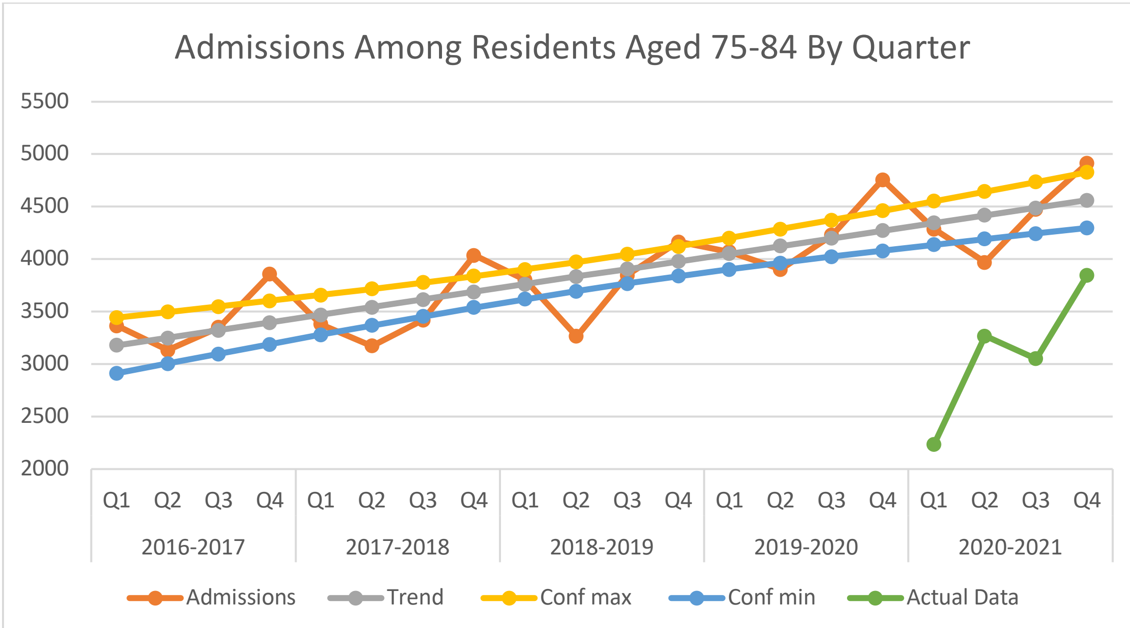

Figure 35: Admissions Among Residents Aged 75-84 by Quarter.

h) By quarter, for the 85-94 age bracket: The number of admissions exceptionally decreased in all quarters in 2020-2021. This follows the trend for the total number of admissions in 2020-2021. The greatest decrease in the actual number of admissions and the lower margin of expected admissions occurred in this age group. Specifically, the decreases were 2944 in quarter one, 1318 in quarter two, 1710 in quarter three, and 1040 in quarter four in 2020-2021.

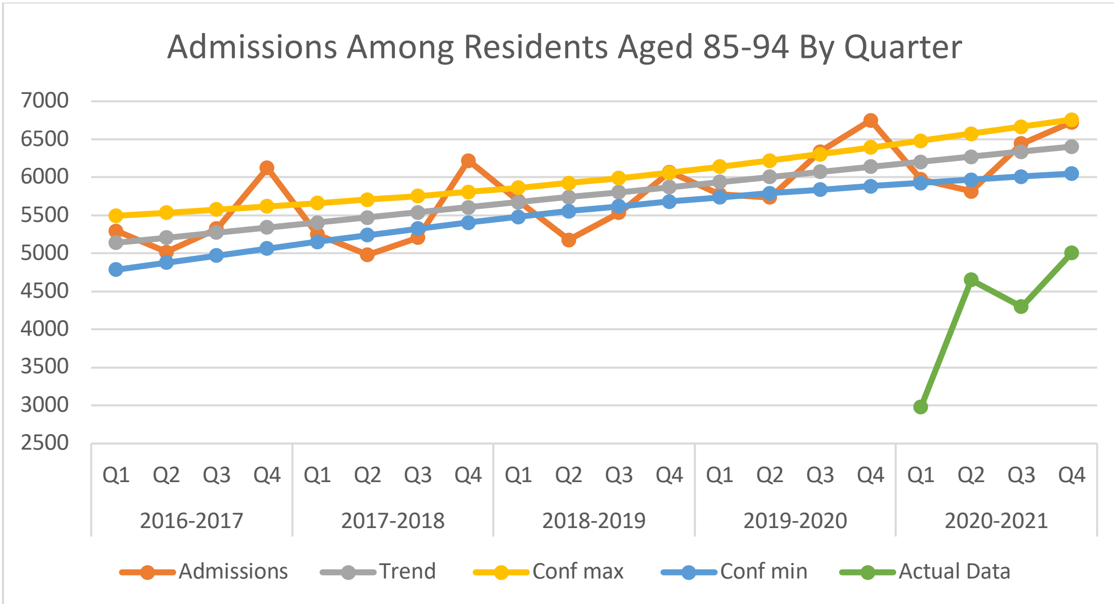

Figure 36: Admissions Among Residents Aged 85-94 by Quarter.

i) By quarter, for the 95+ age bracket: The number of admissions exceptionally decreased in all quarters in 2020-2021 among those aged 95+. Specifically, there are 693, 394, 461, and 386 less admissions than expected in quarter one, two, three, and four, respectively. This follows the trend for the total number of admissions in 2020-2021.

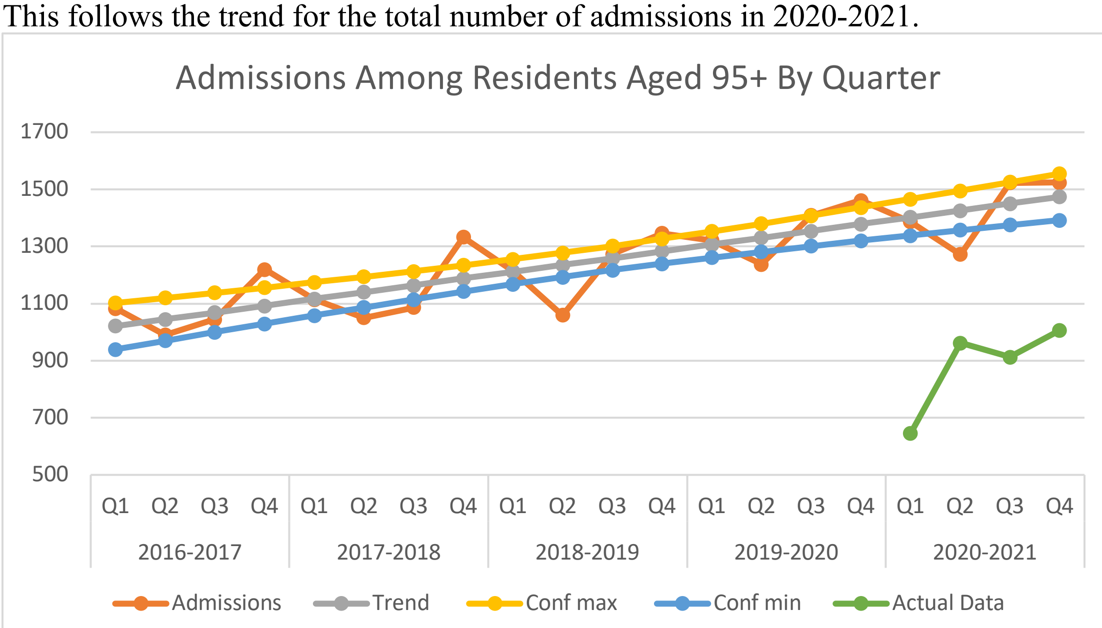

Figure 37: Admissions Among Residents Aged 95+ by Quarter.

From these graphs, it can be seen that overall, the greatest decrease in the number of expected admissions occurs in the 85-94 year age bracket while the lowest decrease in the number of expected admissions occurs in the 65-74 year age group.

j) By month, for the 65-74 age bracket: Admissions decreased in April, May, June, July, August, September, October, November, December, January, and February and increased in March in 2020-2021 among those aged 65-74. This follows the trend for total number of admissions in 2020-2021 by month. The greatest increase in admissions across all years in this age bracket occurs in March 2021, which is seen as an outlier in the data. Refer to figure 21a in the appendix.

k) By month, for the 75-84 age bracket: Admissions decreased April, May, June, July, August, September, October, November, December, January, and February and increased in March in 2020-2021 among those aged 75-84. This follows the trend for total number of admissions in 2020-2021 by month. Again, the greatest increase in admissions across all years occurs in March 2021, which is seen as an outlier in the data. Refer to figure 22a in the appendix.

l) By month, for the 85-94 age bracket: Admissions decreased April, May, June, July, August, September, October, November, December, January, and February and did not significantly change in March in 2020-2021 among those aged 85-94. This follows the trend for total number of admissions in 2020-2021 by month except for March which should have increased. Refer to figure 23a in the appendix.

m) By month, for the 95+ age bracket: Admissions decreased in all months. This follows the trend for total number of admissions in 2020-2021 by month except for March which should have increased. Refer to figure 24a in the appendix.

<u>Section 4. Discharges:</u>

Overall, the number of discharges did not change in quarter one and three and decreased in quarter two and four. However, the exceptions to this are discussed below.

a) The total number of discharges did not change in quarter one and three, and exceptionally decreased in quarter two and four of the 2020-2021 fiscal year. In quarter two there were 2105 less discharges than expected and 1058 less discharges than expected in quarter four.

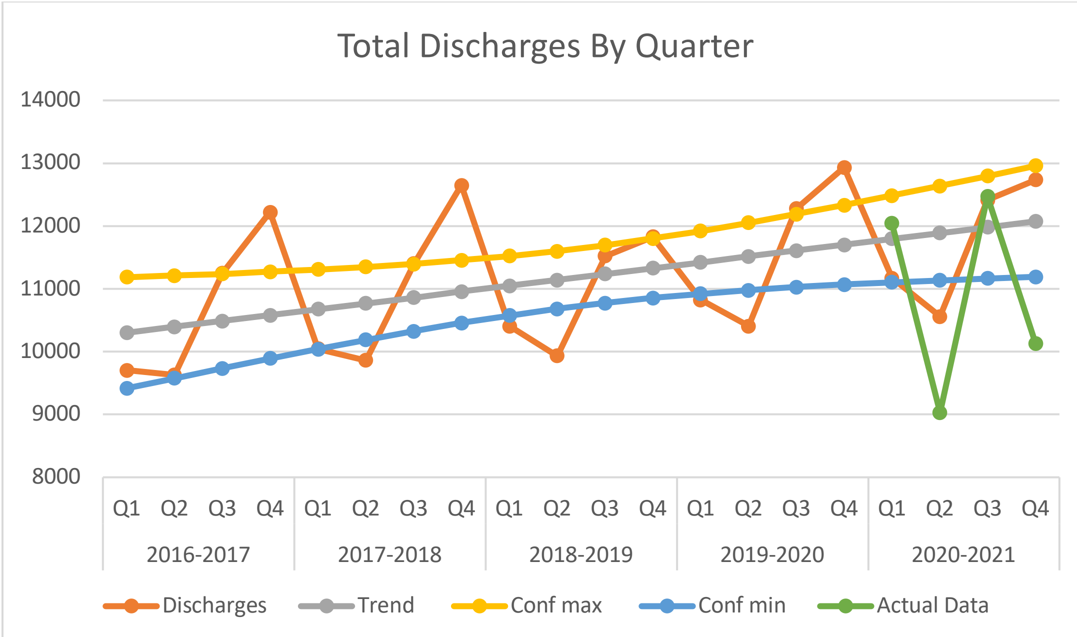

Figure 38: Total discharges by Quarter.

b) The number of discharges among female residents did not significantly change in quarter one and quarter three while the number of discharges exceptionally decreased in quarter two and four of the 2020-2021 fiscal year. This follows the trend seen with total number of discharges among quarters of the 2020-2021 fiscal year. There were 1465 less discharges than expected in quarter one and 803 less in quarter four.

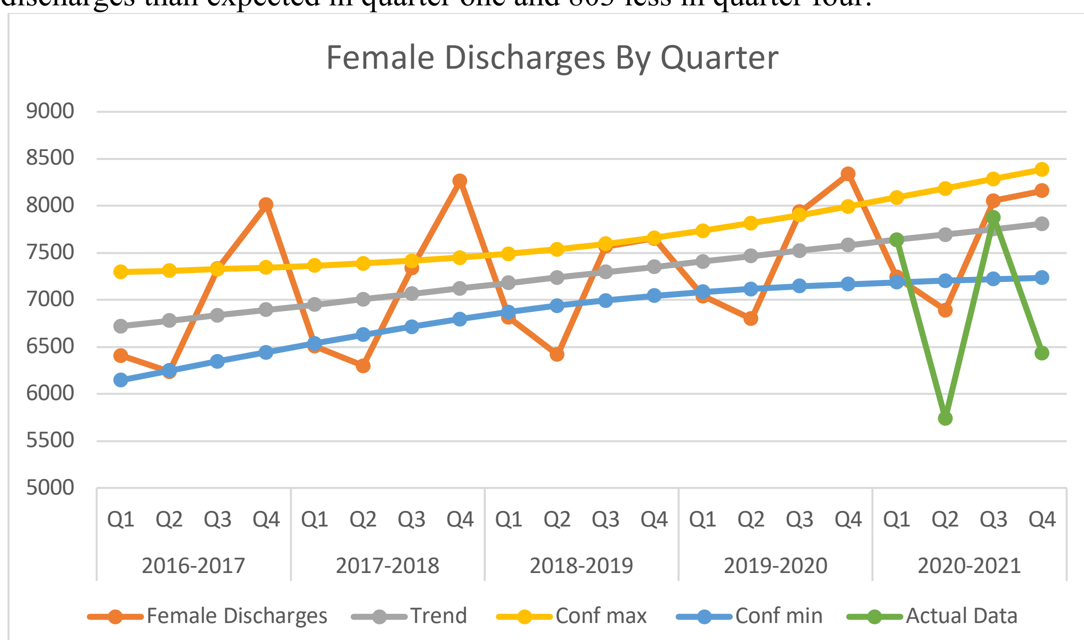

Figure 39: Female Discharges by Quarter.

c) The number of discharges among male residents did not significantly change in quarter one and quarter three and exceptionally decreased in quarter two and four of the 2020-

2021 fiscal year. This follows the trend seen with total number of discharges among quarters of the 2020-2021 fiscal year. There were 861 less discharges than expected in quarter two and 392 discharges deaths in quarter four. The number of male discharges is less than the number of female discharges in the corresponding time periods. Additionally, the difference in expected and actual discharges is greater for females than males.

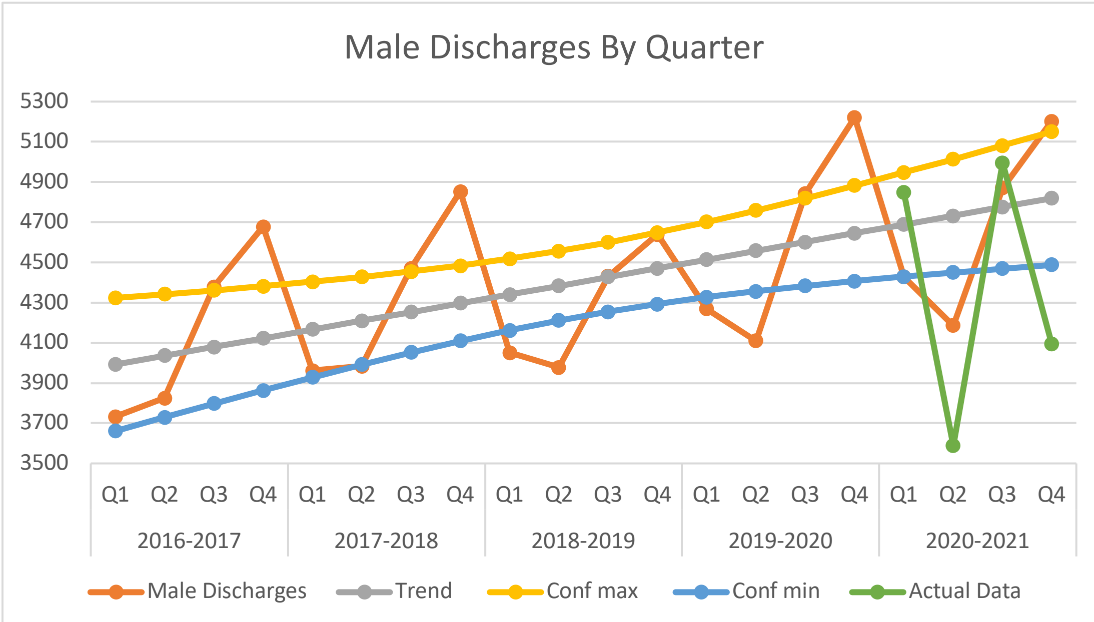

Figure 40: Male Discharges by Quarter.

d) The number of discharges increased in quarter one and decreased in quarter two, three, and four in Ontario in the 2020-2021 fiscal year. This does not follow the trend with the total number of discharges. The decrease in quarter two and four is exceptional. Interestingly, discharges increased in quarter one of 2020-2021 (although not exceptionally in comparison to previous years). There were 2049 less discharges than expected in quarter two, 345 in quarter three, and 1027 in quarter four.

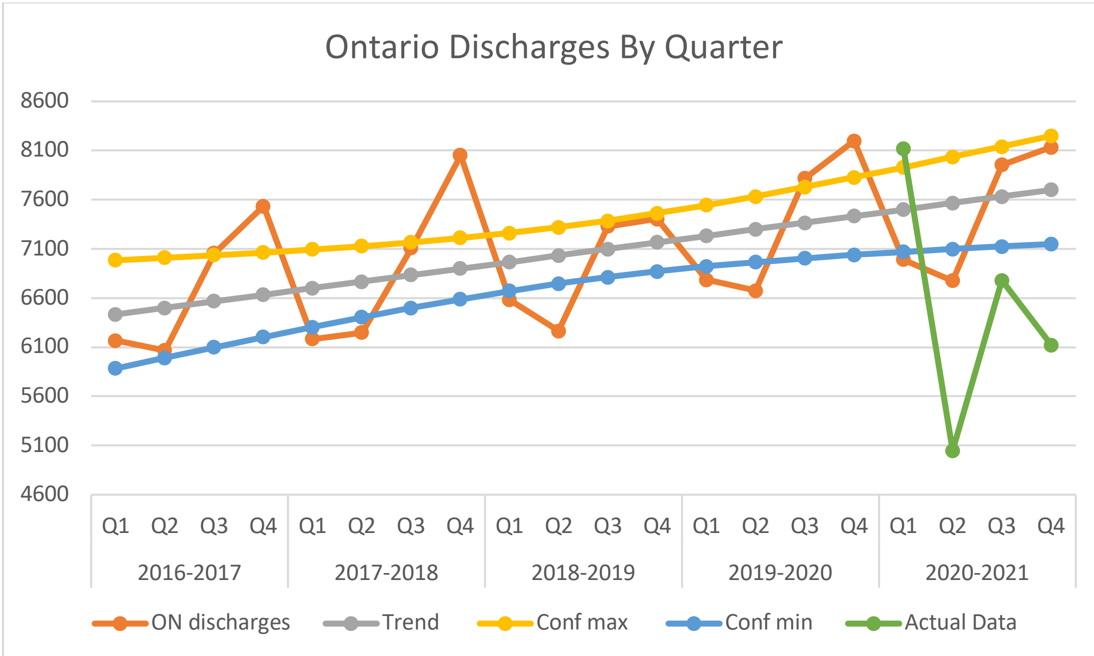

Figure 41: Ontario Discharges by Quarter.

e) The number of discharges did not significantly change in quarter one, exceptionally decreased in quarter two, exceptionally increased in quarter three, and did not significantly change in quarter four in the 2020-2021 fiscal year in Alberta. This does not follow the trend with the total number of discharges. Interestingly, there was an exceptional increase in discharges during 2020-2021 (quarter three). There were 243 less discharges than expected in quarter two and 171 excess discharges in quarter three.

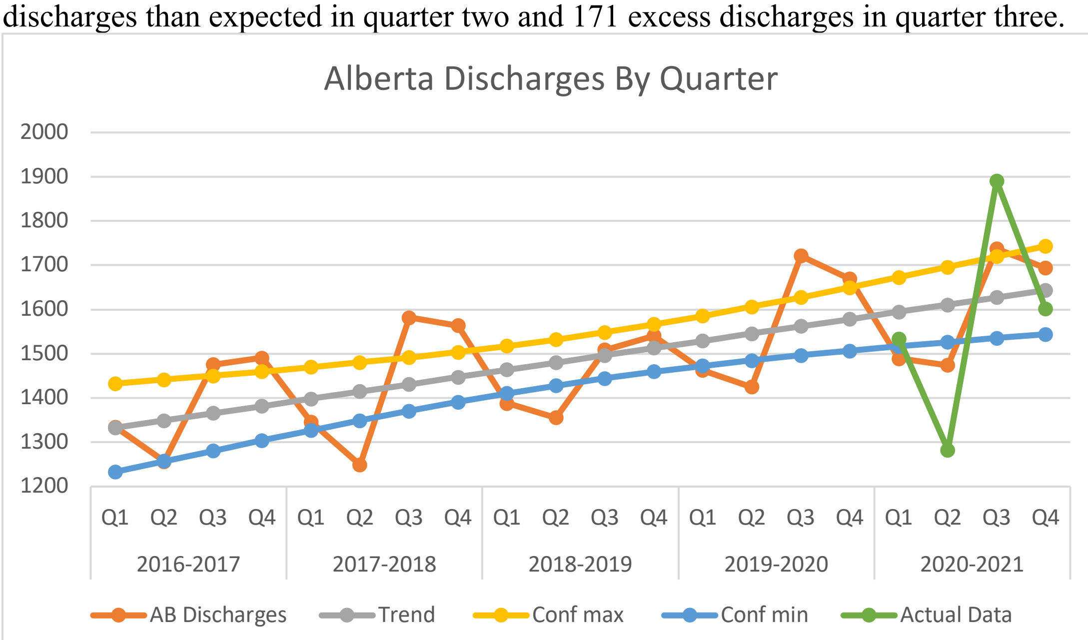

Figure 42: Alberta Discharges by Quarter.

f) The number of discharges decreased in quarter one, did not significantly change in quarter two, exceptionally increased in quarter three, and decreased in quarter four in

2020-2021 in British Columbia. This does not follow the trend with the total number of discharges. For this province there was also an exceptional increase in discharges during 2020-2021 (quarter three). There were 189 less discharges than expected in quarter one, 489 excess in quarter three, and 161 less than expected in quarter four.

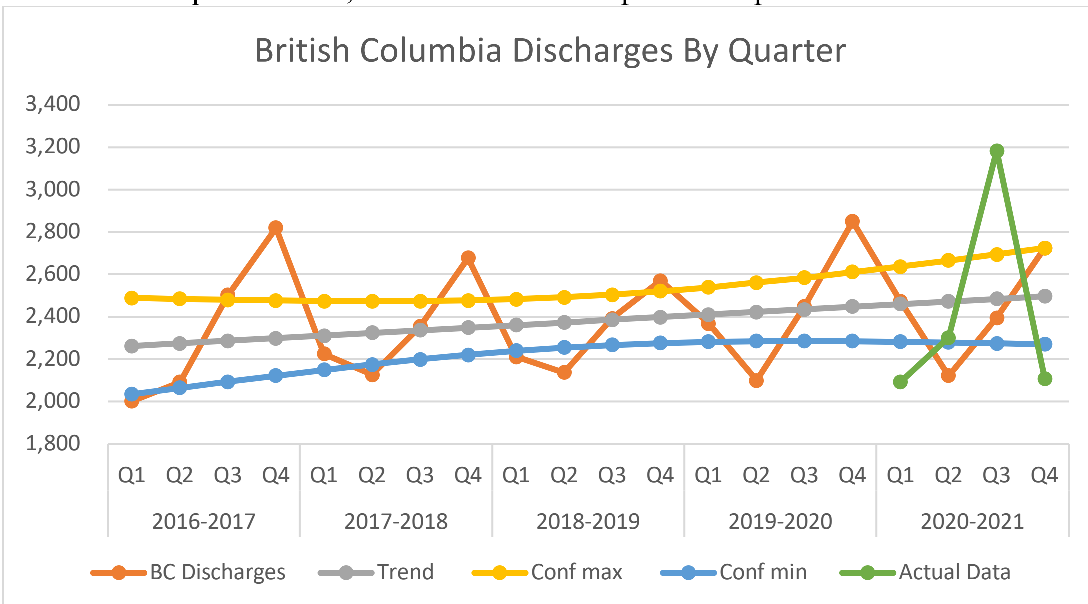

Figure 43: British Columbia Discharges by Quarter.

g) The number of discharges did not significantly change in quarter one and two, exceptionally increased in quarter three, and exceptionally decreased in quarter four in 2020-2021 in Manitoba. This does not follow the trend with the total number of discharges. Again, interestingly, there was an exceptional increase in discharges during 2020-2021 (quarter three). There were 183 excess discharges in quarter three and 62 less discharges than expected in quarter four.

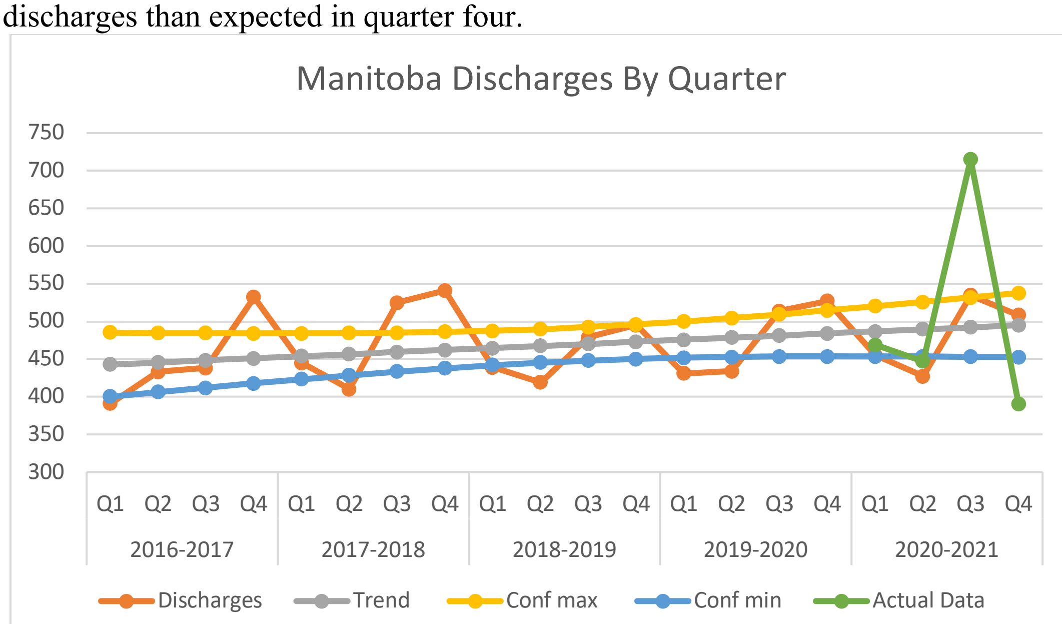

Figure 44: Manitoba Discharges by Quarter.

h) The number of discharges did not significantly change in quarter one, decreased in quarter two, and did not significantly change in quarter three and four in 2020-2021 in Newfoundland and Labrador. Decreases were not exceptional for 2020-2021 in comparison to previous years.

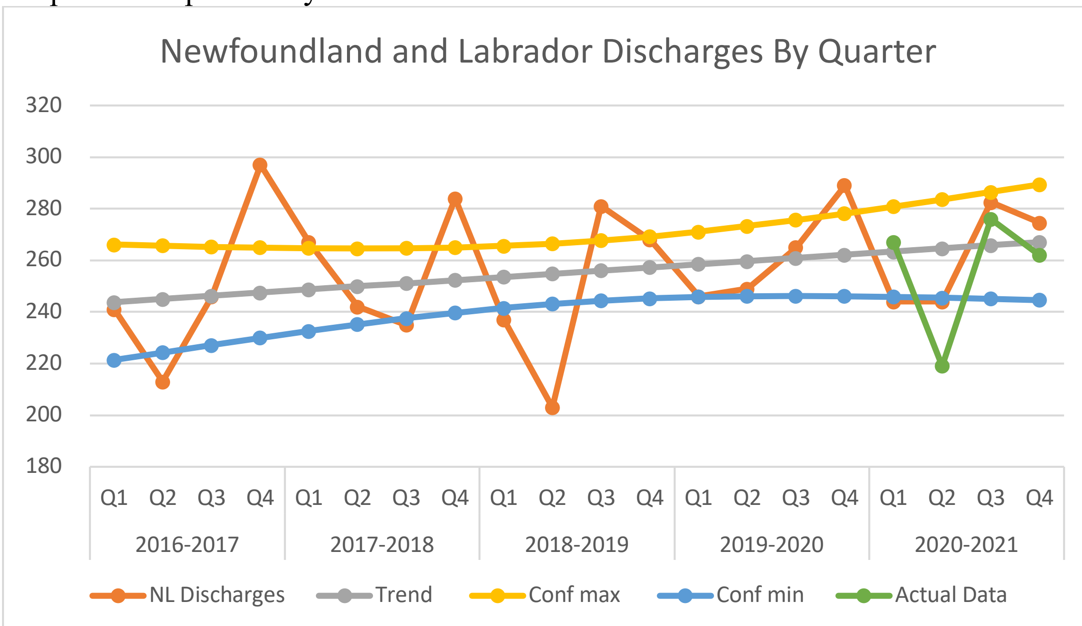

Figure 45: Newfoundland and Labrador Discharges by Quarter.

i) The number of discharges did not significantly change in quarter one and decreased in quarter two (exceptionally), three, and four (exceptionally) in 2020-2021 among those aged 65-74. This does not follow the trend for the total number of discharges wherein the number of discharges should have not significantly changed in quarter three. Discharges for quarter two were exceptionally lower than previous years. There were 258 less discharges than expected in quarter two and 157 less in quarter four.

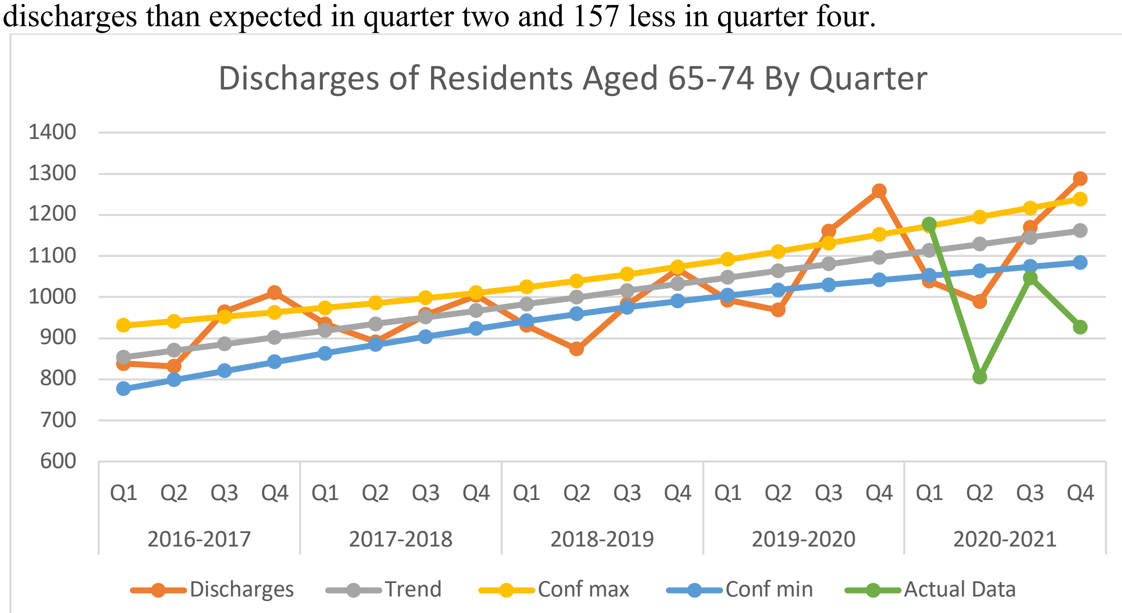

Figure 46: Discharges of Residents Aged 65-74 by Quarter.

a) The number of discharges did not significantly change in quarter one and three and exceptionally decreased in quarter two and four in 2020-2021 among those aged 75-84. This follows the trend for the total number of admissions in 2020-2021. Discharges for quarter two and three were exceptionally lower than previous years. There were 580 less discharges than expected in quarter two and 323 less in quarter four.

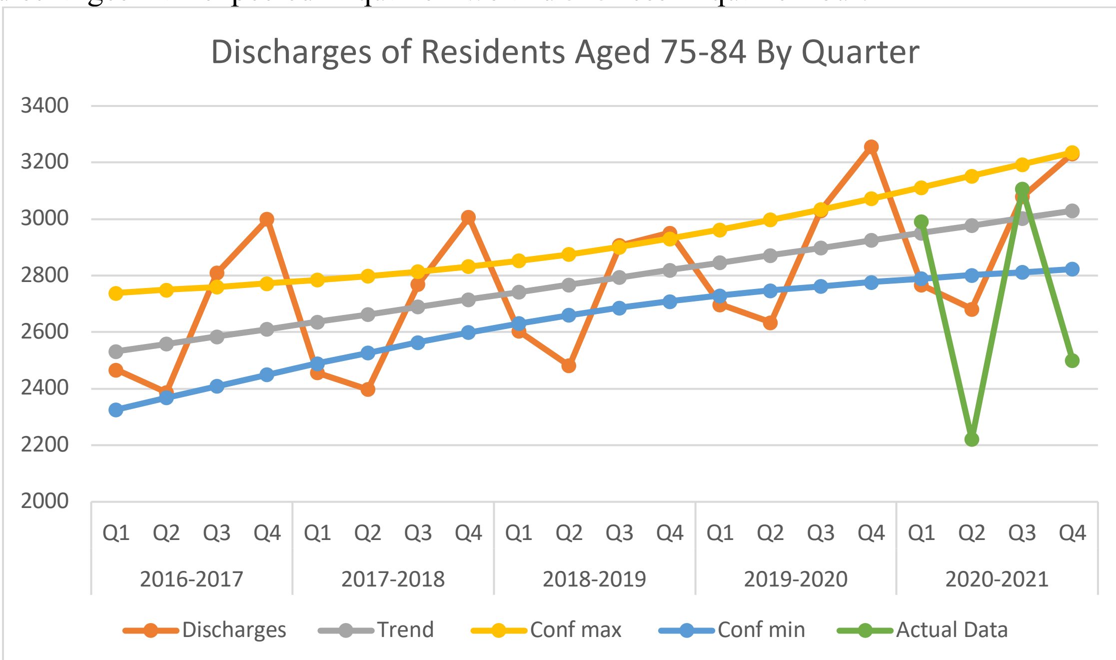

Figure 47: Discharges of Residents Aged 75-84 by Quarter.

j) The number of discharges did not significantly change in quarter one and three and decreased in quarter two (exceptionally) and four in 2020-2021 among those aged 85-94. This follows the trend for the total number of admissions in 2020-2021.There were 934 less discharges than expected in quarter two and 405 less in quarter four.

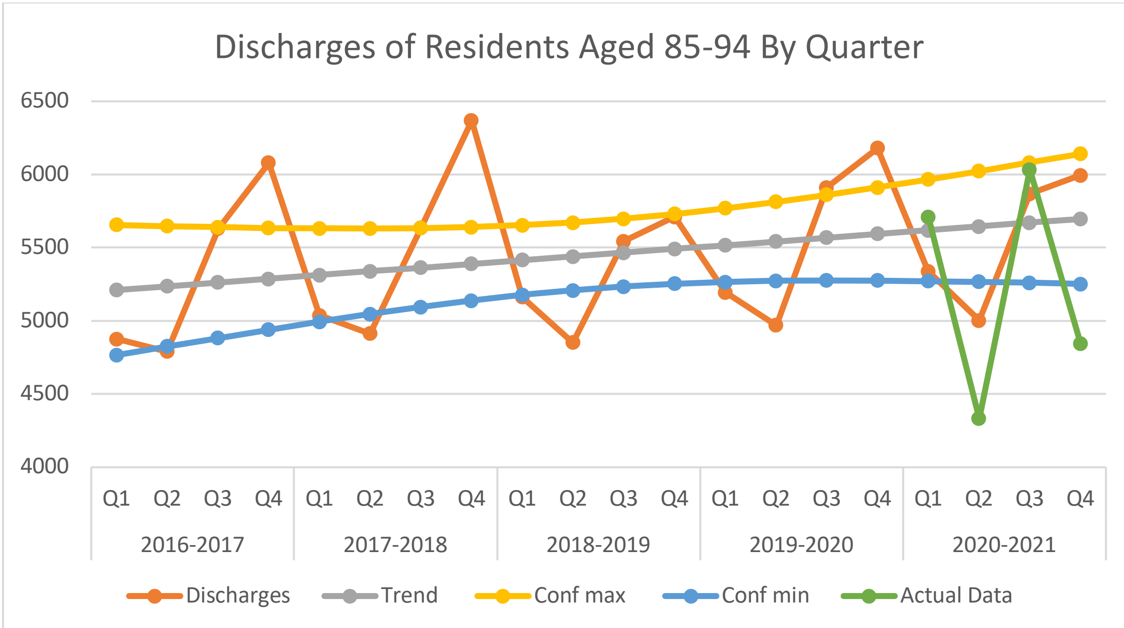

Figure 48: Discharges of Residents Aged 85-94 by Quarter.

b) The number of discharges did not significantly change in quarter one and three and exceptionally decreased in quarter two and four in 2020-2021 among those aged 95+. This follows the trend for the total number of admissions in 2020-2021.

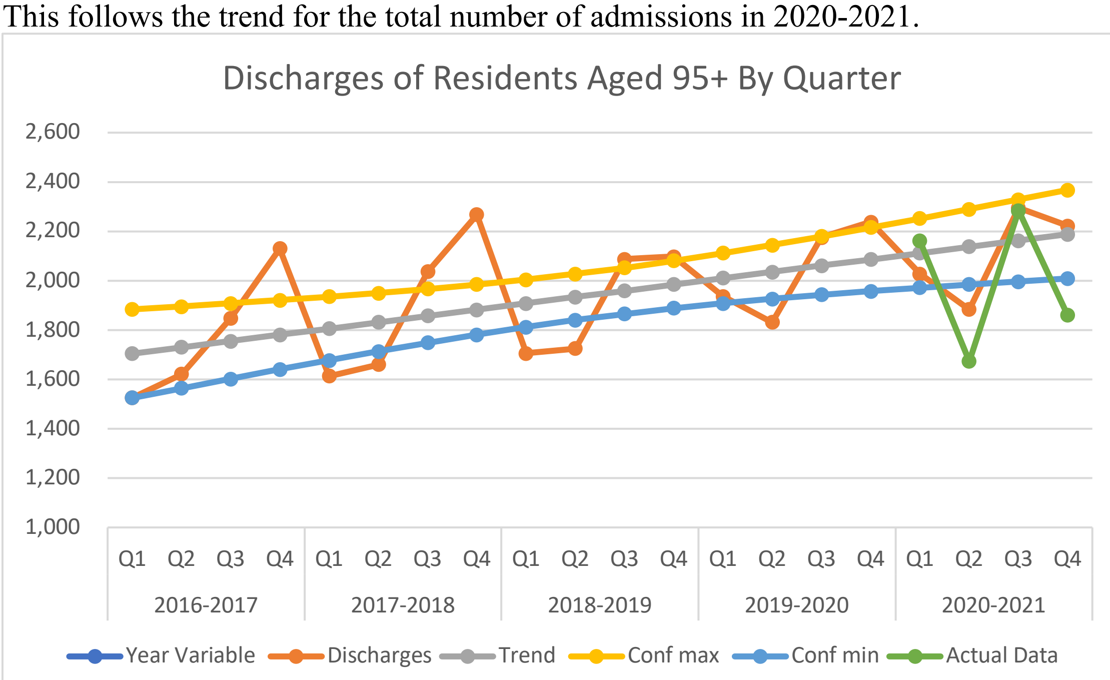

Figure 49: Discharges of Residents Aged 95+ by Quarter.

c) Next, the discharge ratio was calculated to see if the number of residents (which decreased) influenced the number of discharges. It was found that the discharge ratio using the total number of discharges and total number of active residents did not significantly change in quarter one, decreased in quarter two and four, and increased in quarter three of the 2020-2021 fiscal year. These trends are similar for the trends of discharges with total numbers.

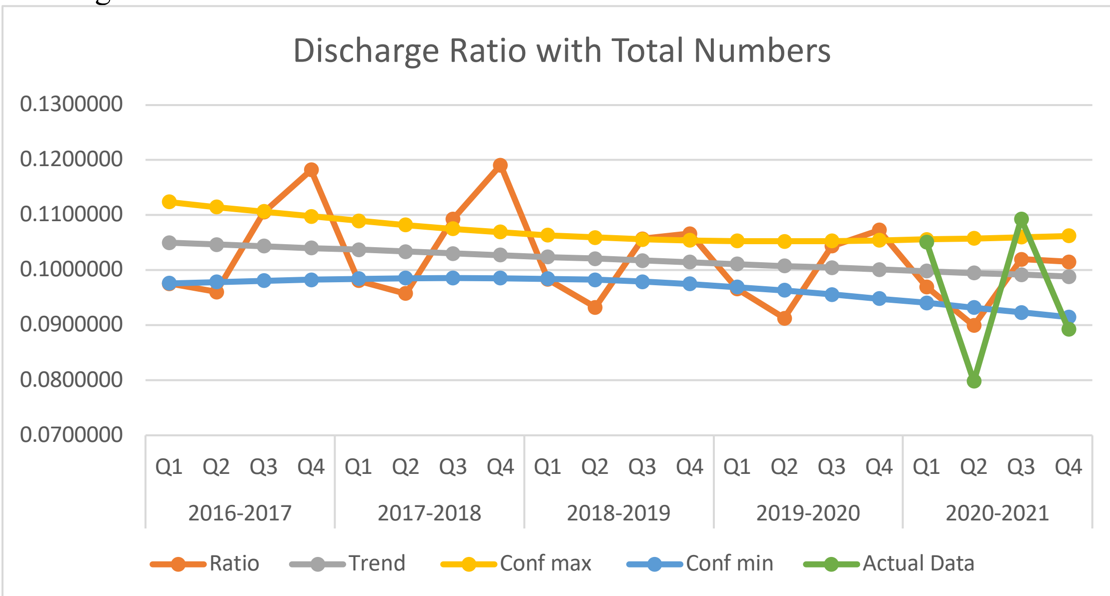

Figure 50: Discharge Ratio with Total Numbers.

<u>Section 5. Death Ratios:</u>

Overall, trends in death ratios are similar to trends in deaths examined by total number and the variables of sex, age, and province. This potentially validates the trends in deaths because death ratios account for increases and decreases in the number active residents which may otherwise skew the results of the analysis for deaths. This section goes further in exploring death rates across health regions, peer groups, and regions with similar levels of socioeconomic variables.

a) The death ratio for deaths increased in quarter one, decreased in quarter two, increased in quarter three, and did not significantly change in quarter four of the 2020-2021 fiscal year. It is now clear that the excess mortality ratio observed in the spring of 2020 is smaller than that observed in the fall of 2016-17 and 2017-18. Firstly, the change in the number of residents is accounted for in this ratio and secondly, the patterns observed in this analysis mirror the patterns observed in the analysis with total deaths. The increase in death ratios was not truly exceptional in quarter one and three of 2020-2021 as greater increases in death ratios were seen in quarter four of 2016-2017 and 2018-2019

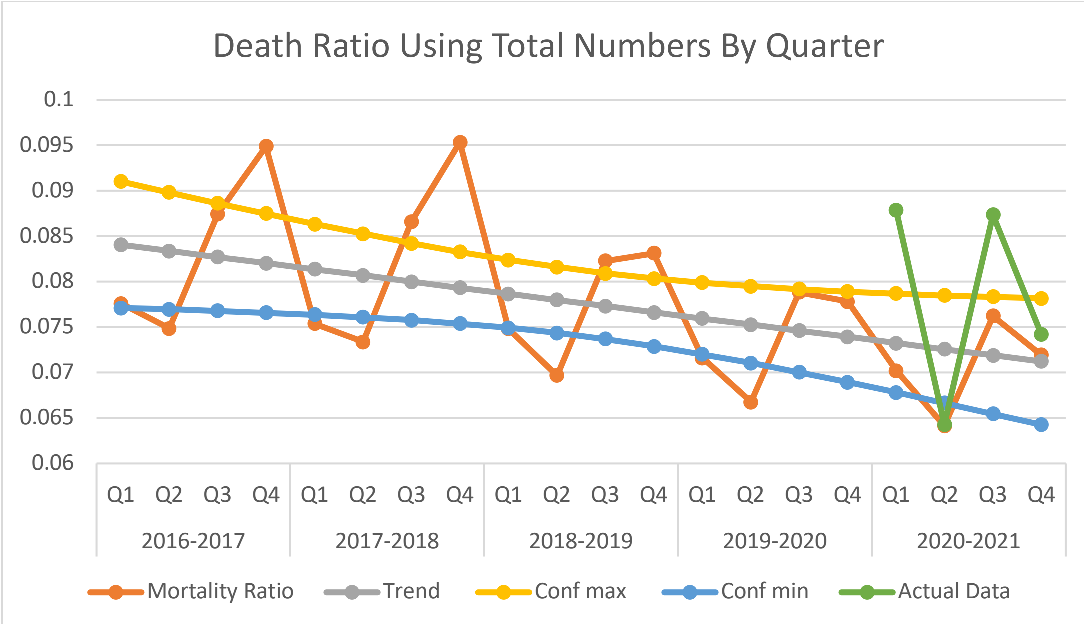

Figure 51: Death Ratio Using Total Numbers by Quarter.

Re-examination of Data:

When the number of deaths in the 0-64 age group was added to the total number of deaths in the 64-95+ age group, the same pattern emerged in the death ratio: there was an increase in the death ratio in quarter one and three, decrease in quarter two, and no significant change in quarter four in the 2020-2021 fiscal year.

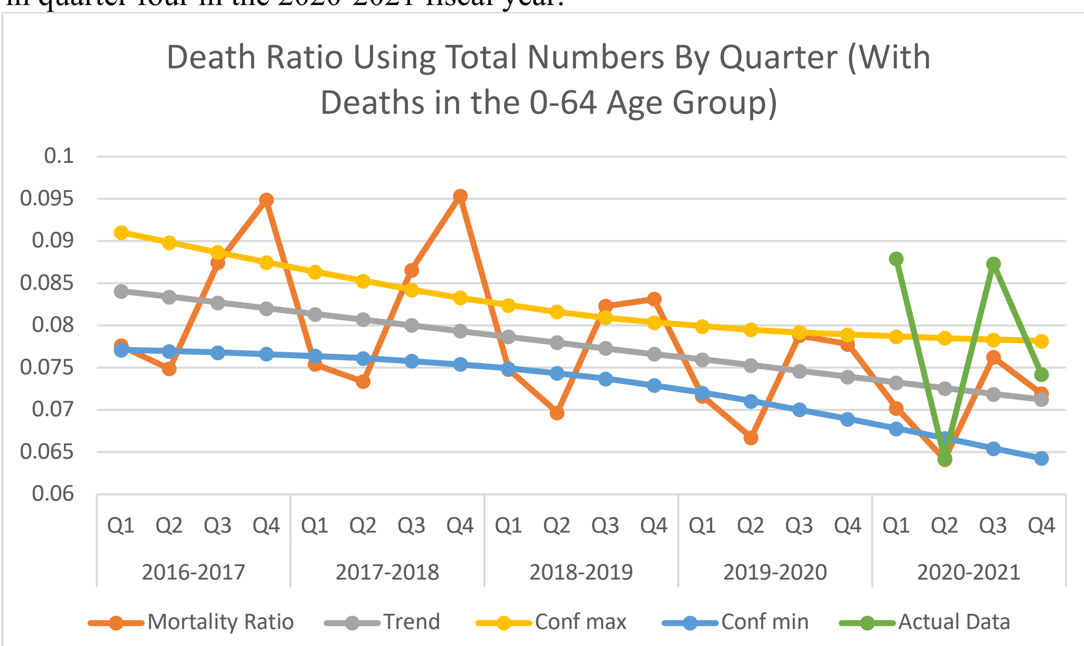

Figure 52: Death Ratio Using Total Numbers By Quarter (With Deaths in the 0-64 Age Group)

b) The death ratio for female residents increased in quarter one and quarter three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. This follows the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year. The increased death ratios for quarter one and three of 2020-2021 are not exceptional compared to the death ratios of previous years (quarter four of 2016-2017 and 2017-2018 were higher).

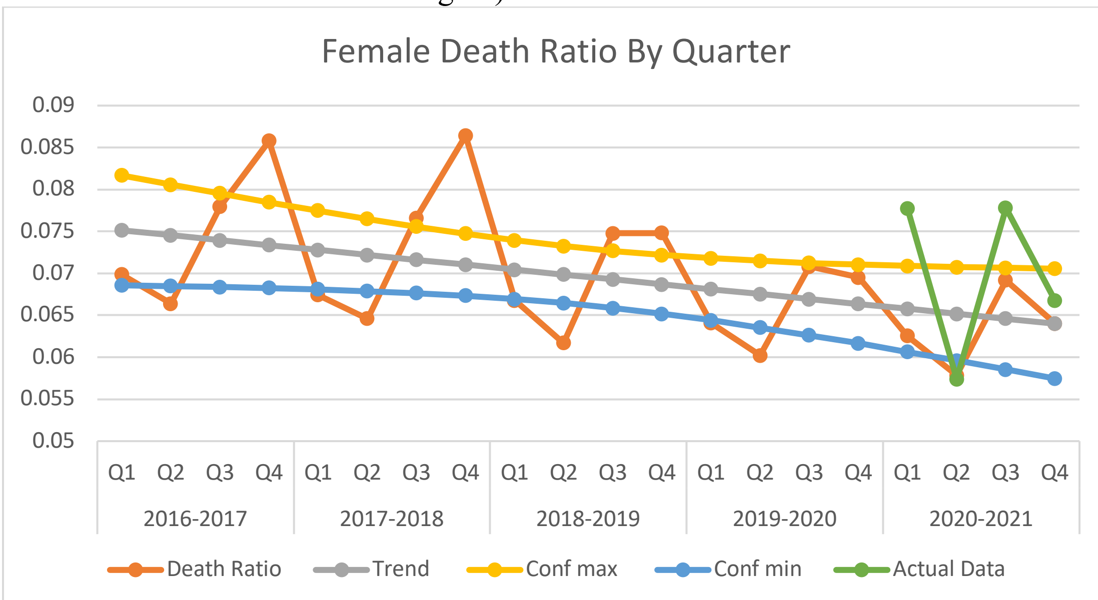

Figure 53: Female Death Ratio by Quarter.

c) The death ratio for male residents increased in quarter one and quarter three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. This follows the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year. The death ratios are larger for males than females in quarter one and three. As such, it can be said there were a greater number of male deaths relative to the number of male residents than female deaths relative to the number of female residents.

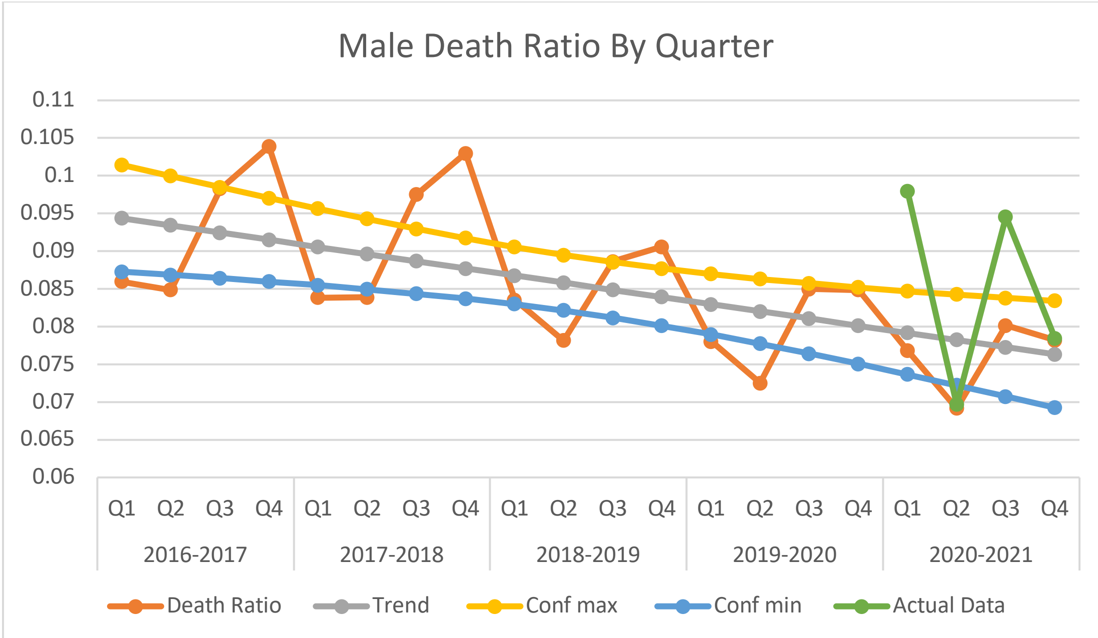

Figure 54: Male Death Ratio by Quarter.

d) The death ratio increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 in Ontario. This follows the trend with the death ratio for total numbers among quarters of the 2020-2021 fiscal year. The death ratio was highest for Ontario in the first quarter, among the regions examined. However, this death ratio was not exceptional compared to the death ratio of the fourth quarter of 2017-2018. Additionally, when examining deaths in quarter three, there was no change for Ontario while there is an increase when examining death ratios. Albeit, again, this change is not exceptional in comparison to previous years.

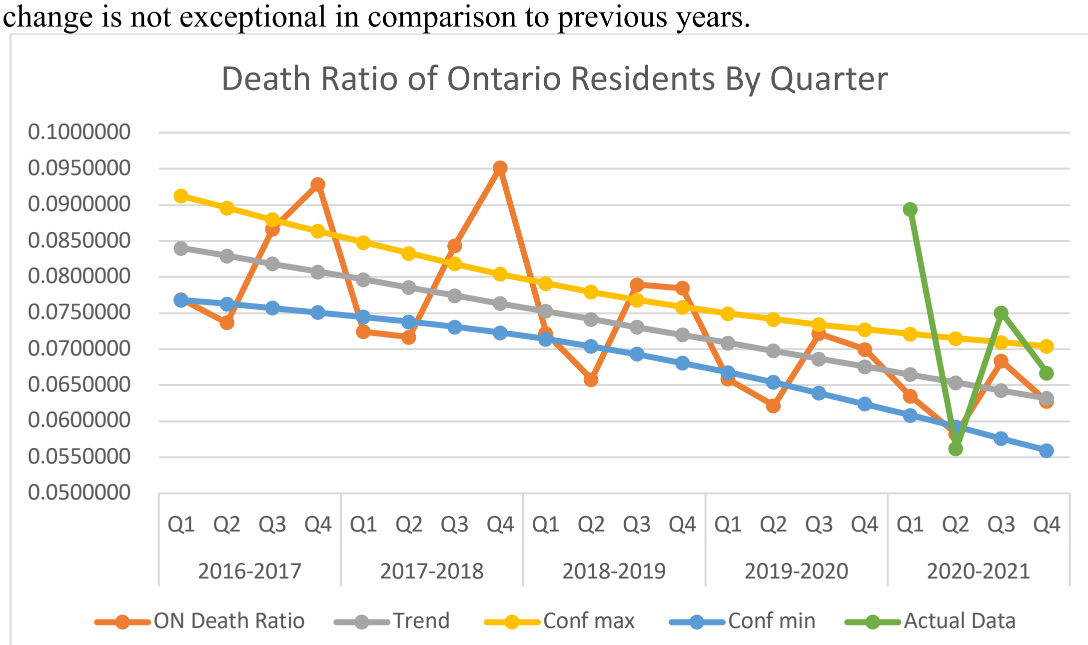

Figure 55: Death Ratio of Ontario Residents by Quarter.

e) The death ratio did not significantly change in quarter one, decreased in quarter two, and increased in quarter three and four in 2020-2021 in Alberta, however; this trend follows the patterns seen in the analysis on deaths for this province. This does not follow the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year. The increase in the death ratio for quarter three of 2020-2021 was exceptional in comparison to previous years and was also the second highest ratio among the regions examined. This ratio follows the same patterns as the analysis on deaths for Alberta by quarter.

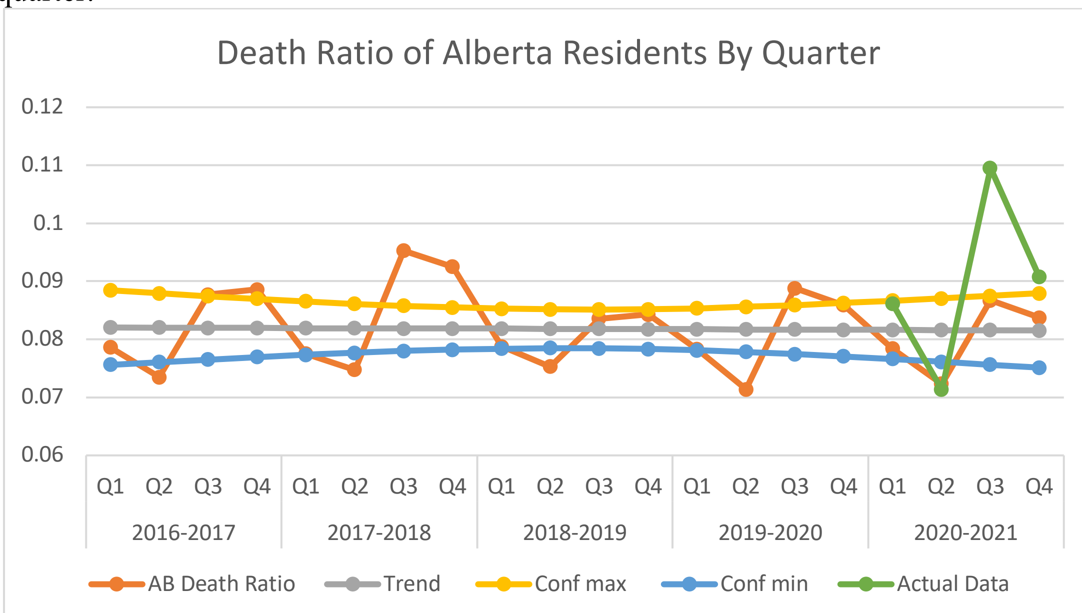

Figure 56: Death Ratio of Alberta Residents by Quarter.

f) The death ratio did not significantly change in quarter one, two, and four, and increased in quarter three in 2020-2021 in British Columbia. This does not follow the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year, however; this trend follows the patterns seen in the analysis on deaths in British Columbia by quarter. The increase in death ratio in quarter three of 2020-2021 is not exceptional compared to previous years (quarter four of 2016-2017).

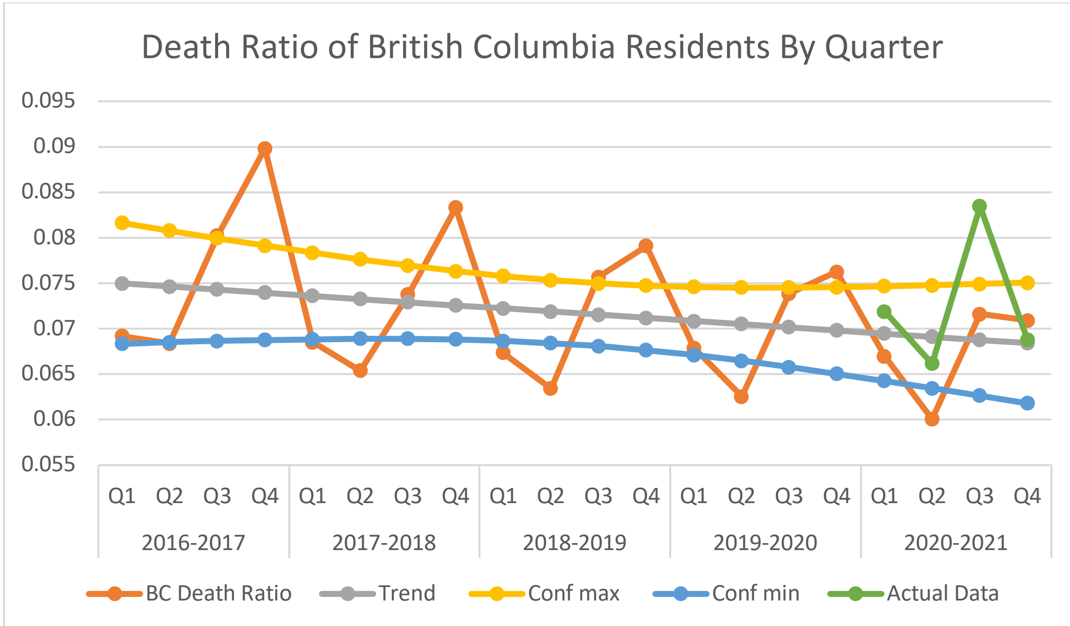

Figure 57: Death Ratio of British Columbia Residents by Quarter.

g) The death ratio decreased in quarter one, two, and four, and increased in quarter three in 2020-2021 in Manitoba. This does not follow the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year, however; this trend follows the patterns seen in the analysis on deaths for this province. The increase in death ratio in quarter three of 20202-2021 was exceptional in comparison to the death ratios from previous years and was the highest death ratio among examined regions in quarter three of 2020-2021.

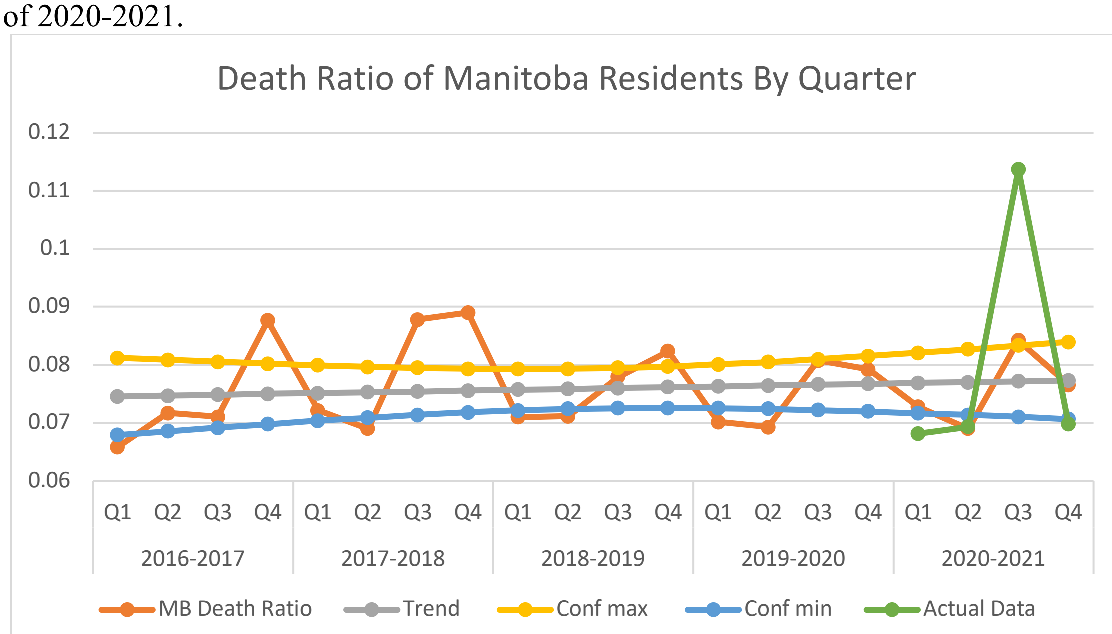

Figure 58: Death Ratio of Manitoba Residents by Quarter.

h) The death ratio did not significantly change in quarter one, three, and four, and decreased in quarter two in 2020-2021 in Newfoundland and Labrador. This does not follow the trend seen with the death ratio for total numbers among quarters of the 2020-2021 fiscal year, however; this trend follows the patterns seen in the analysis on deaths for this province. COVID-19 does not seem to have had a large impact in regard to the death ratio on LTC in this province.

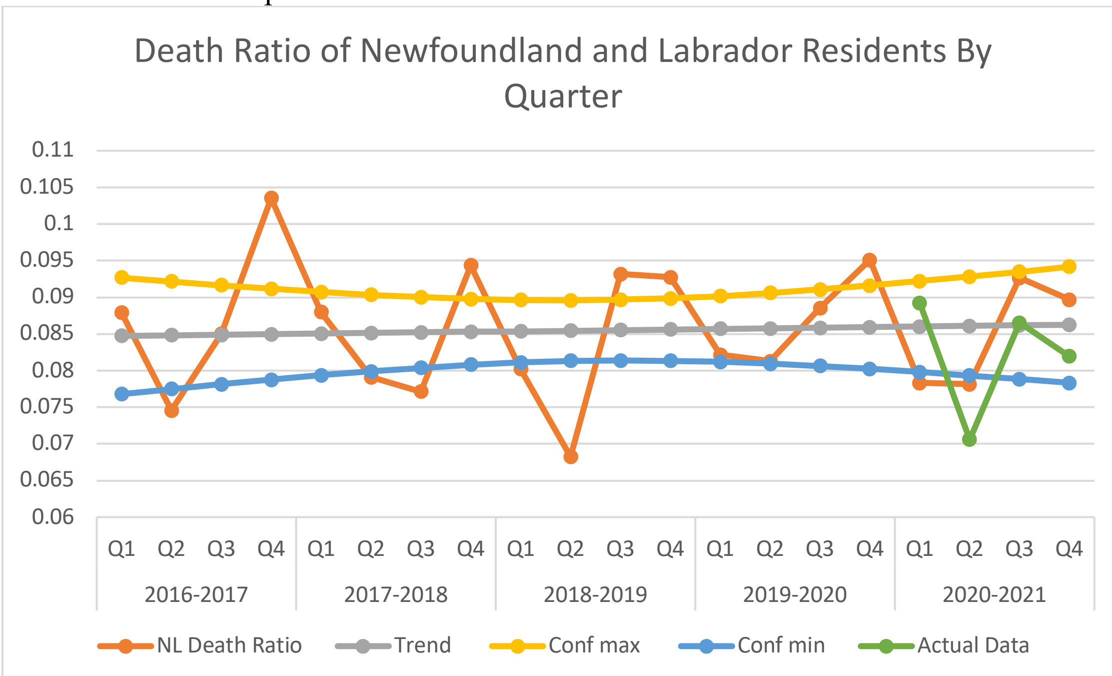

Figure 59: Death Ratio of Newfoundland and Labrador Residents by Quarter.

i) The death ratio increased in quarter one and quarter three and did not significantly change in quarter two and quarter four in 2020-2021 among those age 64-75. This does not follow the trend for the death ratio using total numbers (quarter two should have decreased). Except for quarter two (which decreased when looking at deaths), the death ratio trends followed the death trends for this age group. The death ratio in quarter four in 2016-2017 was still higher than the ratio in quarter one of 2020-2021. Additionally, the death ratio in 2020-2021 goes against the downward trend in the death ratio over time. The peaks in quarter one and three were exceptional only when looking at deaths for this age group.

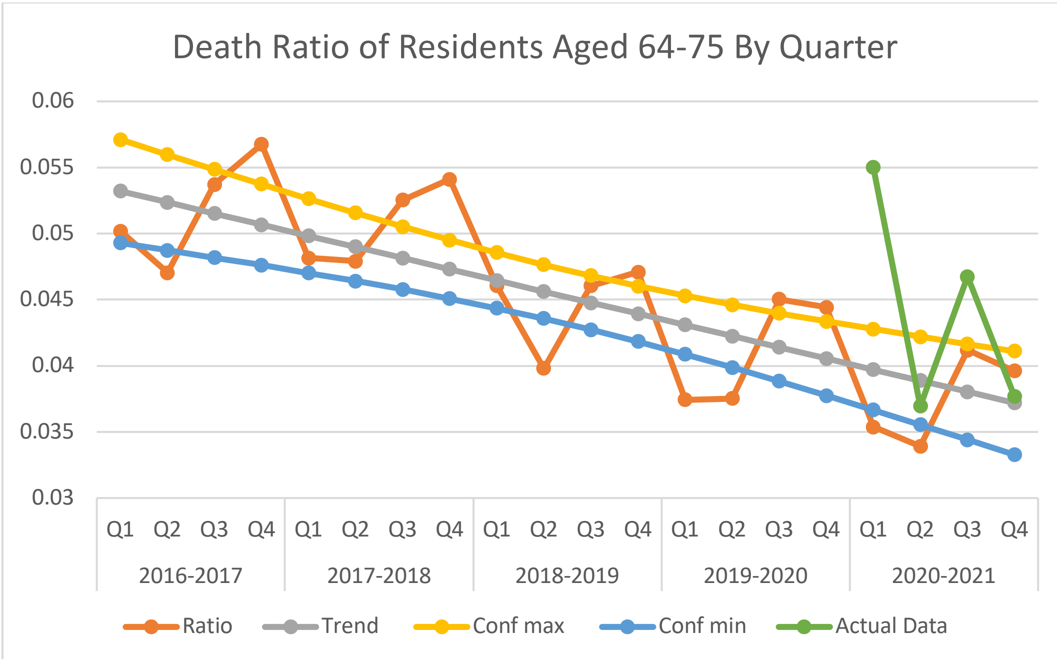

Figure 60: Death Ratio of Residents Aged 65-74 by Quarter.

j) The death ratio increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those aged 75-84. This follows the trend for the death ratio calculated using total numbers in 2020-2021 and the pattern for deaths of residents in this age group in terms of relative changes above or below the predicted intervals. The increases in quarter one and three were not exceptional in comparison to the peaks in previous years while the increases were exceptional using death data only. As such, when using active residents as a denominator in the analysis, results no longer are significant when compared to previous years.

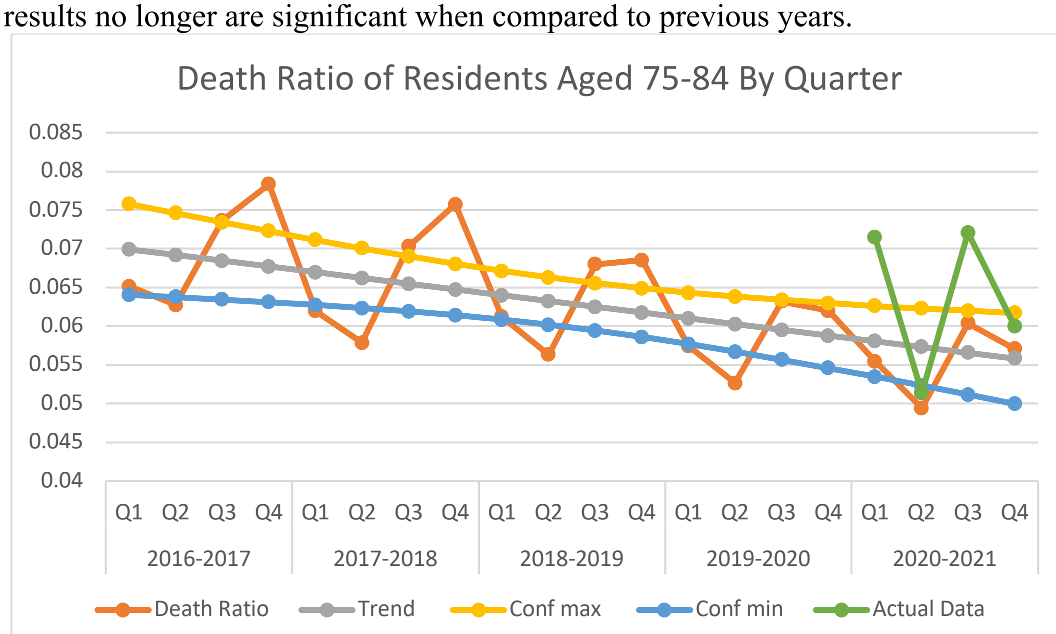

Figure 61: Death Ratio of Residents Aged 75-84 by Quarter.

k) The death ratio increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those aged 85-94. This follows the trend for the death ratio calculated using total numbers in 2020-2021 and the pattern for deaths of residents in this age group.

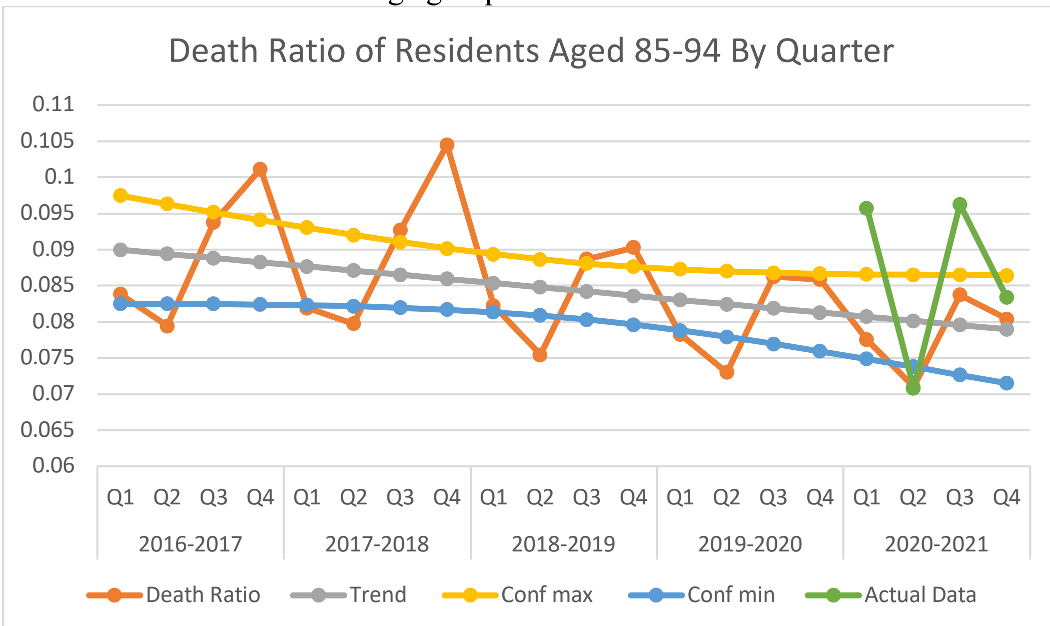

Figure 62: Death Ratio of Residents Aged 85-94 by Quarter.

l) The death ratio increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four in 2020-2021 among those aged 95+. This follows the trend for the death ratio calculated using total numbers in 2020-2021 and the pattern for deaths of residents in this age group. Changes are not exceptional in comparison to data from previous years, however.

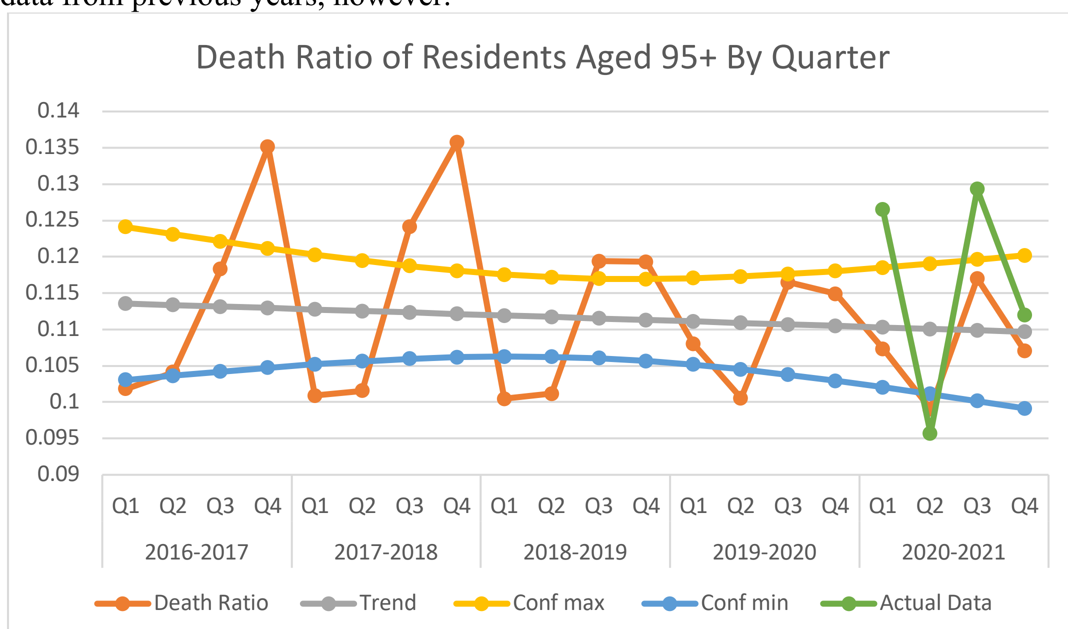

Figure 63: Death Ratio of Residents Aged 95+ by Quarter.

The death ratio for each health region/authority/LHIN (for which data was acquired) was then determined by quarter. Health regions/authorities/LHINs are only examined via the death ratio in order to maintain the scope and depth of the thesis.

m) The death ratio for residents in LTC homes in Calgary Zone in Alberta increased in quarter one and three, decreased in quarter two and did not significantly change in quarter four of the 2020-2021 fiscal year. However, these increases are not necessarily exceptional when compared to the peak in quarter two of 2017-2018. Additionally, it is interesting to see that the decreases in the ratio in quarter two and four in 2020-2021 mirrors the small changes in the same time periods for the case rates in the general population.

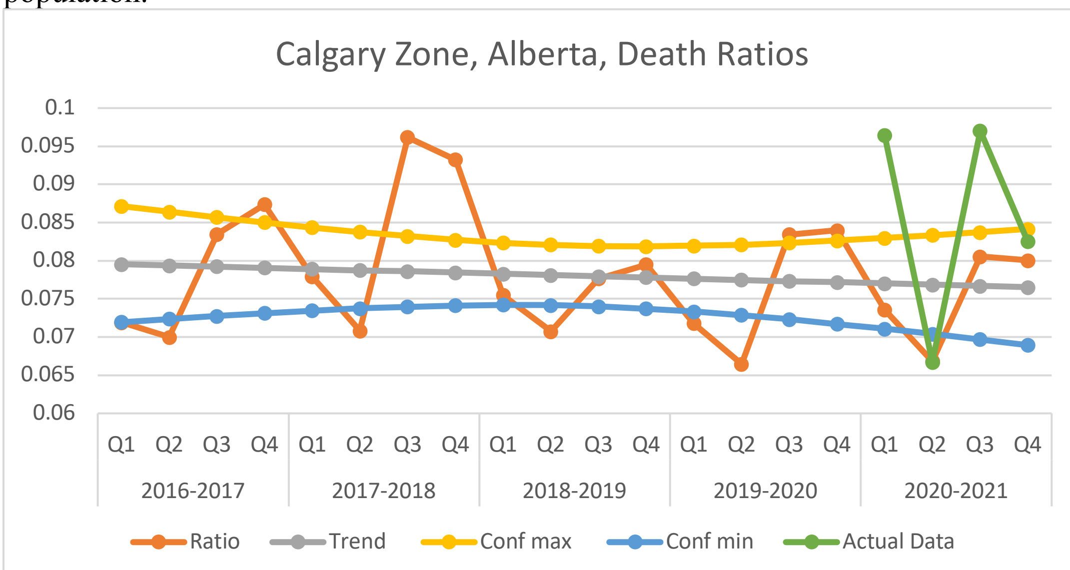

Figure 64: Calgary Zone, Alberta, Death Ratios by Quarter.

n) The death ratio for residents in homes in Central Zone in Alberta did not significantly change in quarter one and four and decreased in quarter two and three of the 2020-2021 fiscal year. Notably, death ratios for previous years are higher than death ratios in 2020-2021.

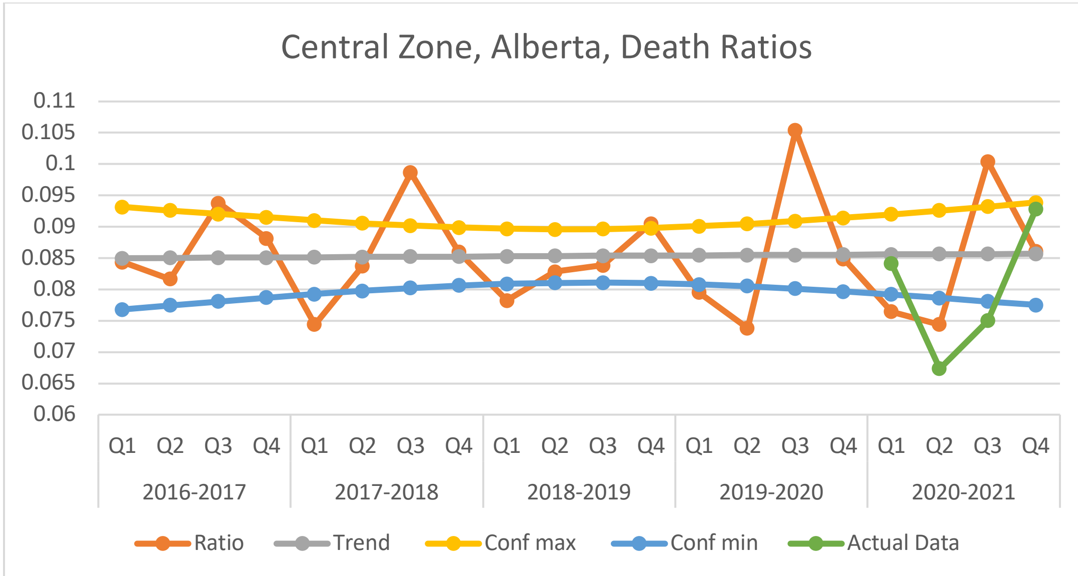

Figure 65: Central Zone, Alberta, Death Ratios by Quarter.

o) The death ratio for residents in LTC homes in Edmonton Zone in Alberta did not significantly change in quarter one, decreased in quarter two, and increased in quarter three and four of the 2020-2021 fiscal year. The increase in the death ratios in quarter three and four is exceptionally greater than the death ratios of previous years. Edmonton Zone and North Zone (below) more closely follows the trends seen for Alberta as a whole (i.e., exceptional increase in deaths in quarter three). Alternatively, it can be said these two regions skewed the pattern (exceptional increase in deaths in quarter three) for Alberta. Notably, Edmonton Zone has the highest death rate among health regions in Alberta by the end of December 2020 (i.e., the end of the third quarter) for the general population. Here there may be two possible reasons for this high rate: the deaths in LTC in this region contributed to this high number and/or the high case rates (that also occur in this period) in the community led to an increase in spread of COVID-19 cases and subsequently deaths in LTC.

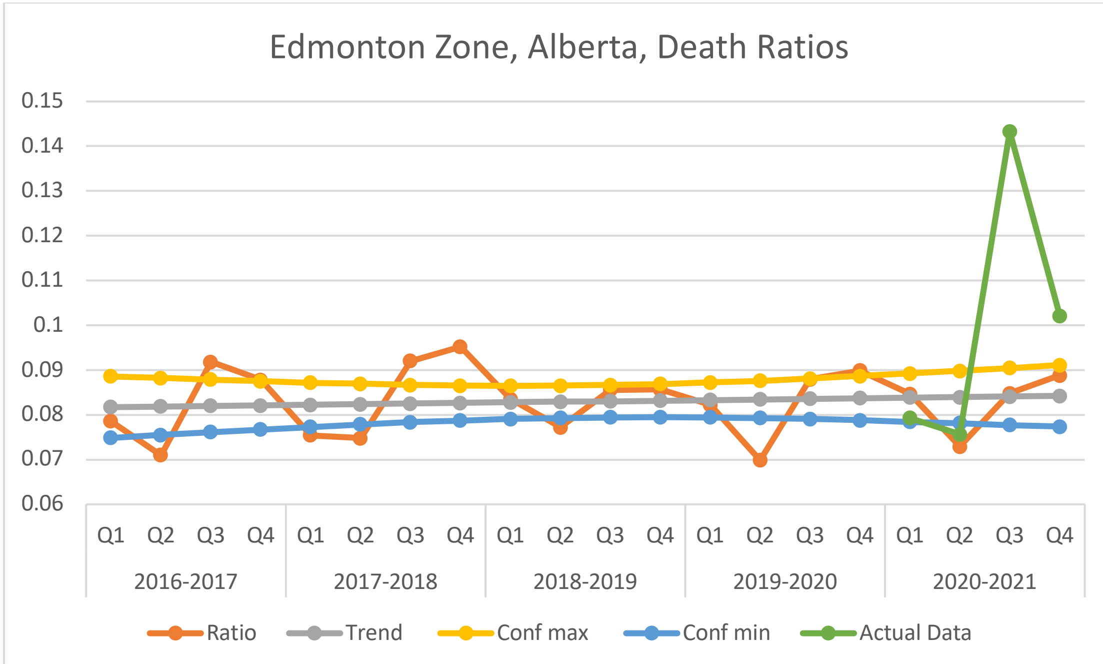

Figure 66: Edmonton Zone, Alberta, Death Ratios by Quarter.

p) The death ratio for residents in homes in North Zone in Alberta decreased in quarter one and two and increased in quarter three and four of the 2020-2021 fiscal year. There are not exceptional changes.

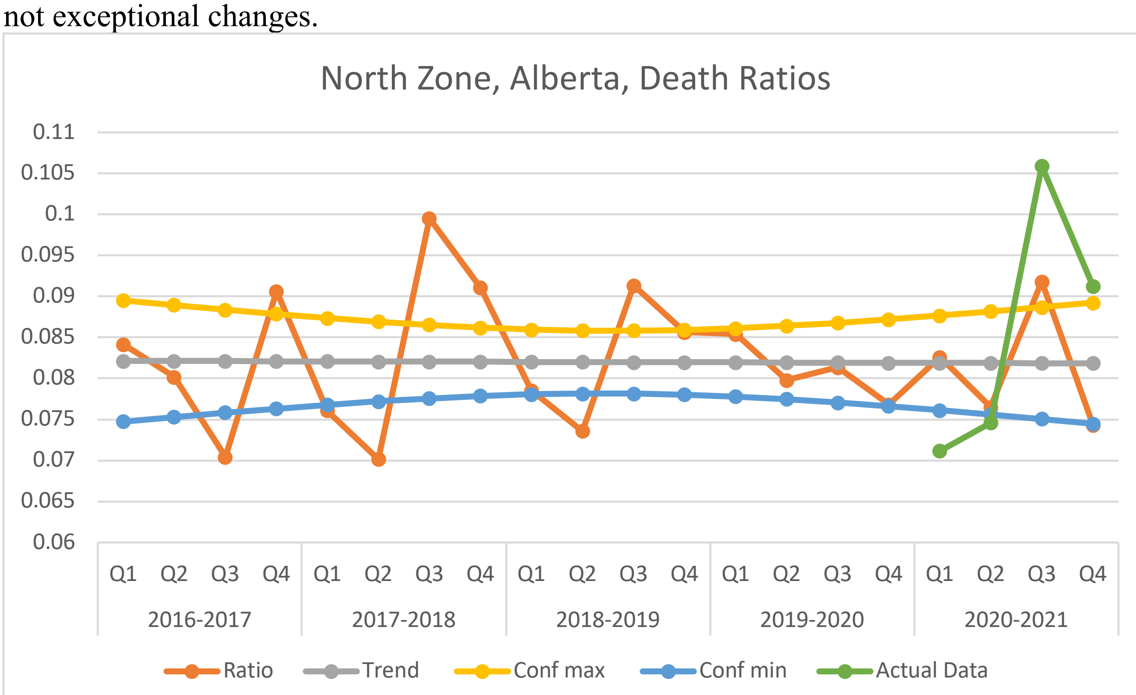

Figure 67: North Zone, Alberta, Death Ratios by Quarter.

q) The death ratio for residents in homes in South Zone in Alberta did not significantly change in quarter one and two, increased in quarter three, and decreased in quarter four of the 2020-2021 fiscal year. There are no exceptional changes.

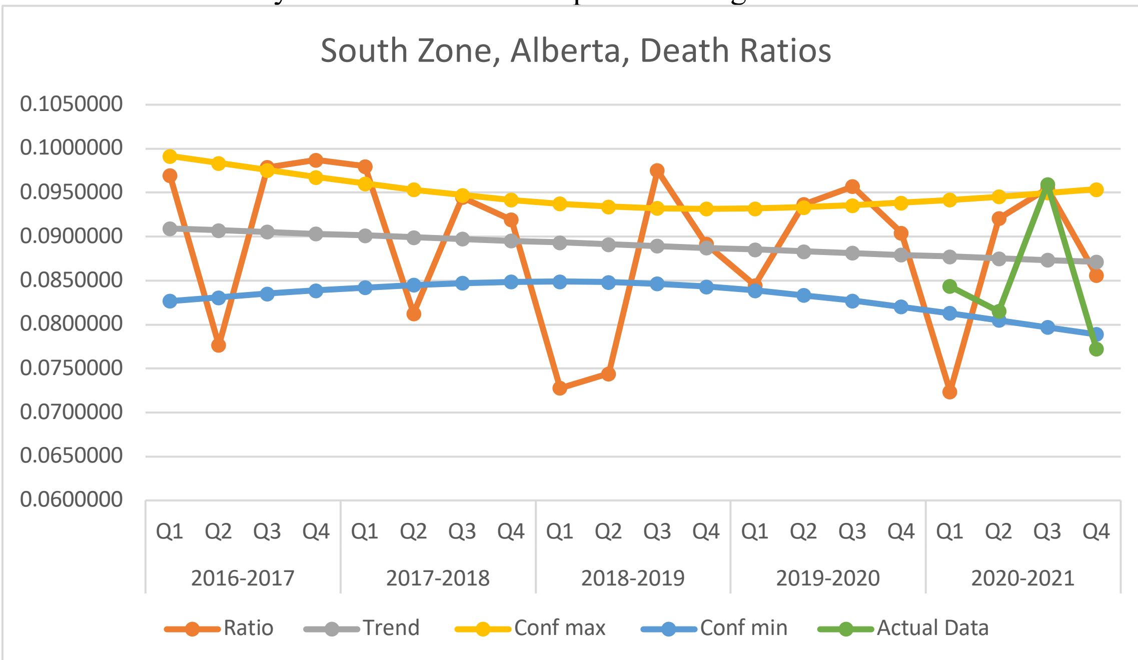

Figure 68: South Zone, Alberta, Death Ratios by Quarter.

r) The death ratio for residents in homes in Fraser Health in British Columbia did not significantly change in quarter one, two, and four and increased in quarter three of the 2020-2021 fiscal year. This trend reflects the trend for British Columbia as a whole. Similar to the discussion above for Calgary Zone, it is interesting to see that the change between quarter two and three (which is exceptional from changes in consecutive quarters in previous years) mirrors the largest increase in case rates in the general population (i.e., largest increase in case rates between these two time periods in this health region).

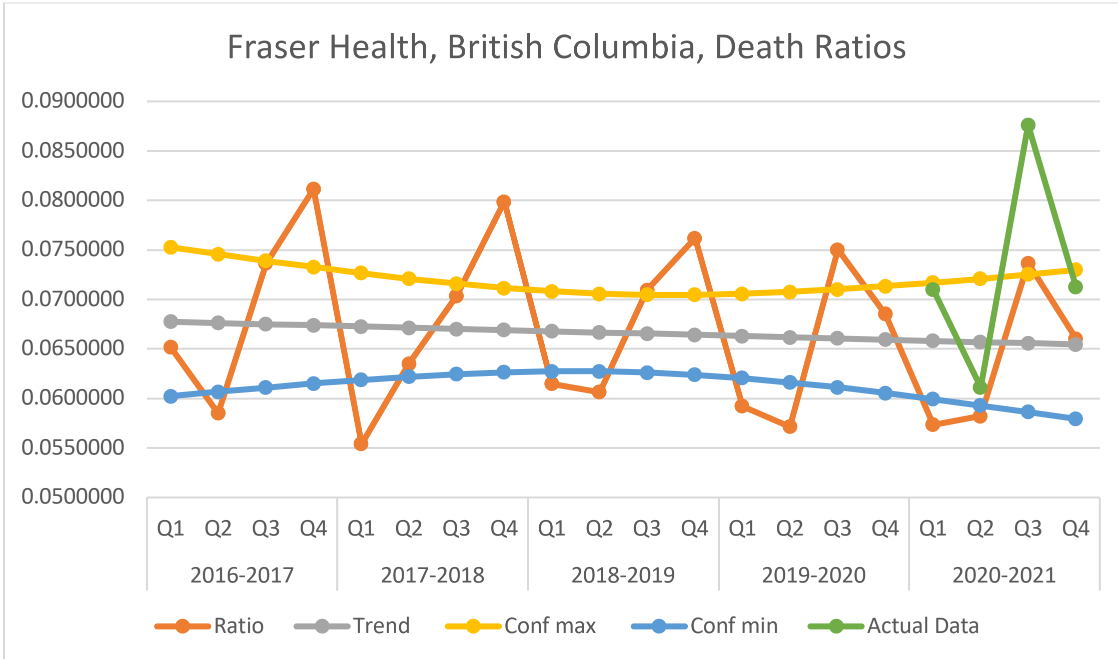

Figure 69: Fraser Health, British Columbia, Death Ratios by Quarter.

s) The death ratio for residents in homes in Interior Health in British Columbia did not significantly change in quarter one, two, and three and decreased in quarter four of the 2020-2021 fiscal year. Unlike the large increase in case rates for this health region among the entire population between quarter three and four, there is a decrease in the death ratio in this period among LTC homes. As such, it can perhaps be said that case rates in the community do not always mirror increased death ratios in LTC. There was also a substantial increase in the community deaths rates in this period for this region. Although there could have been an increase in cases in LTC in this health region, these cases may not have led to an increase in deaths and/or infection prevention measures could have been strong enough to prevent an increase of cases and subsequently deaths among LTCs in this health region. This is also the period in which COVID-19 vaccines were introduced and were readily administered in British Columbia to a large proportion of residents in LTC homes.

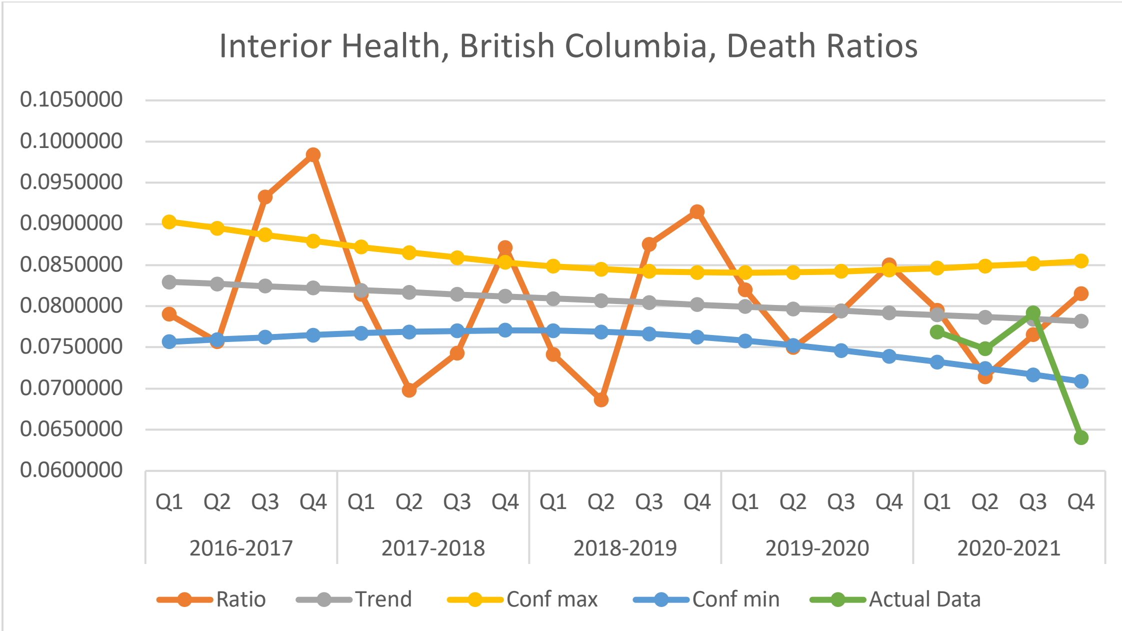

Figure 70: Interior Health, British Columbia, Death Ratios by Quarter.

t) The death ratio for residents in LTC homes in the Island Health Authority in British Columbia decreased in quarter one and did not change significantly in quarter two, three, and four of the 2020-2021 fiscal year. Case rates in this community remained lower than other health regions in this province and this is potentially reflected in the lack of exceptional changes across same time period in 2020-2021.

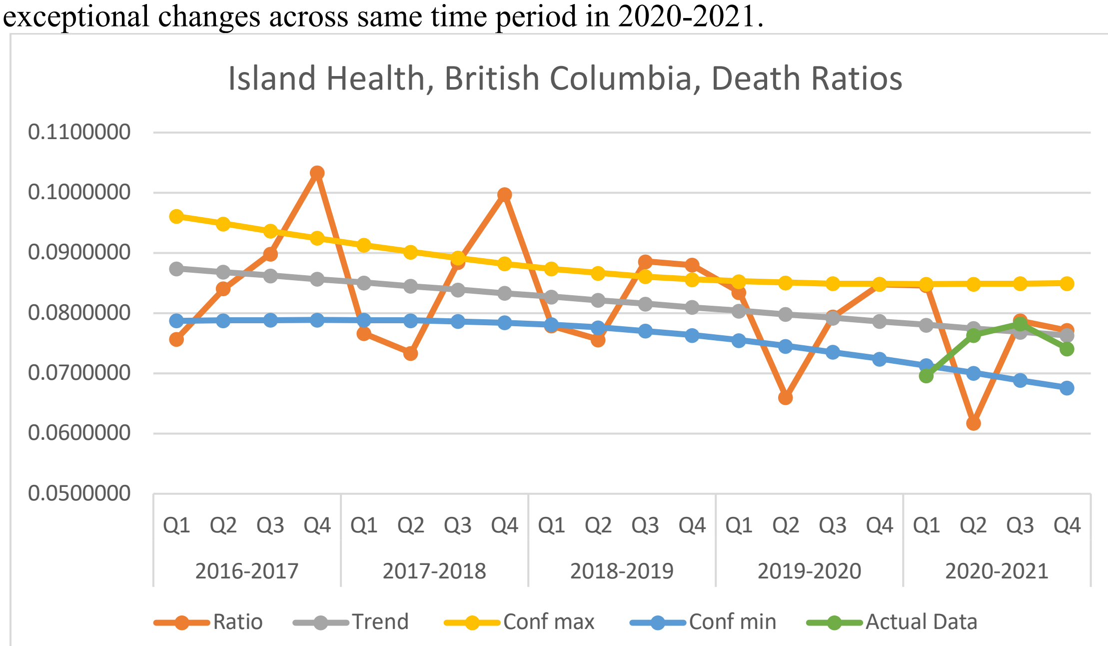

Figure 71: Island Health, British Columbia, Death Ratios by Quarter.

u) The death ratio for residents in homes in Northern Health in British Columbia increased in all quarters of the 2020-2021 fiscal year. Northern Health has the most exceptional changes in death ratios in 2020-2021 compared to previous years. The trends in 2020-

2021 are against the clear downward trend in the death ratio across time. Northern Health did not have the highest case rates in the general population in British Columbia in 2020-2021, which makes the results for LTC even more interesting. Notably, while the difference in the actual death ratio and the upper margin of the expected death ratio is highest in quarter one and two of 2020-2021 compared to previous years, the peaks in this period are actually lower than the peaks in quarter four of 2016-2017 and 2017-2018.

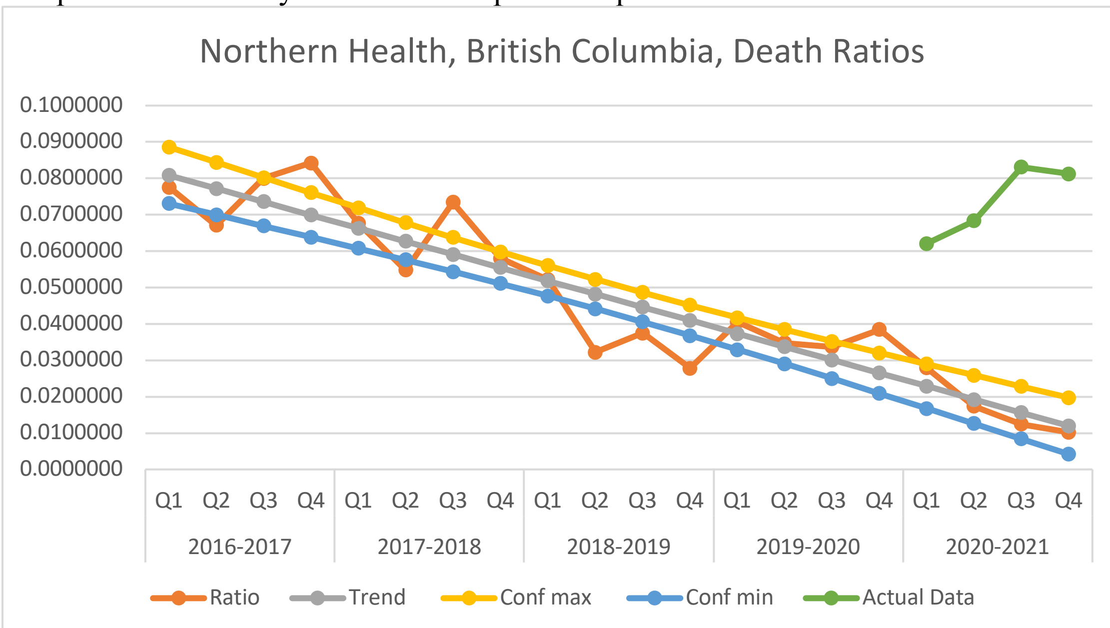

Figure 72: Northern Health, British Columbia, Death Ratios by Quarter.

v) The death ratio for residents in LTC homes in Vancouver Coastal Health in British Columbia increased in quarter three, decreased in quarter two, and did not significantly change in quarter one and four of the 2020-2021 fiscal year. This trend reflects the trend for British Columbia as a whole. Again, the increase in the death ratio between quarter two and three (which is exceptional in comparison to previous years, but not by much) is similar to the pattern of case rates in the general population wherein the largest increase in case rates between quarters in the community occurs in the same time period.

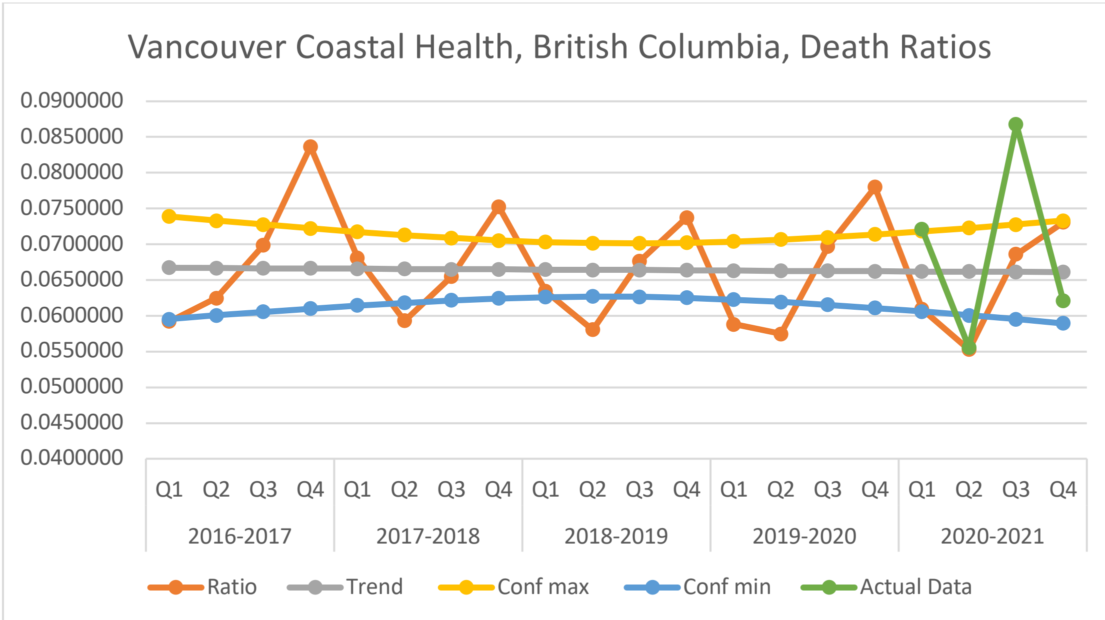

Figure 73: Vancouver Coastal Health, British Columbia, Death Ratios by Quarter.

w) The death ratio of residents in LTC homes in Winnipeg Regional Health in British Columbia did not significantly change in quarter one, decreased in quarter two and four, and increased in quarter three (exceptionally) of the 2020-2021 fiscal year. This trend is similar to the trend for Manitoba as a whole (excluding the lack of change in quarter one in this data versus a decrease at the same time for Manitoba as a whole, a change that is nonetheless not exceptional). Case and death rate data was not available for this region grouping for the general population.

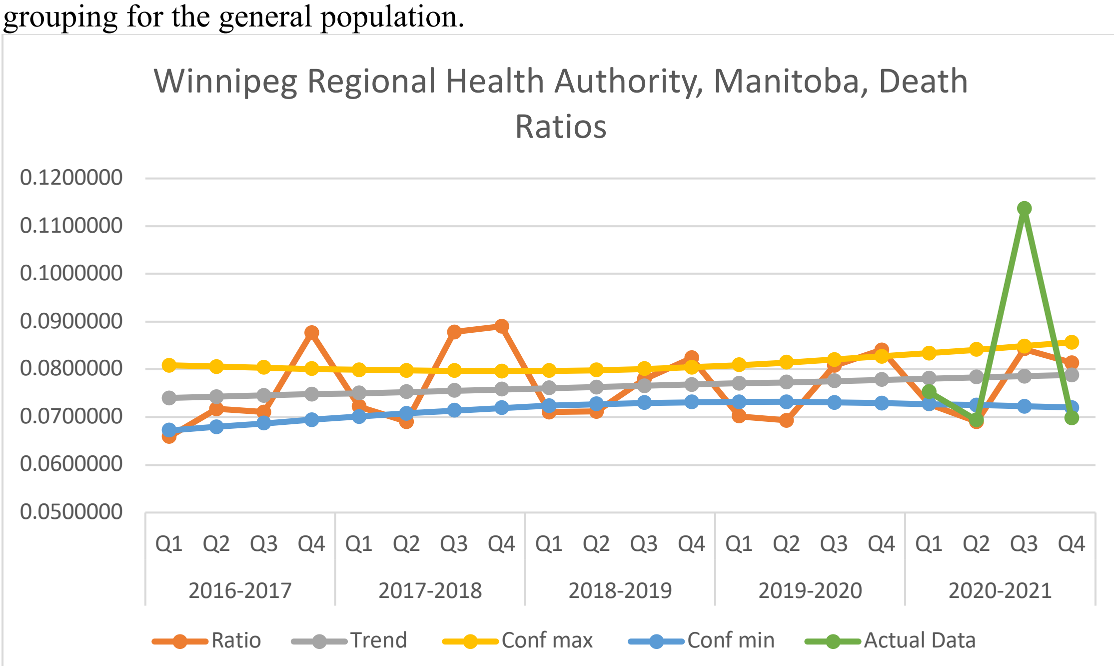

Figure 74: Winnipeg Regional Health Authority, Manitoba, Death Ratios by Quarter.

x) The death ratio of residents in homes in Central Health in Newfoundland and Labrador did not significantly change in quarter one and two and increased in quarter three and four of the 2020-2021 fiscal year. This trend does not follow the trend for Newfoundland and Labrador as a whole. However, the increase in quarter three is not exceptional compared to previous years. The increase in the death ratio between quarter two and three is similar to the pattern of increase in case rates in the general population in the same time period.

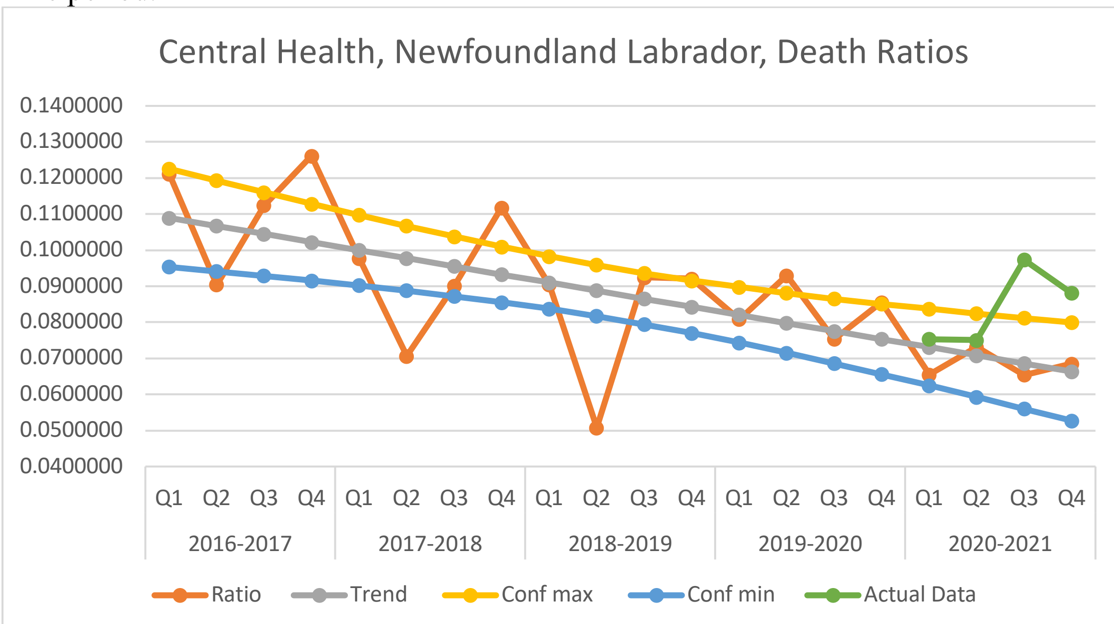

Figure 75: Central Health, Newfoundland Labrador, Death Ratios by Quarter.

y) The death ratio of residents in homes in Eastern Health in Newfoundland and Labrador did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. This follows the trend for Newfoundland and Labrador as a whole. The decrease in the death ratio in quarter two is exceptional.

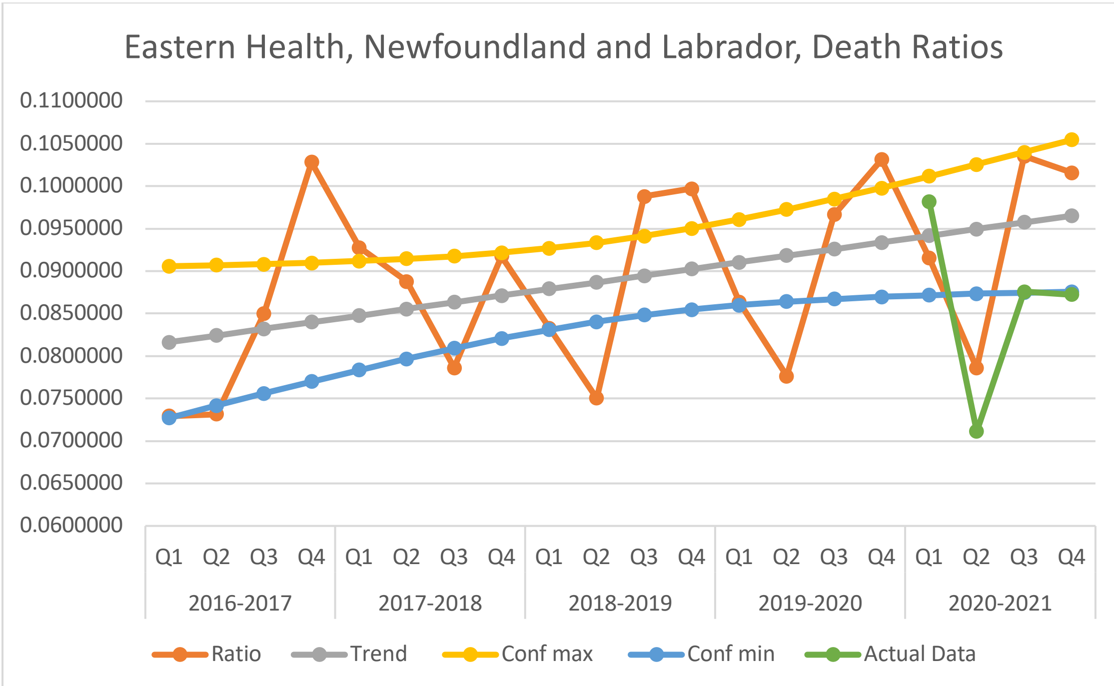

Figure 76: Eastern Health, Newfoundland and Labrador, Death Ratios by Quarter.

z) The death ratio of residents in homes in Labrador-Grenfell Health in Newfoundland and Labrador decreased in quarter one, two, and four and increased in quarter three of the 2020-2021 fiscal year. The actual death ratios in this region are very similar to trends in deaths ratios in previous years (especially 2017-2018) and 2020-2021 was not exceptional.

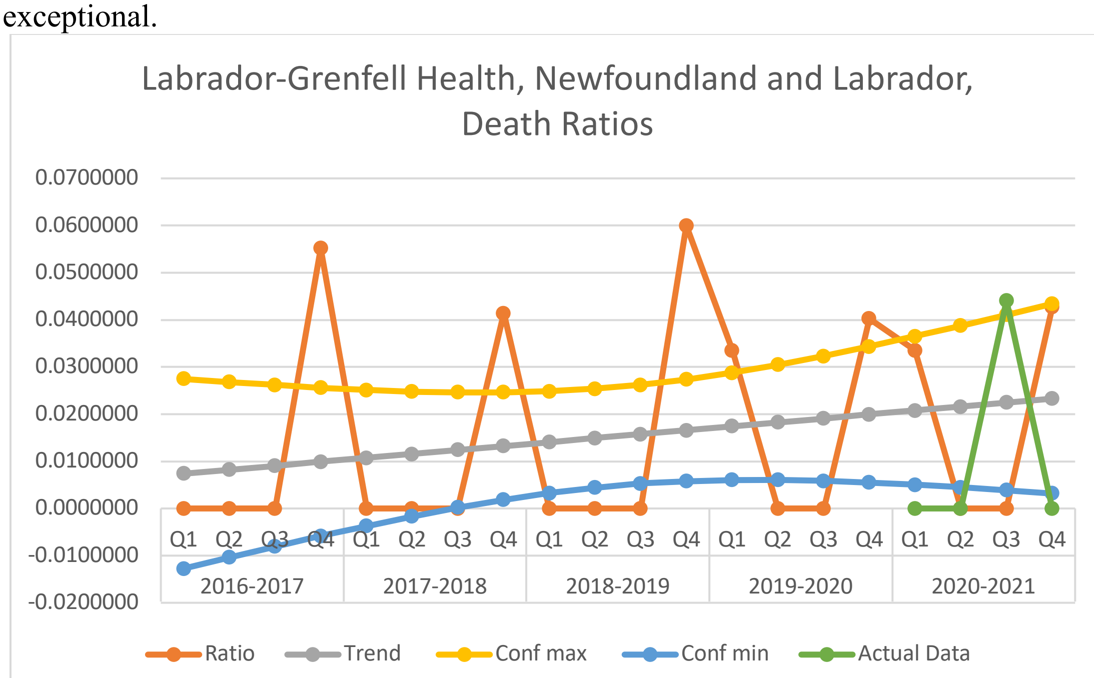

Figure 77: Labrador-Grenfell Health, Newfoundland and Labrador, Death Ratios by Quarter.

aa) The death ratio of residents in homes in Western Health in Newfoundland and Labrador did not significantly change in any quarter of the 2020-2021 fiscal year. COVID-19 does not have seemed to adversely affected LTC homes in this region.

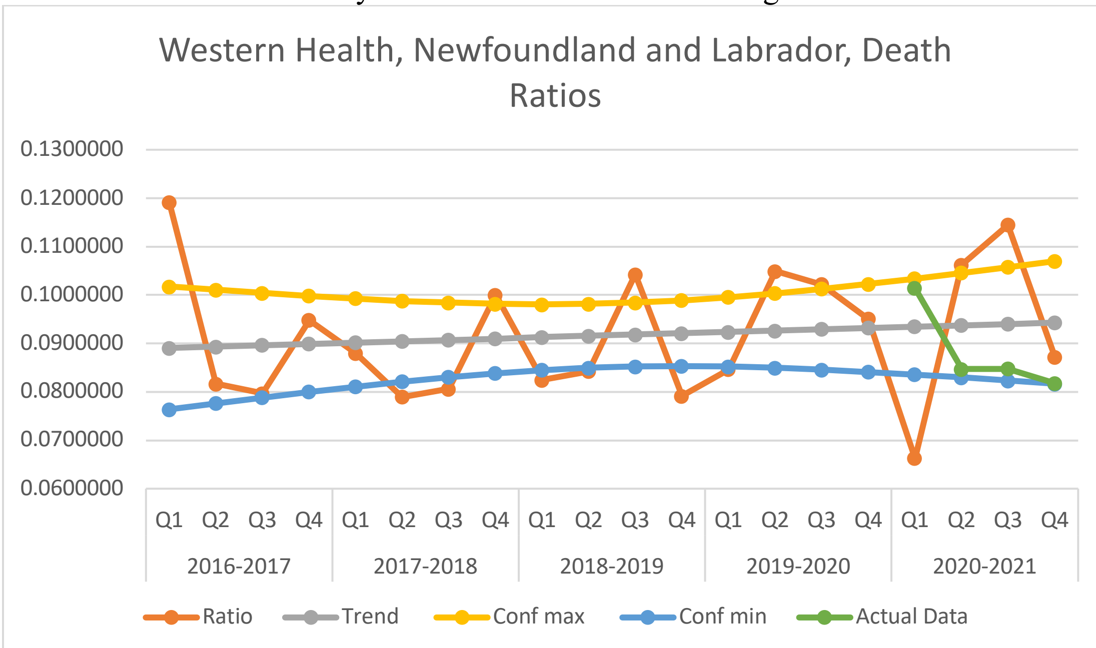

Figure 78: Western Health, Newfoundland and Labrador, Death Ratios by Quarter.

bb) The death ratio of residents in homes in Central East LHIN in Ontario increased in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. In comparison to the trends in Ontario, where increases in death ratios where not exceptional in 2020-2021, the increase in quarter one is exceptional in quarter one for this LHIN and COVID-19 seems to have had an impact on death in LTC during this period.

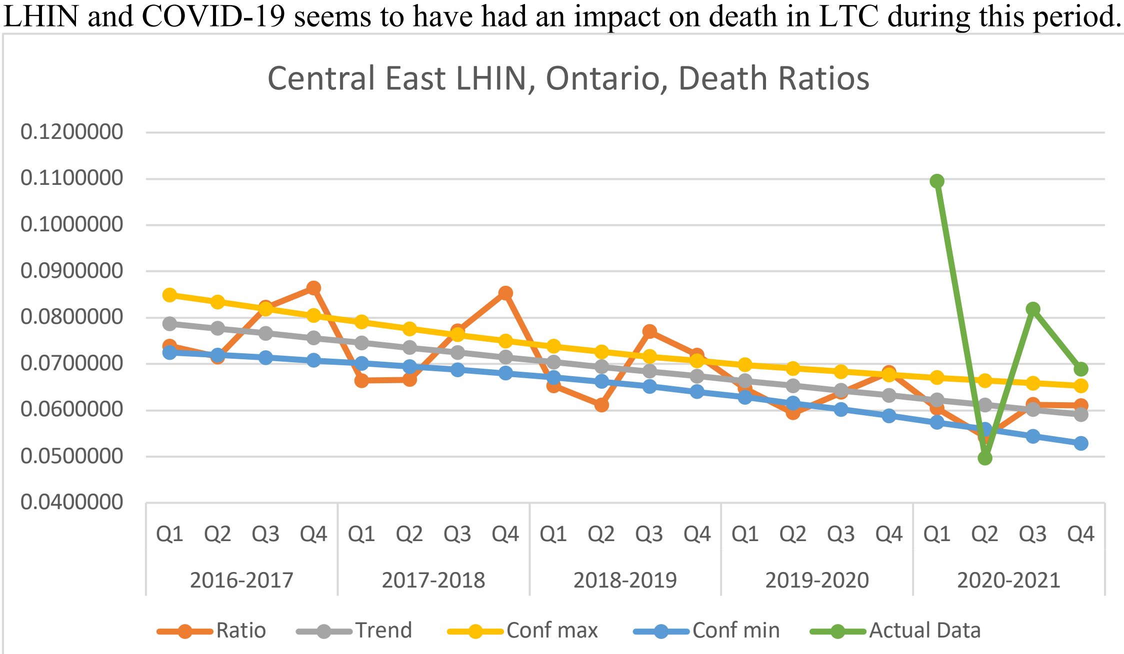

Figure 79: Central East LHIN, Ontario, Death Ratios by Quarter.

cc) The death ratio of residents in homes in Central LHIN in Ontario increased in quarter one, three, and four and did not significantly change in quarter two of the 2020-2021 fiscal year. Again, the death ratio in quarter one is exceptional compared to previous years.

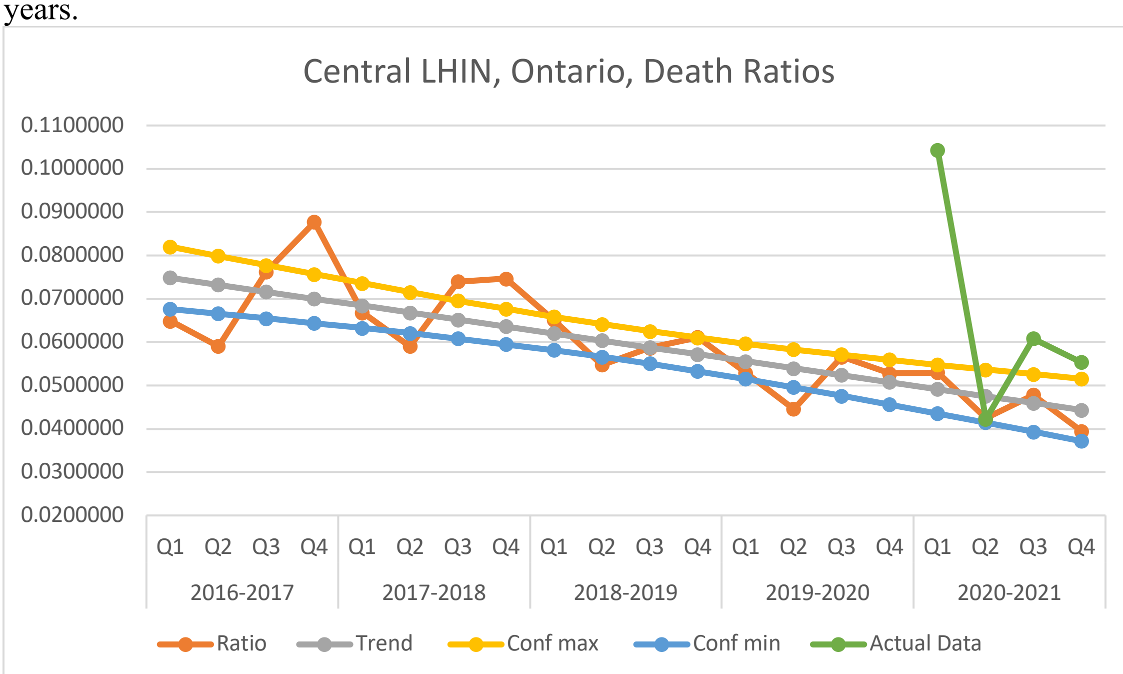

Figure 80: Central LHIN, Ontario, Death Ratios by Quarter.

dd) The death ratio of residents in homes in Central West LHIN in Ontario increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. The increase in the ratio in quarter one and three 2020-2021 is exceptional compared to previous years. The increase in the ratio between quarter two and three is also exceptional and follows the trend in the increase in case rates for the general population in this LHIN.

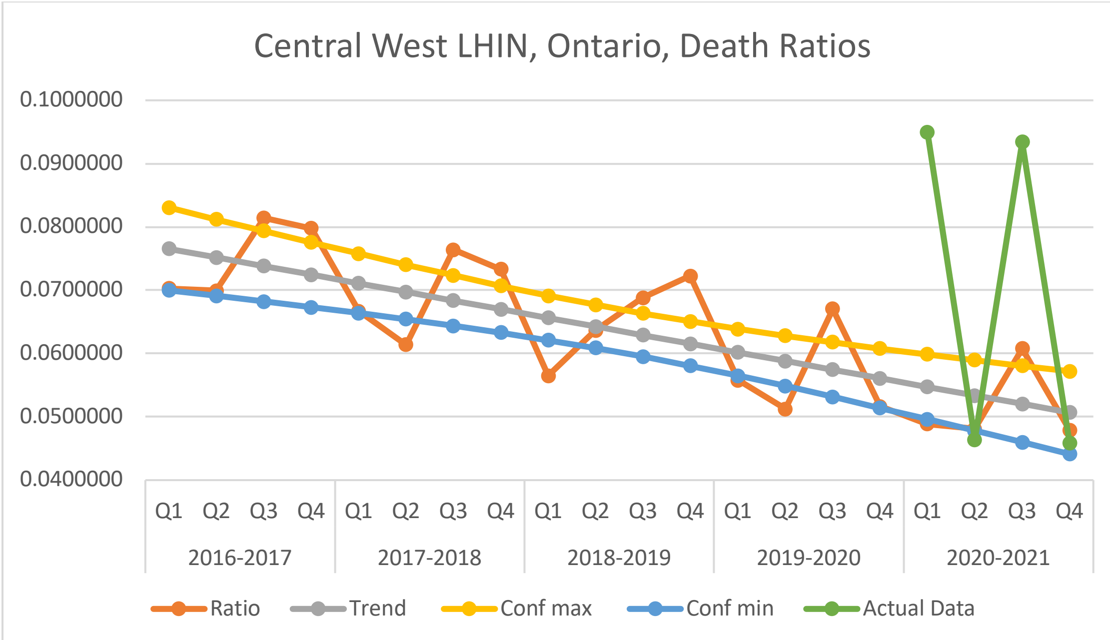

Figure 81: Central West LHIN, Ontario, Death Ratios by Quarter.

ee) The death ratio of residents in homes in Champlain Health in Ontario increased in quarter one, decreased in quarter two, and did not significantly change in quarter three and four of the 2020-2021 fiscal year. Although there is an increase in quarter one of 2020-2021, this increase is not notably exceptional (there is a similar increase in 2016-2017). It seems the deaths in quarter two to four are also not necessarily a result of the impact of COVID-19 on this health region as there is not a significant change in the death ratio in 2020-2021.

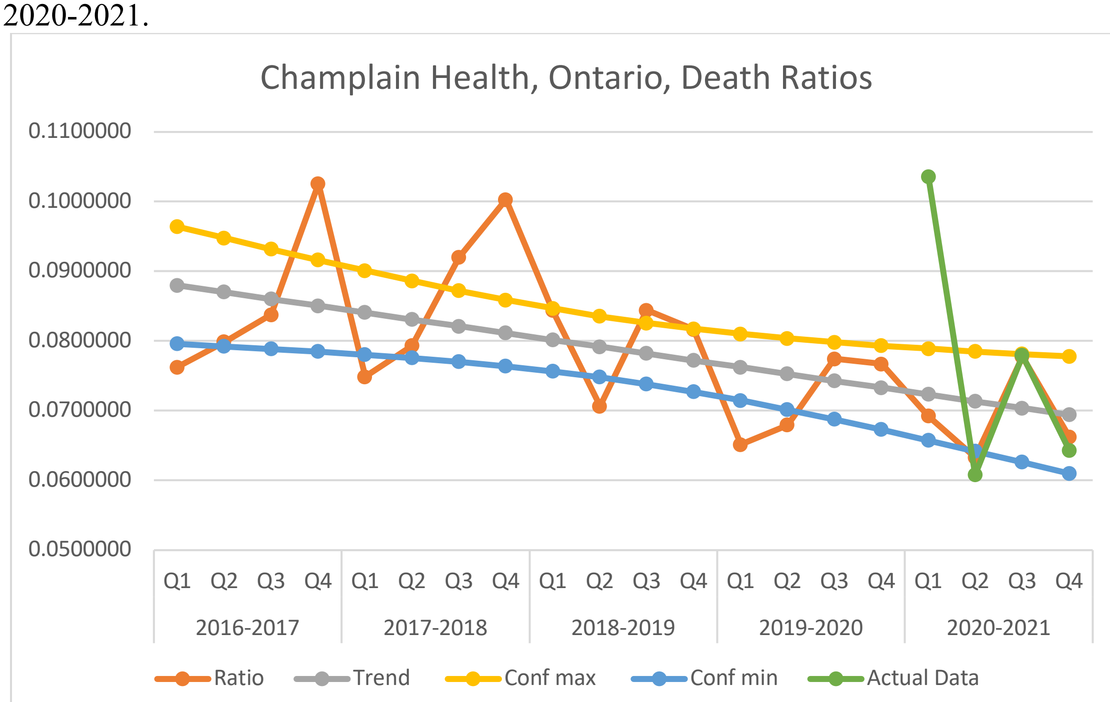

Figure 82: Champlain Health, Ontario, Death Ratios by Quarter.

ff) The death ratio for residents in homes in Erie St. Clair LHIN in Ontario did not significantly change in quarter one and four, decreased in quarter two, and increased in quarter three of the 2020-2021 fiscal year. The ratio in 2020-2021 is not exceptional across LTC homes in this LHIN, rather the trend is similar to that of the year prior.

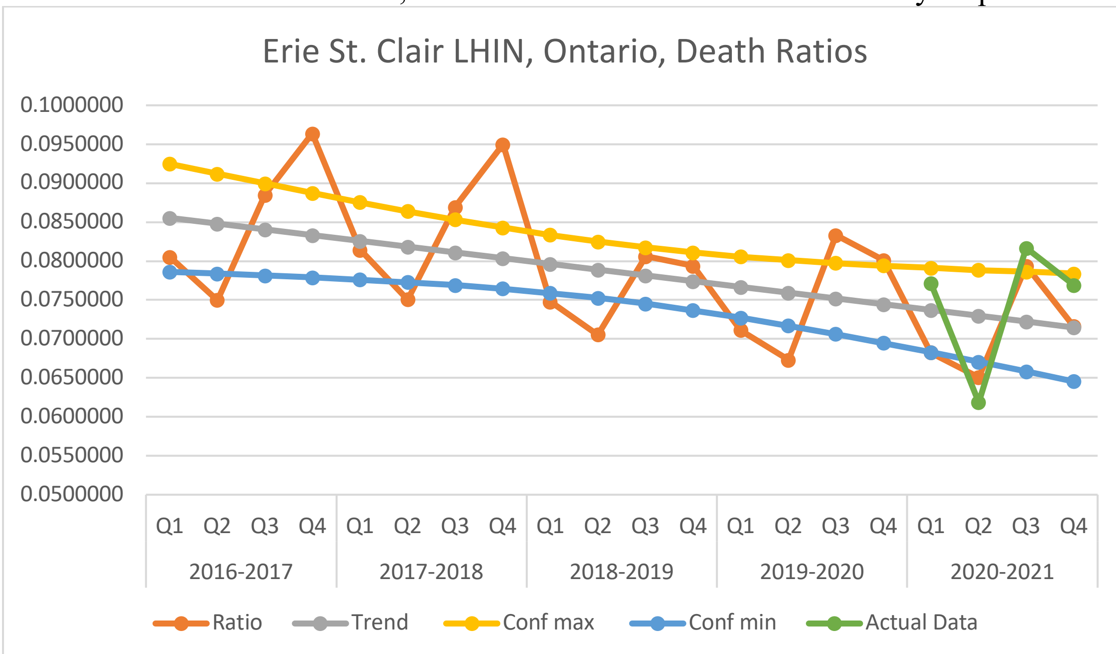

Figure 83: Erie St. Clair LHIN, Ontario, Death Ratios by Quarter.

gg) The death ratio of residents in the Hamilton Niagara Haldimand Brant LHIN in Ontario did not significantly change in quarter one and two and increased in quarter three and four of the 2020-2021 fiscal year. The death ratio in 2020-2021 is not exceptional in comparison to previous years. Although there was an increase in case rates for the general population in quarter three to four, the death ratios remain stagnant for LTCs in this health region for this time period. COVID-19 does not seem to have had an exceptional impact on death ratios in 2020-2021.

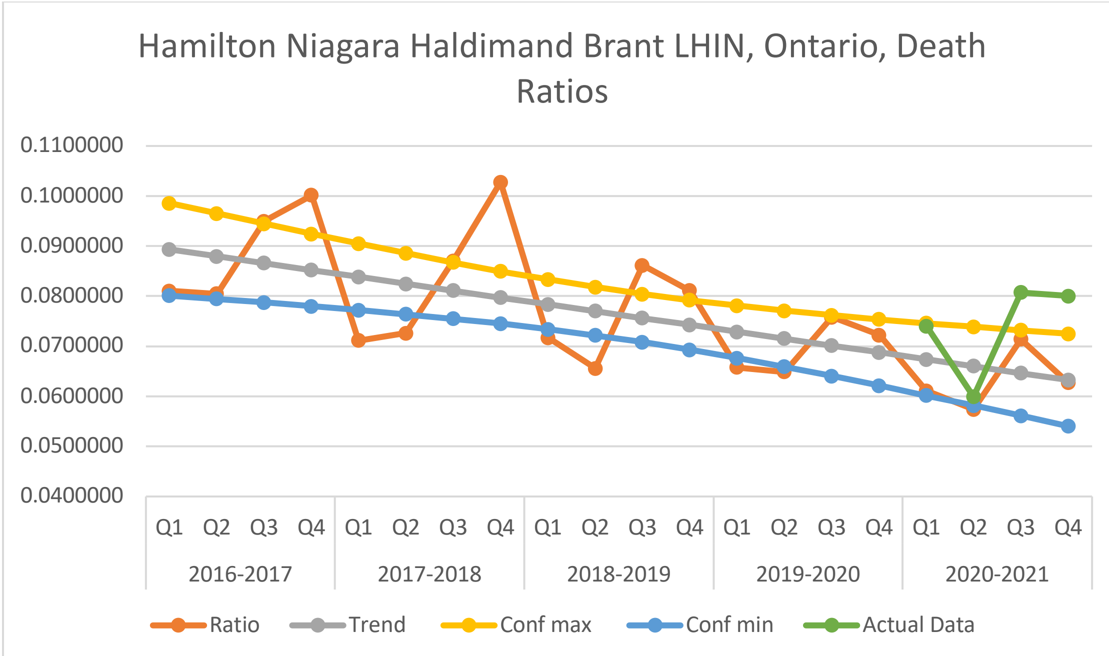

Figure 84: Hamilton Niagara Haldimand Brant LHIN, Ontario, Death Ratios by Quarter.

hh) The death ratio for residents in homes in Mississauga Halton LHIN in Ontario increased in quarter one and three and did not significantly change in quarter two and four of the 2020-2021 fiscal year. This health region had the highest peak in quarter one for death ratios wherein this peak was exceptional compared to previous years. Otherwise, the death ratios were not exceptional.

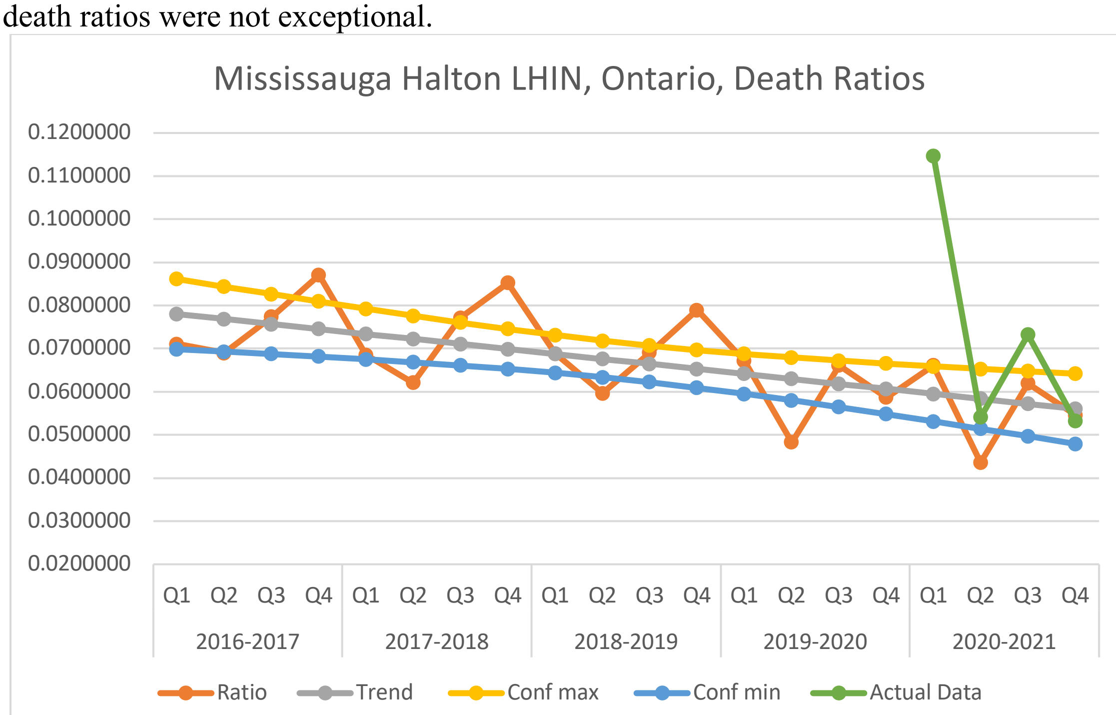

Figure 85: Mississauga Halton LHIN, Ontario, Death Ratios by Quarter.

ii) The death ratio for residents in the North East LHIN in Ontario did not significantly change in any of the quarters of the 2020-2021 fiscal year and in conjunction with the fact that COVID-19 case rates in the general population were lower than other LHINs, it does not seem the pandemic had a major impact on the death ratio for LTCs in this LHIN.

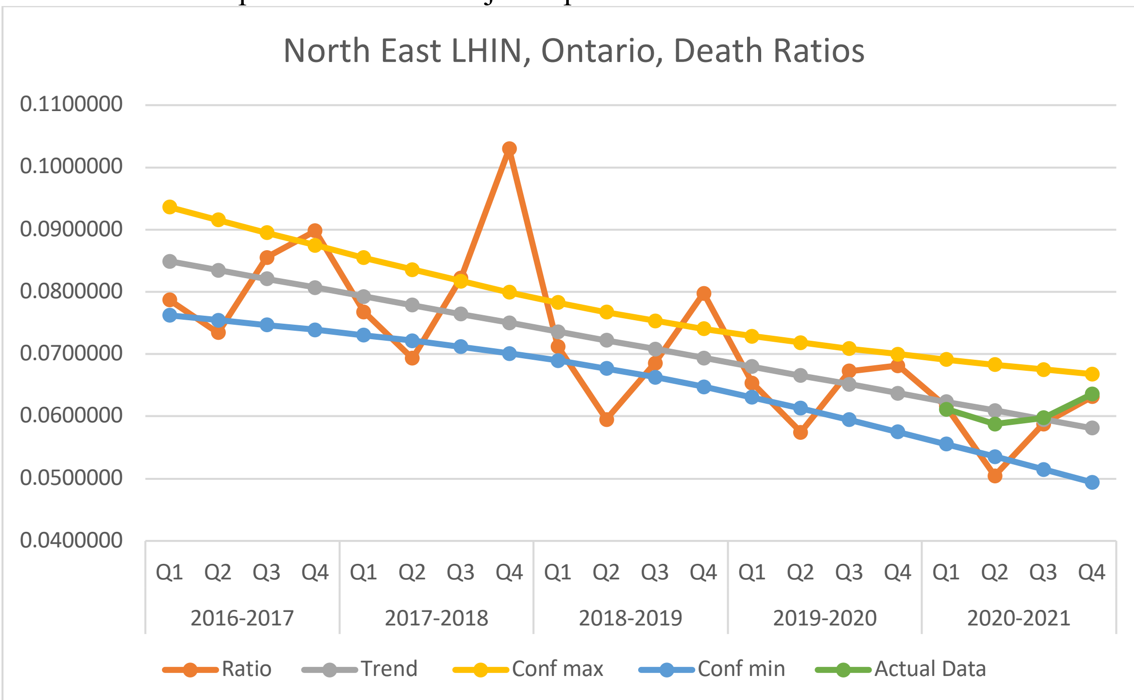

Figure 86: North East LHIN, Ontario, Death Ratios by Quarter.

jj) The death ratio of residents in the North Simcoe Muskoka LHIN in Ontario did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. COVID-19 does not seem to have had a large impact on this LHIN.

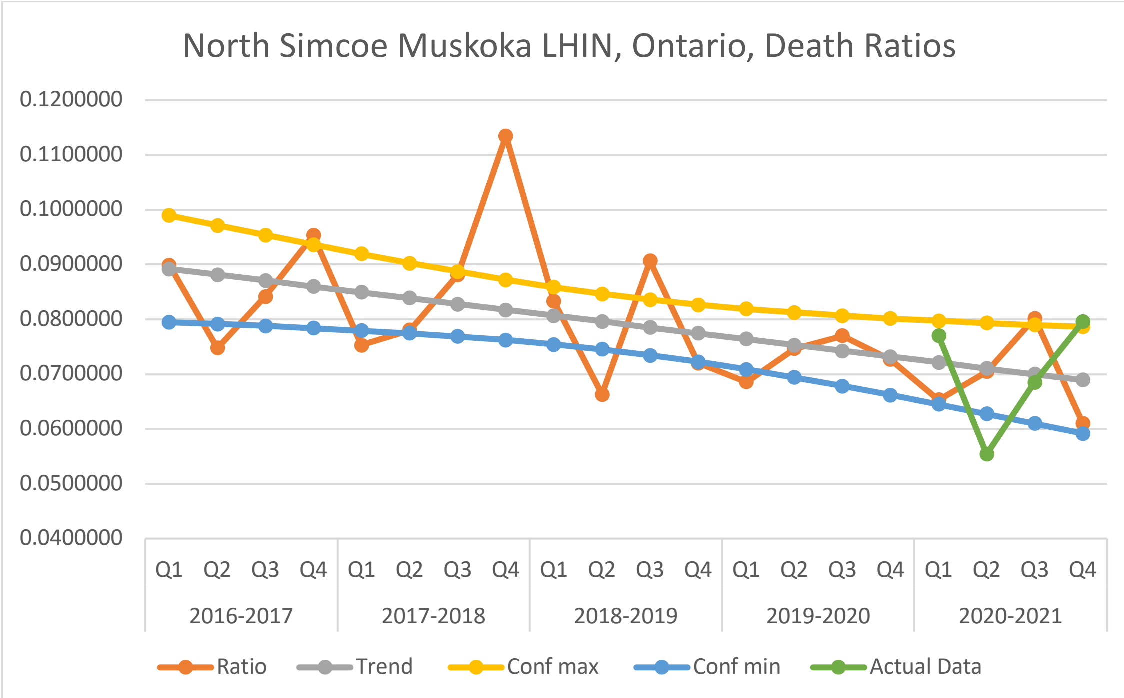

Figure 87: North Simcoe Muskoka LHIN, Ontario, Death Ratios

kk) The death ratio for residents in the North West LHIN in Ontario did not significantly change in quarter one, two, and three and decreased in quarter four of the 2020-2021 fiscal year. COVID-19 does not seem to have had a large impact on this LHIN.

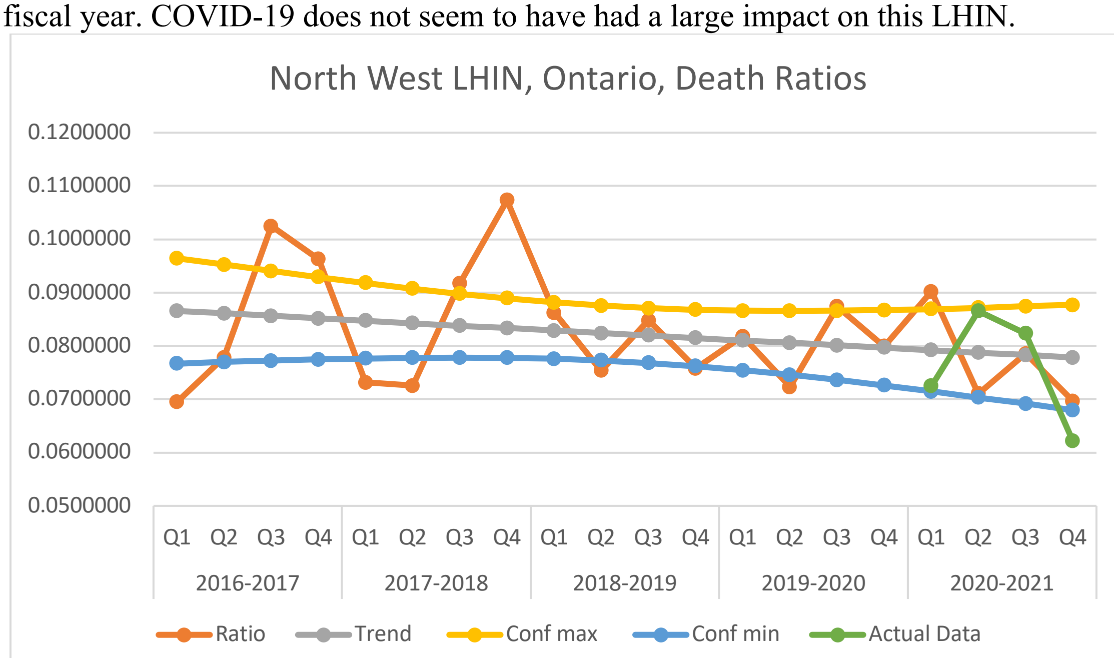

Figure 88: North West LHIN, Ontario, Death Ratios by Quarter.

ll) The death ratios for residents in the South East LHIN in Ontario did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. This decrease is not exceptional, however. This LHIN experienced the lowest case rates across regions in Ontario. Considering these two observations, COVID-19 does not seem to have had a large impact on this LHIN.

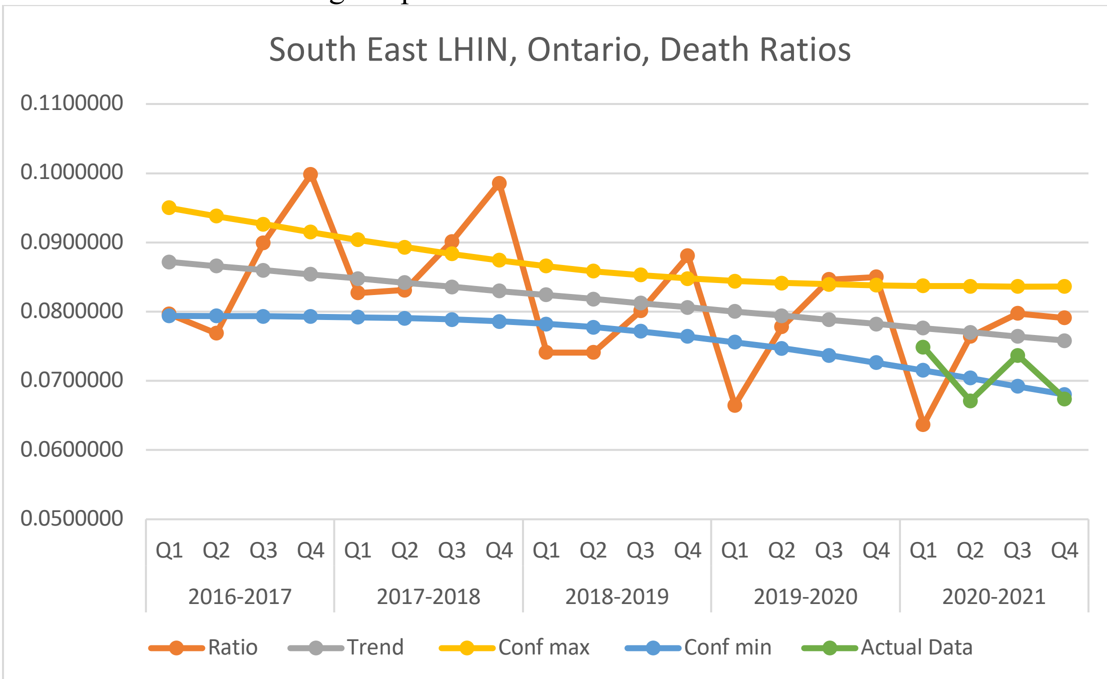

Figure 89: South East LHIN, Ontario, Death Ratios by Quarter.

mm) The death ratio for residents in homes in South West LHIN in Ontario did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. The decrease in quarter two is exceptional but COVID-19 does not seem to have had a large impact on this LHIN.

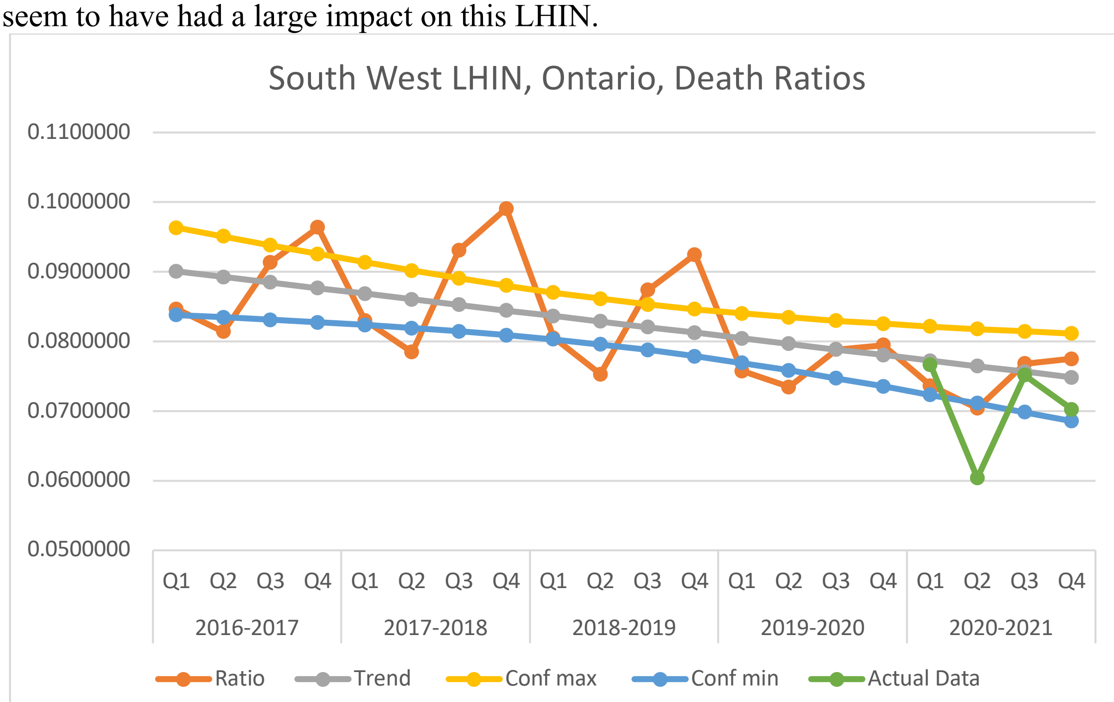

Figure 90: South West LHIN, Ontario, Death Ratio by Quarter.

nn) The death ratio for residents in the Toronto Central LHIN in Ontario increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. The increase in quarter one was exceptional compared to previous years. Along with Central West LHIN, Toronto experienced the highest case rates of COVID-19 in the general population but the lack of exceptional change in the death ratio in quarter two to four prevents one from making the assumption that case rates greatly affected LTC death rates for this LHIN in these quarters.

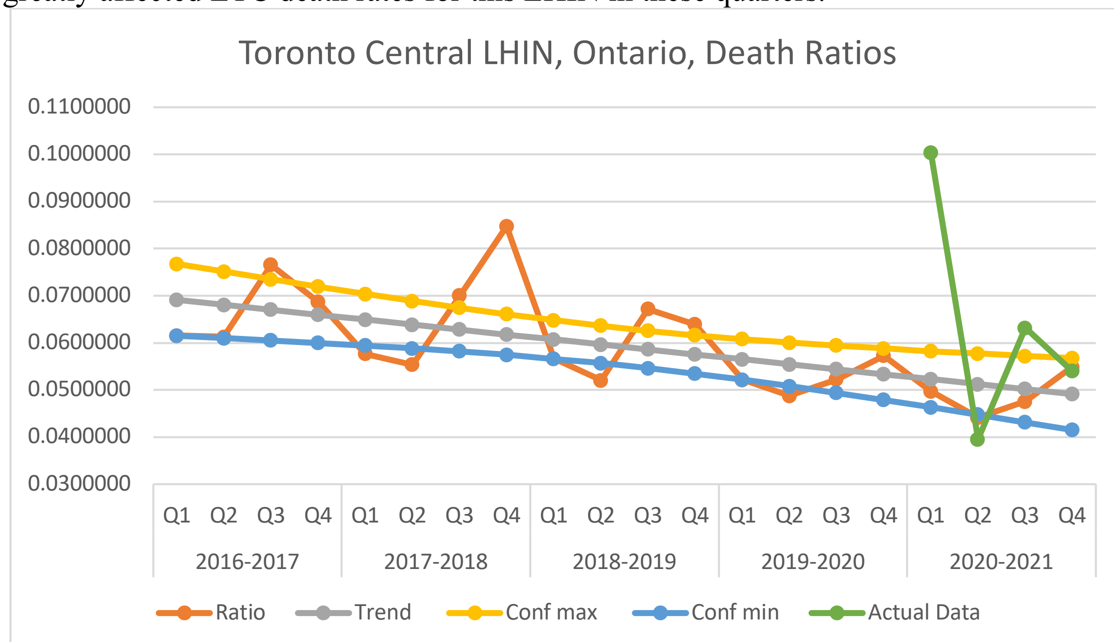

Figure 91: Toronto Central LHIN, Ontario, Death Ratios by Quarter.

oo) The death ratio for residents in the Waterloo Wellington LHIN in Ontario did not significantly change in quarter, three, and four and decreased in quarter two in the 2020-2021 fiscal year. COVID-19 does not seem to have had a large impact on this LHIN.

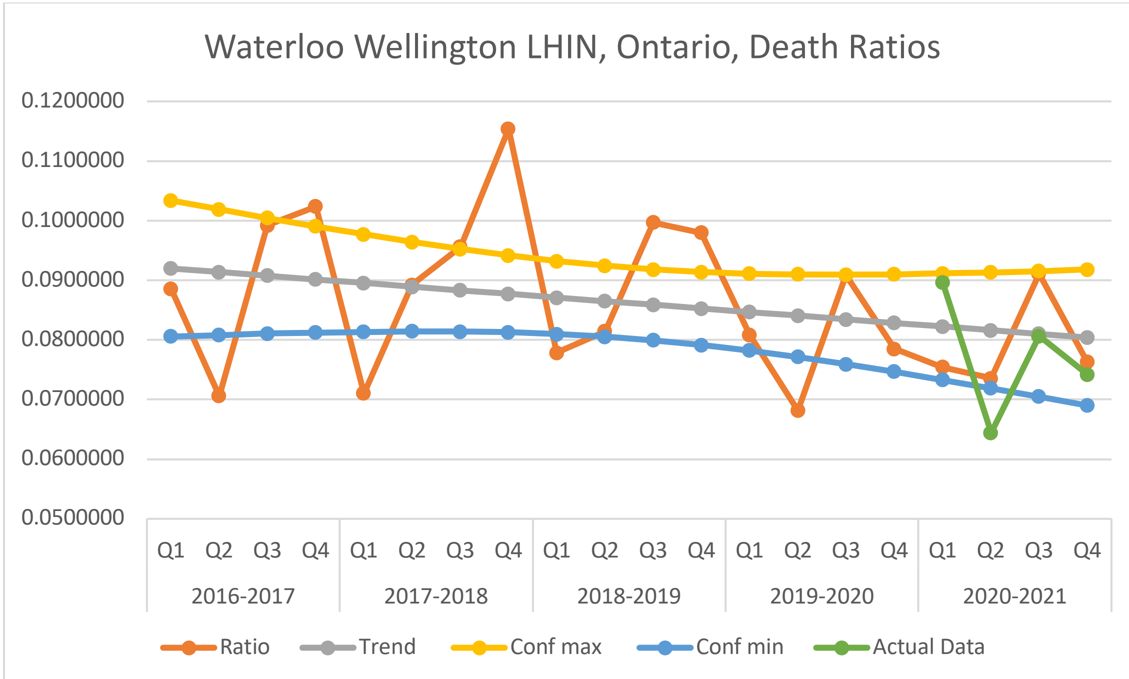

Figure 92: Waterloo Wellington LHIN, Ontario, Death Ratios by Quarter.

pp) The death ratio for residents in the Yukon Territory did not significantly change in any quarter of the 2020-2021 fiscal year. COVID-19 does not seem to have had a large impact on this LHIN wherein death ratios were lower than previous years.

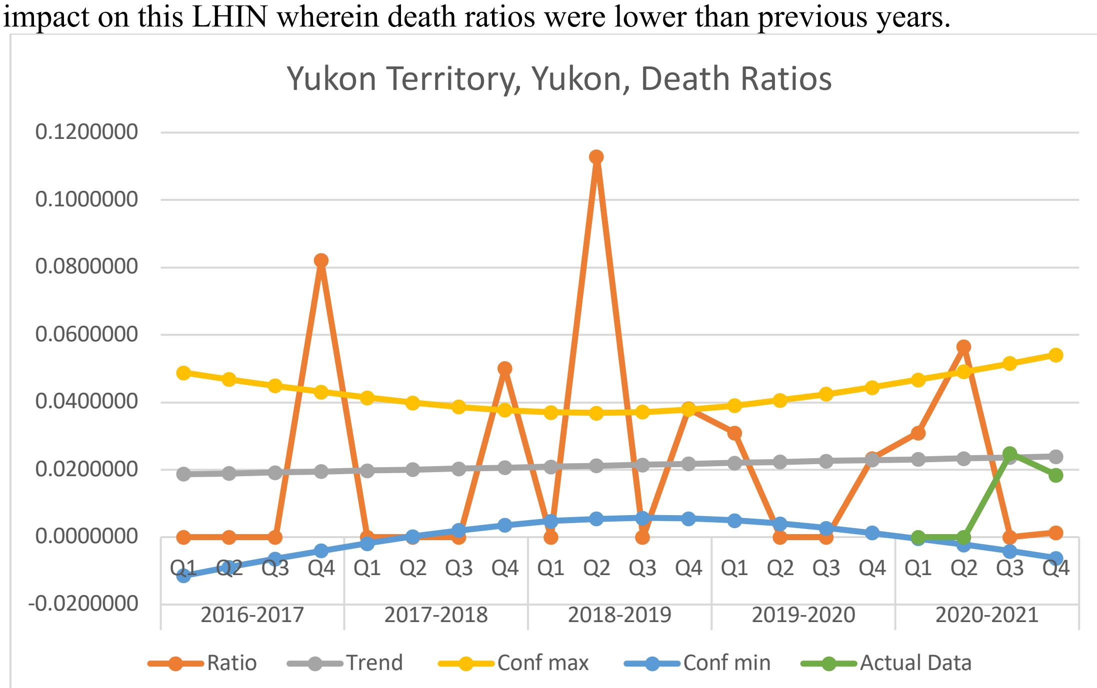

Figure 93: Yukon Territory, Yukon, Death Ratios by Quarter.

Next, death ratios by peer groups were established. The groupings of health regions/ health authorities/LHINS and the characteristics of each peer group are provided in the methodology section.

qq) The death ratio for residents in homes in peer group A did not significantly change in quarter one and four, decreased in quarter two, and increased in quarter three of the 2020-2021 fiscal year. This group has a low population density and includes rural and remote regions.

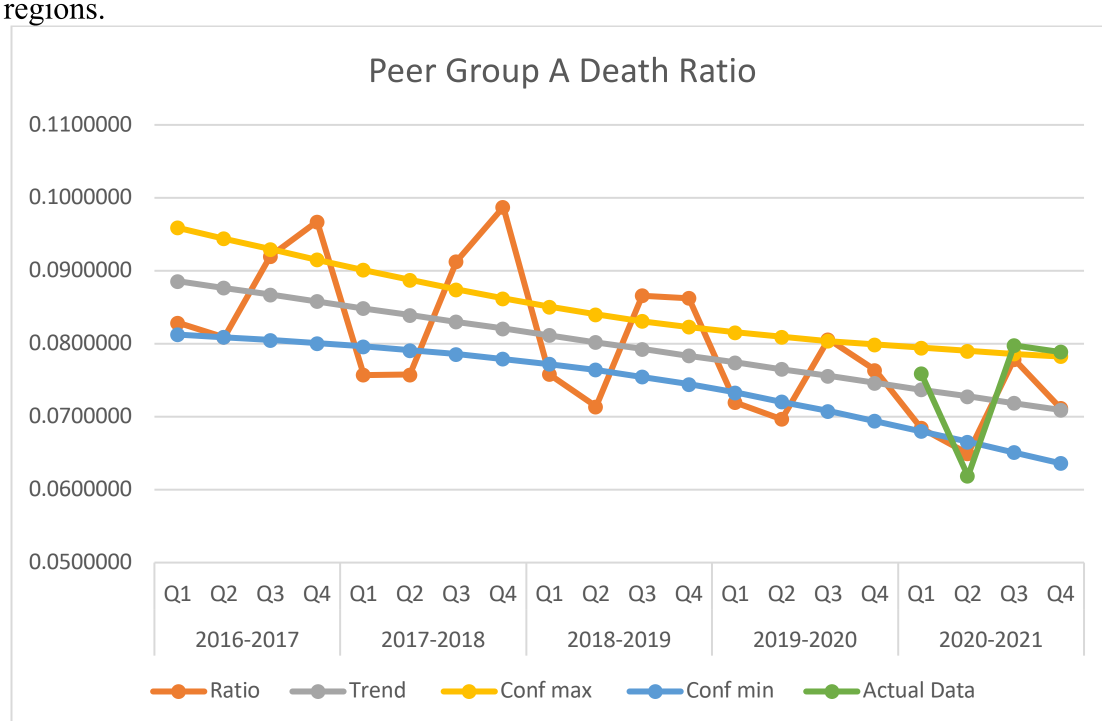

Figure 94: Peer Group A Death Ratio

rr) The death ratio for residents in homes in peer group B increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. This peer group includes urban centers with high population density, very high employment rates, and a high proportion of immigrant and visible minority populations. These variables could potentially be associated with higher death ratios. However, COVID-19 did not exceptionally affect the death ratios when the ratio is compared to previous years. As such, there is merit in a further analysis that follows on these mentioned variables and death ratios.

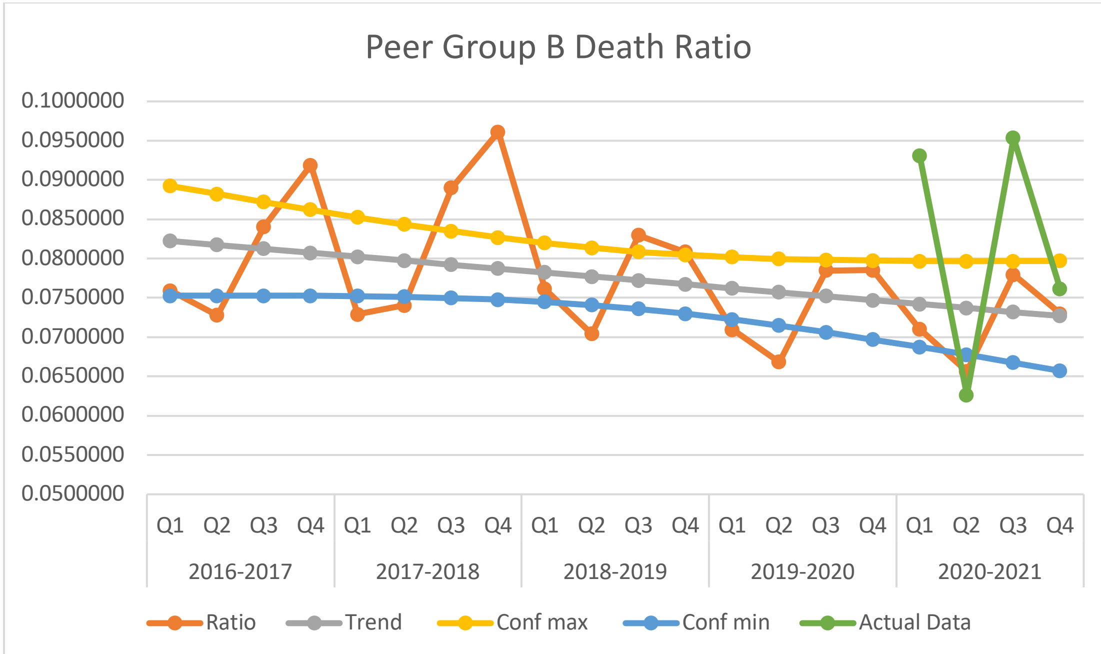

Figure 95: Peer Group B Death Ratio

ss) The death ratio for residents in homes in peer group C did not significantly change in any quarters in the 2020-2021 fiscal year. This group includes sparsely populated regions and a high employment rate, but it also includes a high proportion of immigrant and visible minority populations. Additionally, this group includes regions with a relatively high level of individuals receiving income assistance. COVID-19 does not seem to have influenced this group.

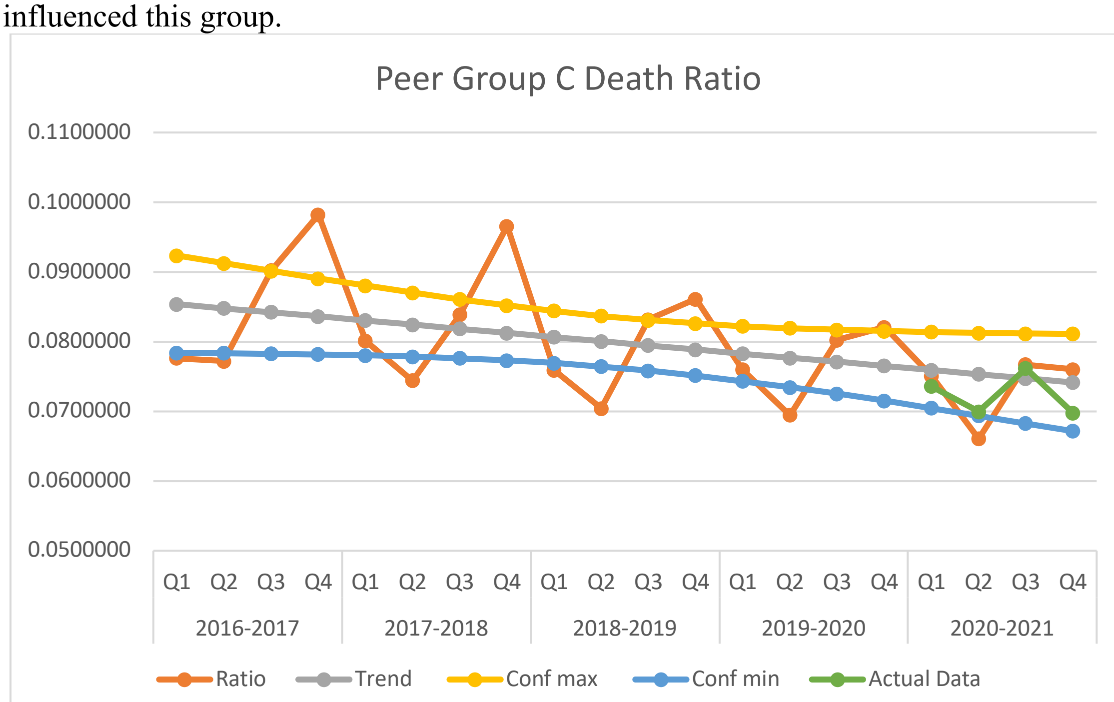

Figure 96: Peer Group C Death Ratio

tt) The death ratio for residents in homes in peer group D increased in all quarters of the 2020-2021 fiscal year. This peer group is only comprised of two health regions (that are included in the data for this study) and as such the results may be more skewed by the data in one health region. Specifically, Northern Health in British Columbia experienced exceptionally high death ratios in LTC homes in 2020-2021 and as such this health authority may influence the results of this analysis. What is interesting here is that this peer group mainly includes rural areas and whereas the peer groups above that included rural areas were not seemingly as impacted by COVID-19, this does not seem to be the case here.

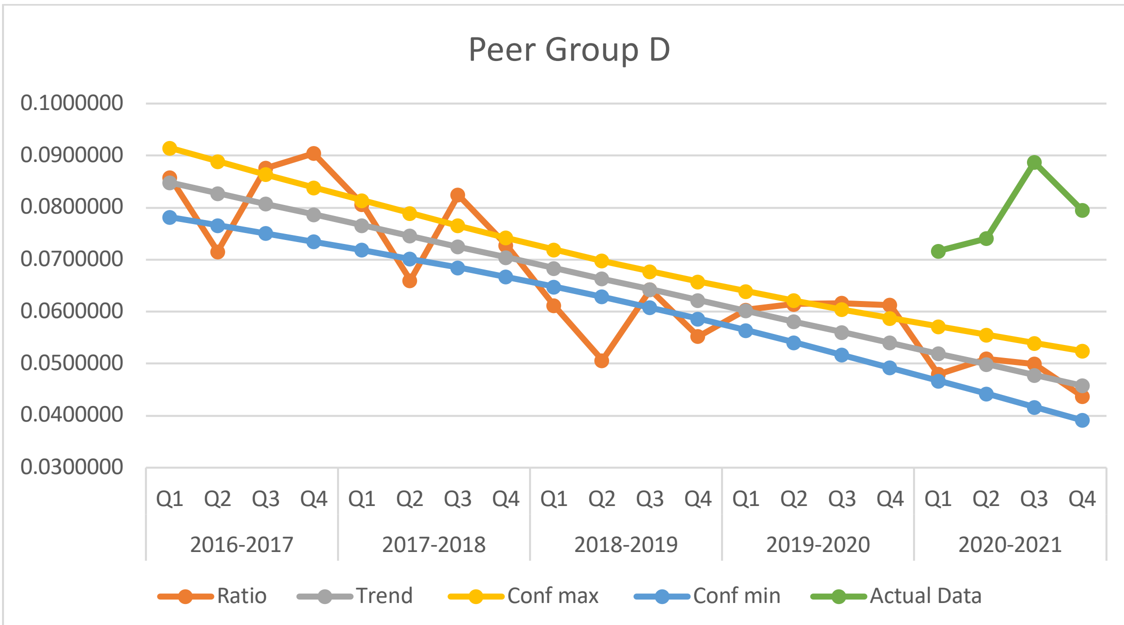

Figure 97: Peer Group D Death Ratio

uu) The death ratio for residents in homes in peer group E did not significantly change in quarter one, two, and four and increased in quarter three of the 2020-2021 fiscal year. This group includes mainly rural regions, and regions with a low population density and a high proportion of individuals receiving government assistance. COVID-19 does not seem to have had a major influence on death ratios in the LTCs in this region as there are no exceptional changes and the increase in quarter three is minimal.

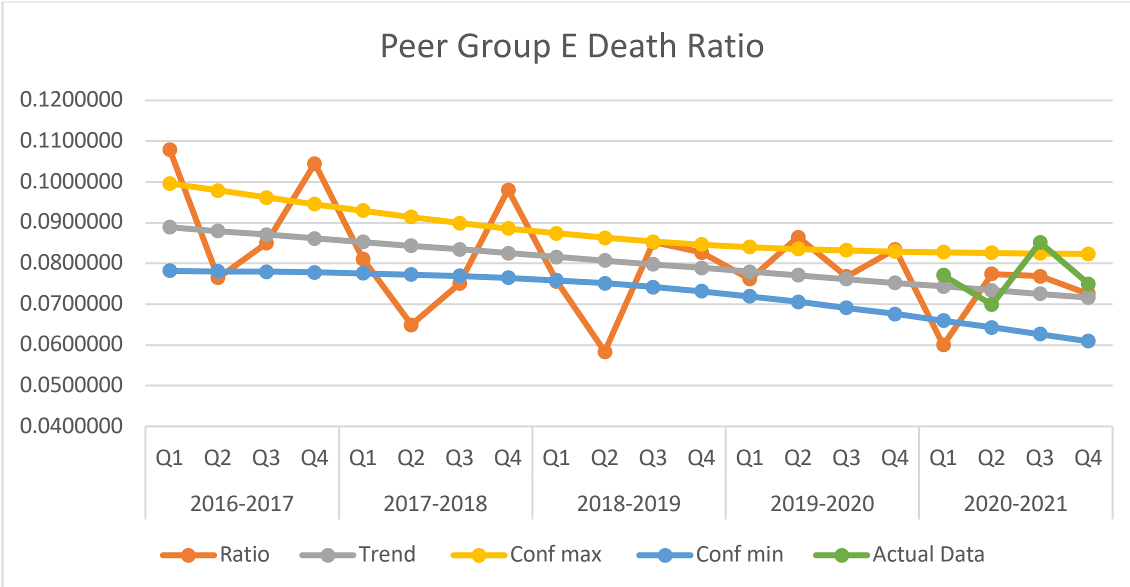

Figure 98: Peer Group E Death Ratio

vv) The death ratio for residents in homes in peer group G increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. This peer group includes Vancouver Coastal Health and Toronto Central LHIN i.e., regions with high population density, moderate levels of government assistance, a high level of immigrant and visible minorities, and high levels of post-secondary students. These factors and their potential association will be examined in the discussion section in detail, however; there may be an association between high death ratios and LTC homes in highly populated areas. Albeit, this association may not be simple: in the above analysis result it was seen that high case rates in a health region do not necessarily translate to higher death ratios for that region.

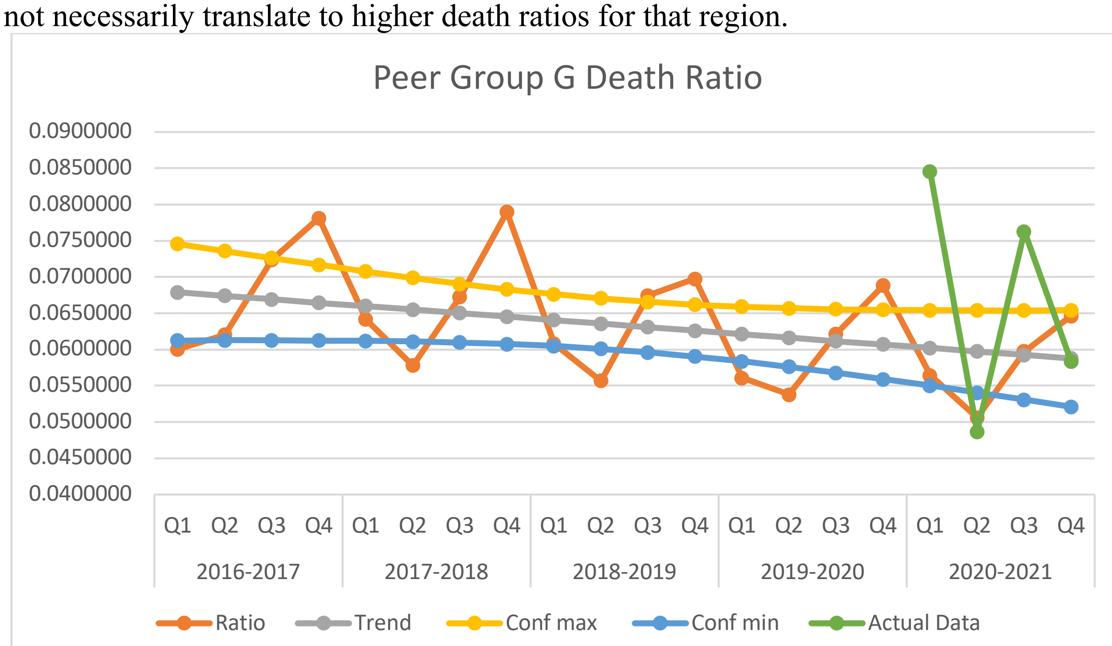

Figure 99: Peer Group G Death Ratio.

ww) The death ratio for residents in homes in peer group H increased in quarter one and three and did not significantly change in quarter two and four of the 2020-2021 fiscal year. As was noted earlier, several LHINS in Ontario had similar death ratios in the first quarter of 2020-2021, three of these LHINS belong to peer group H (Central, Central West, Mississauga Halton). The regions have high population densities and a high level of immigrants and visible minority populations. The increase in quarter one is exceptional and the difference in the actual and expected ratios in quarter three is higher than previous years while the peak in quarter three is not greater than previous years.

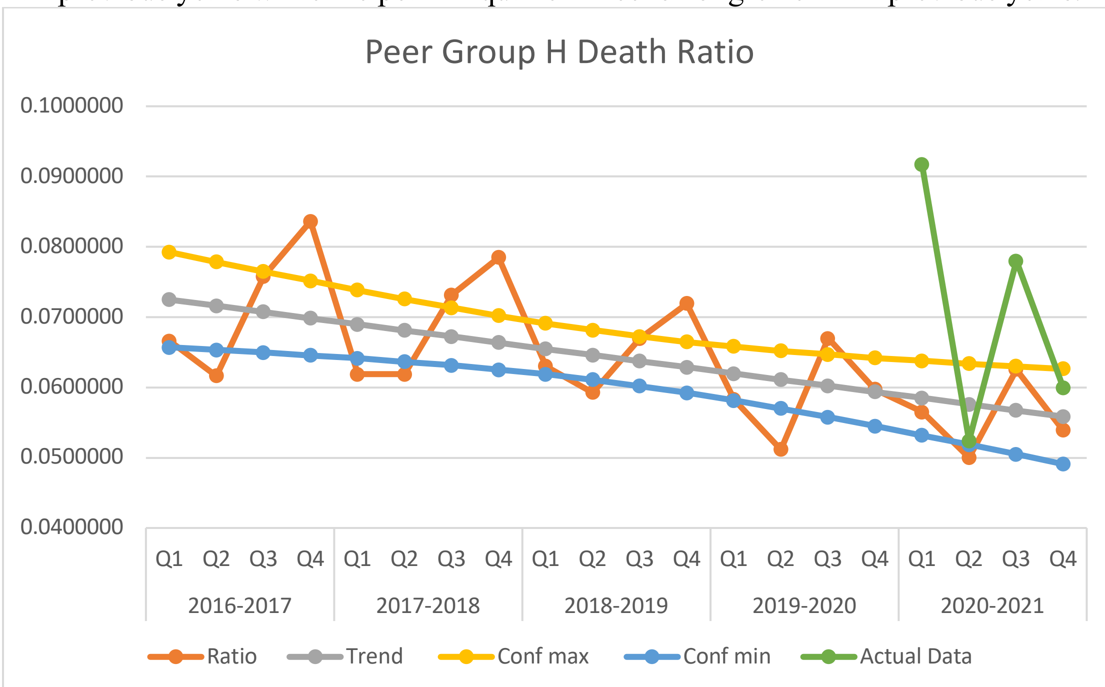

Figure 100: Peer Group H Death Ratio.

xx) The death ratio for residents in homes in peer group I did not significantly change in any quarters of the 2020-2021 fiscal year. Peer group I represents Yukon.

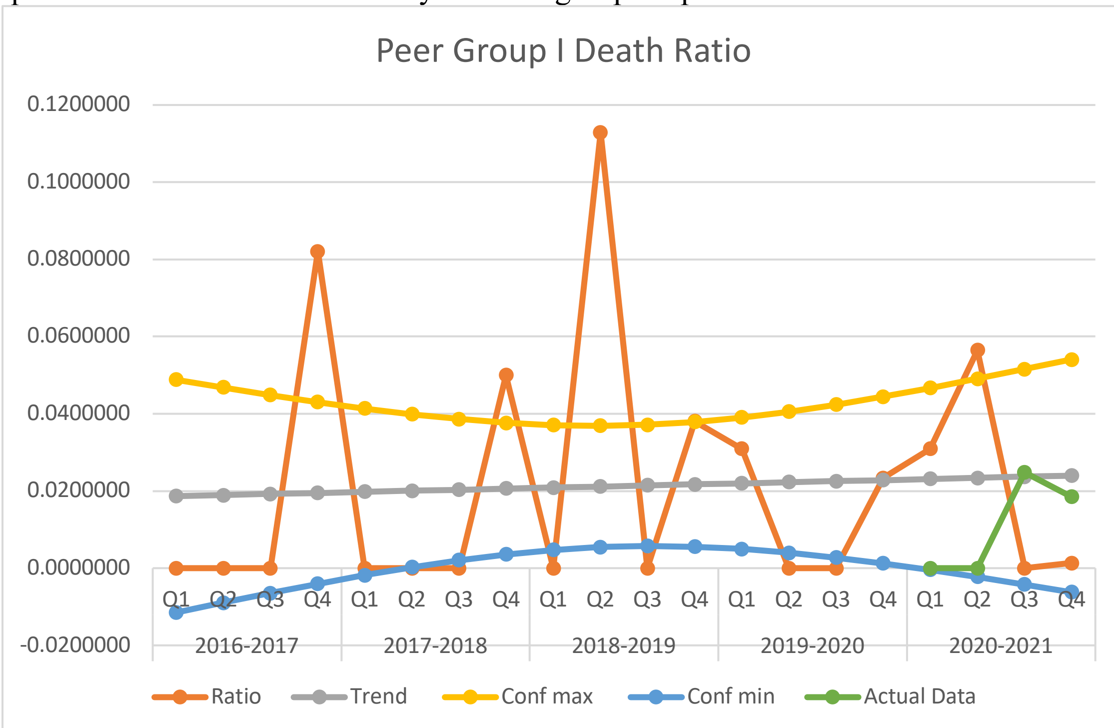

Figure 101: Peer Group I Death Ratio.

Next, the same analysis for peer groups was re-conducted for peer group C, D, G, and H (these peer groups contained health authorities in British Columbia which could not be matched exactly to peer groups and as such, this re-analysis excluded these health authorities from the mentioned peer groups).

yy) Death ratios for residents in homes in peer group C without inclusion of British Columbia did not significantly change in any quarter of the 2020-2021 fiscal year. There is little difference between this analysis and the analysis including British Columbia and as such the health authorities in British Columbia (2/7 regions in the group) may not have had a large influence on the overall death ratios for this peer group.

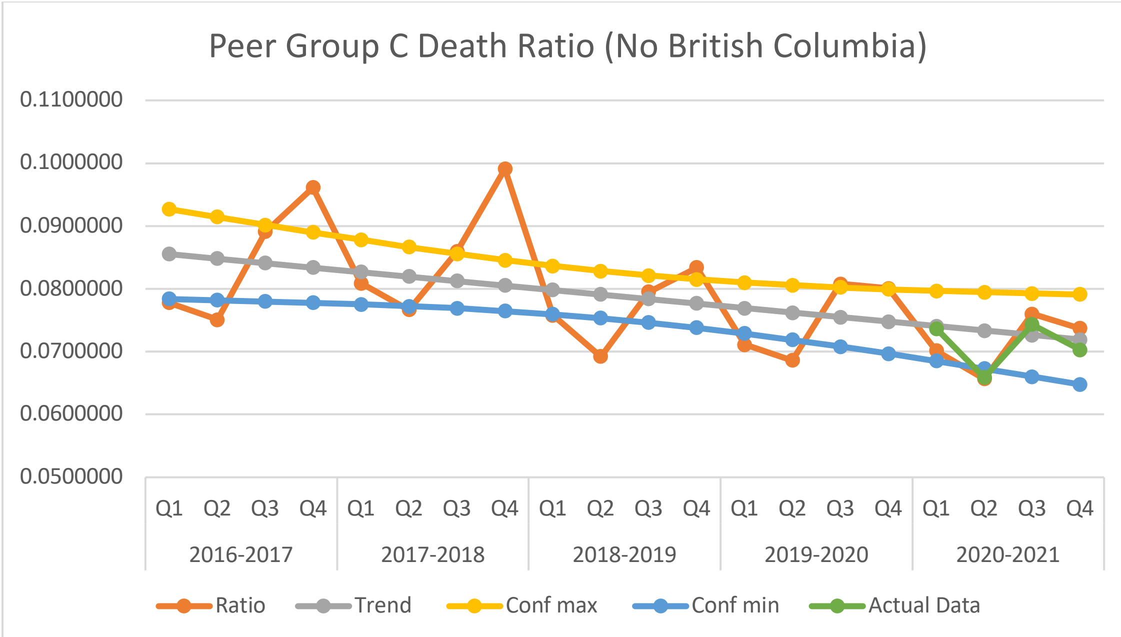

Figure 102: Peer Group C Death Ratio Without British Columbia.

zz) Death ratios for residents in homes in peer group D without inclusion of British Columbia did not significantly change in quarter one, two, and three and decreased in quarter four of the 2020-2021 fiscal year. The exclusion of Northern Health from this grouping results in a substantial difference in data i.e., there is no longer large increases in death ratios in 2020-2021 through all quarters. The earlier discrepancy in which this peer group's analysis resulted in high death ratios despite being comprised of rural regions no longer stands and as such, all peer groups with rural regions had little change in death ratios in their LTC homes. However, it should be noted that this analysis only included one health region and no concrete conclusions about this specific peer group can be made.

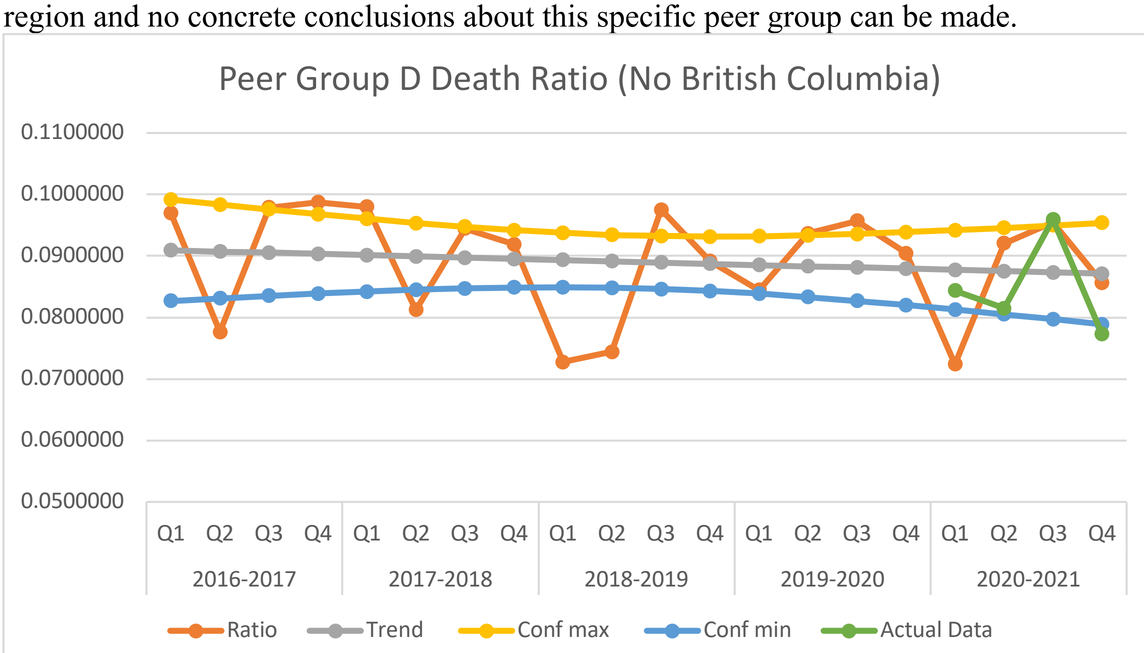

Figure 103: Peer Group D Death Ratio Without British Columbia.

aaa) Death ratios for residents in homes in peer group G without inclusion of British Columbia increased in quarter one, decreased in quarter two and three, and did not significantly change in quarter four of the 2020-2021 fiscal year. The general trends (increases and decreases beyond the expected interval) are still the same in the analysis with British Columbia included. However, the rise in the death ratio in quarter three is no longer as large as it was in the previous analysis. The rise in quarter one remains exceptional in this analysis.

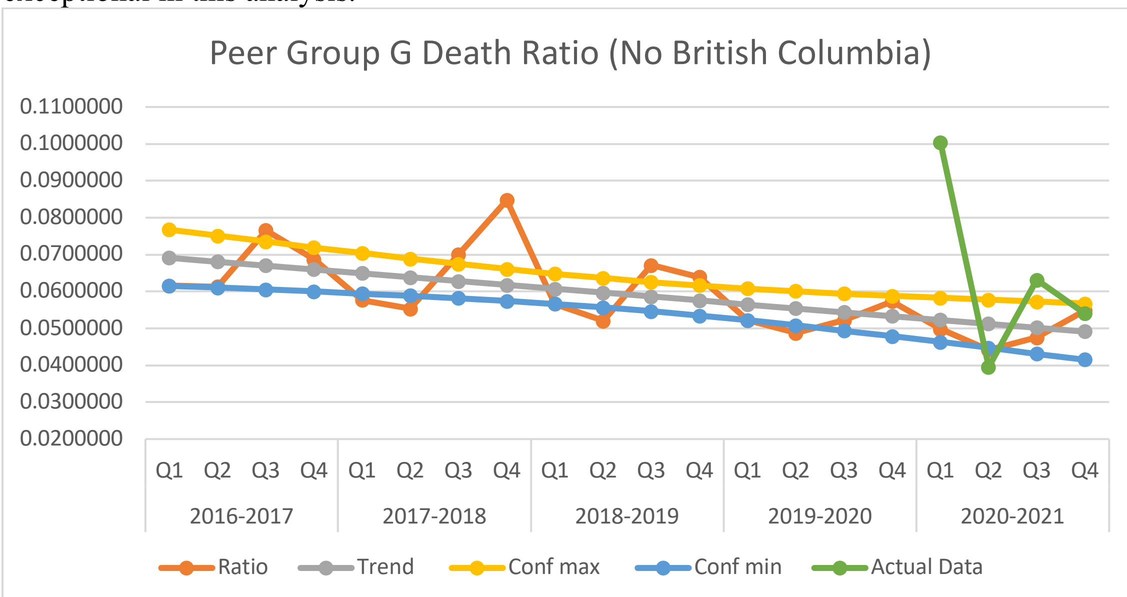

Figure 104: Peer Group G Death Ratio Without British Columbia.

bbb) Death ratios for residents in homes in peer group H without inclusion of British Columbia, increased in quarter one and three and did not significantly change in quarter two and four of the 2020-2021 fiscal year. The general death ratio trends are the same as the trends in the analysis with British Columbia included.

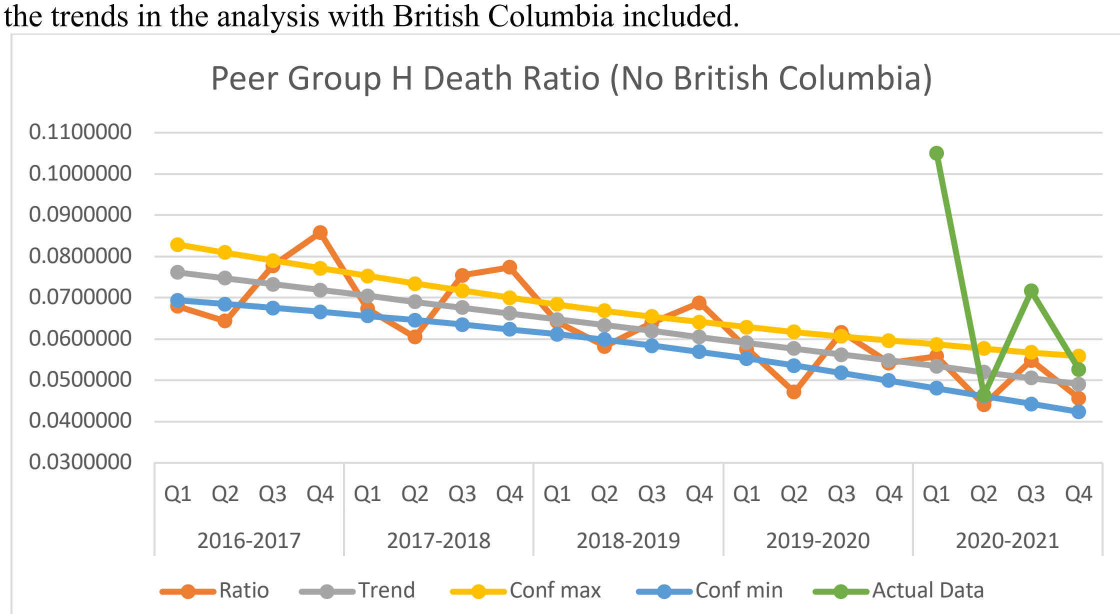

Figure 105: Peer Group H Death Ratio Without British Columbia.

Death Ratios by SES Analysis:

Next, three socioeconomic variables of peer groups were examined. High and low unemployment rates, proportion of visible minority populations, and population density were examined in relation to death ratios. Categorization of peer groups by these variables is described in the methods section.

a) The death ratios for residents in LTC homes in peer groups with high unemployment rates did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. The decrease in the death ratio in 2020-21 was exceptional in comparison to previous years.

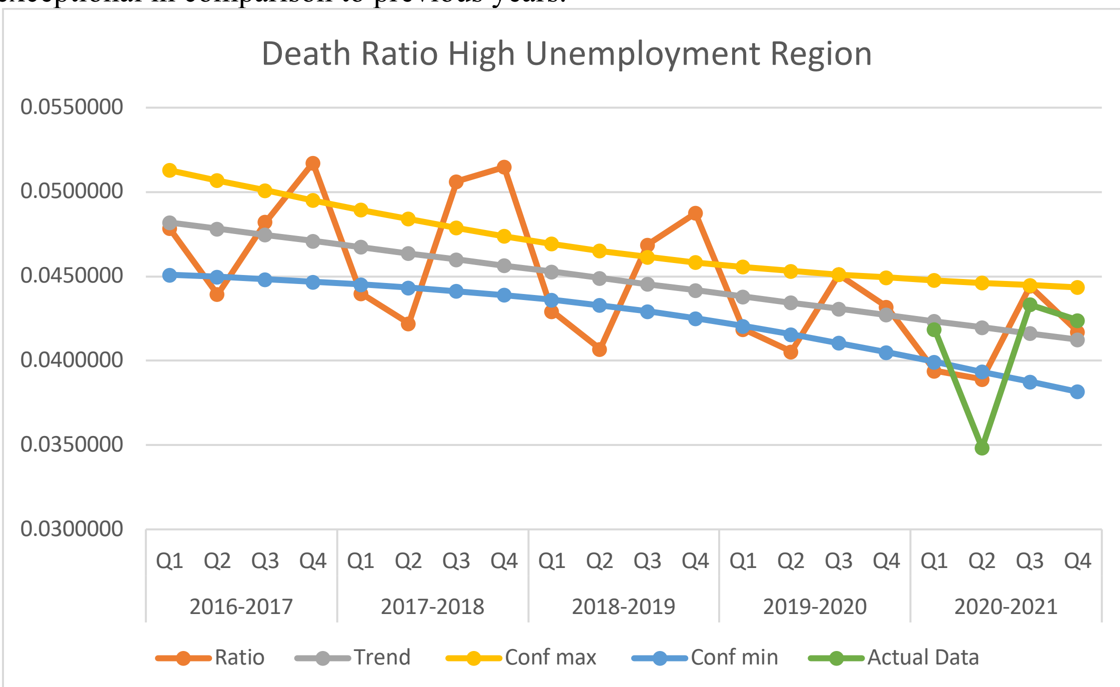

Figure 106: Death Ratios in High Unemployment Regions.

b) The death ratios for residents in homes in peer groups with middle unemployment rates did not significantly change in any quarter of the 2020-2021 fiscal year.

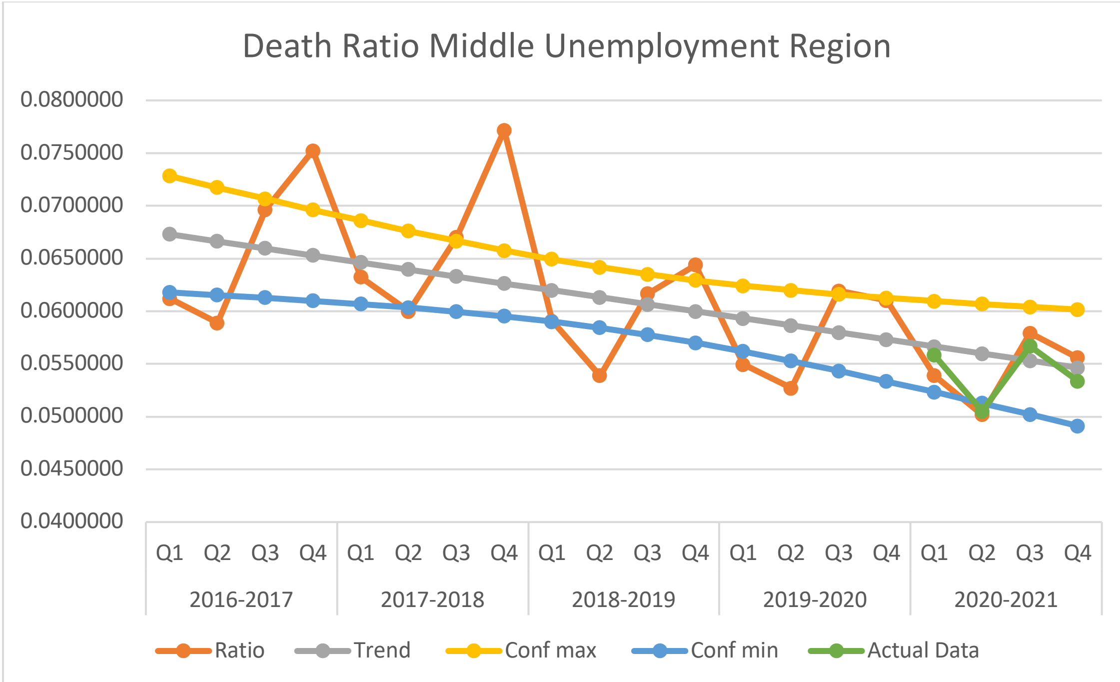

Figure 107: Death Ratios in Middle Unemployment Region.

c) The death ratios for residents in LTC homes in peer groups with low unemployment rates increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. The increases in quarter one and three are indeed exceptional and low unemployment rates in a region may potentially be associated with higher death ratios. The peer groups that comprised this analysis were peer groups B, D, and H. The health regions that comprise these peer groups in Ontario did not have exceptionally high case rates in the community in quarter one and three (compared to other regions) while the health regions that comprise these peer groups in Alberta did. Therefore, it is difficult to make a conclusion on how low unemployment in a community is associated with higher death ratios in LTC.

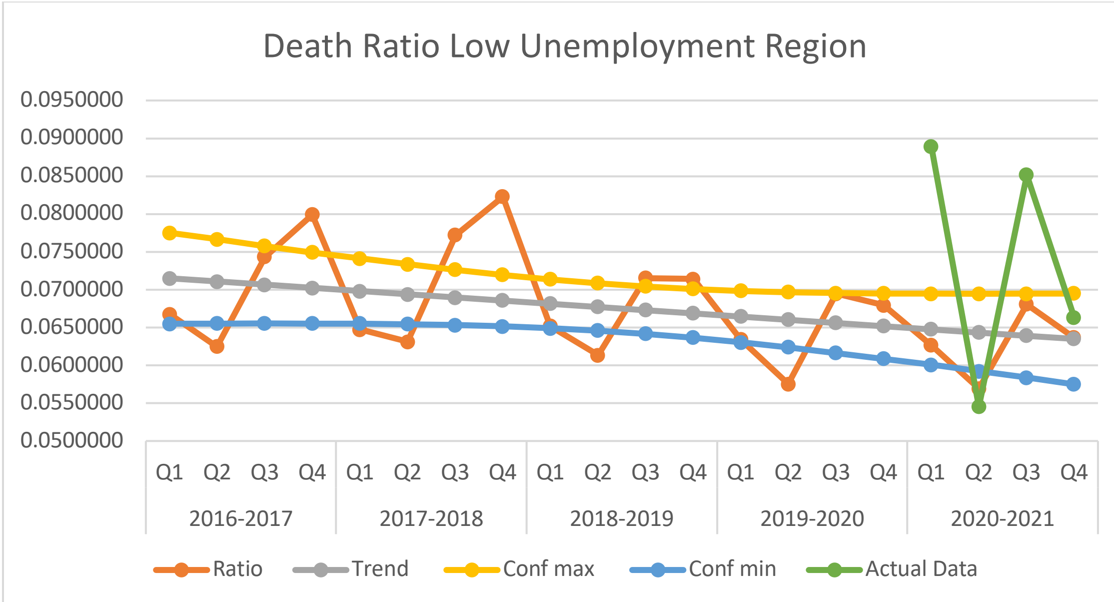

Figure 108: Death Ratios in Low Unemployment Regions.

d) Death ratio for residents in homes in peer groups with high numbers of visible minority populations increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. It can be seen that most of the health regions that comprise the peer groups in this analysis had high community case rates (in comparison to other regions within the same province and across provinces). From this data, an assumption would be that there are higher case rates in regions with a proportion of high visible minorities. However, the influence this has on case and subsequently death rates in LTC is not concretely known especially because the results of this analysis do not create exceptional results in 2020-2021.

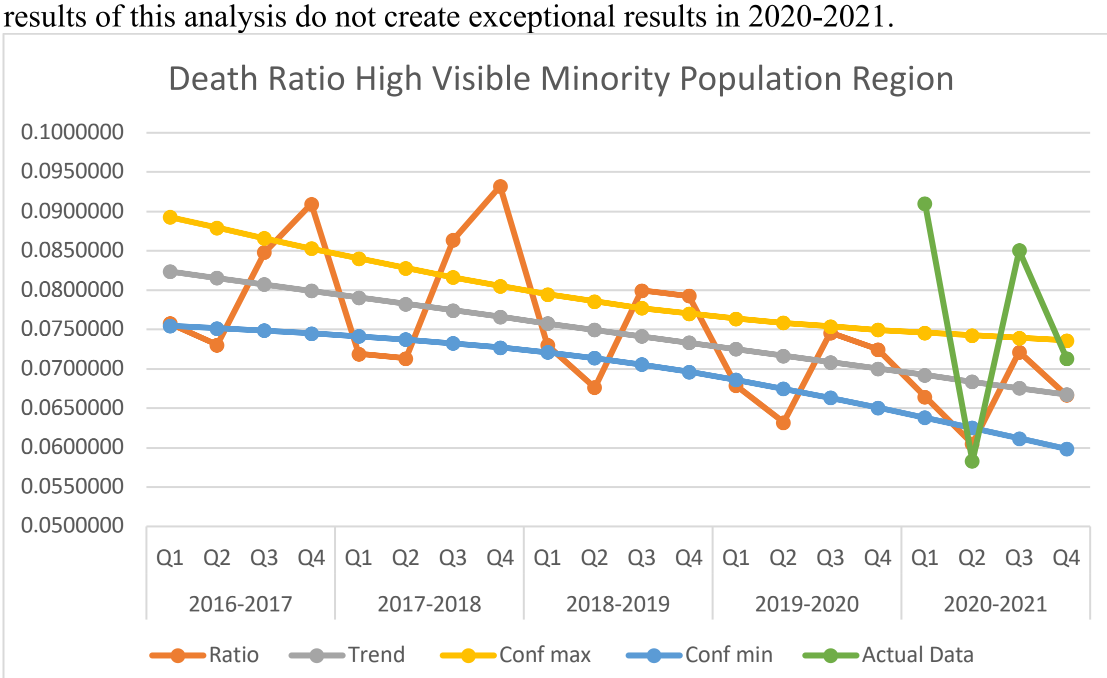

Figure 109: Death Ratios in High Visible Minority Regions.

e) Death ratio for residents in homes in peer groups with middle numbers of visible minority populations did not significantly change in any quarters of the 2020-2021 fiscal year.

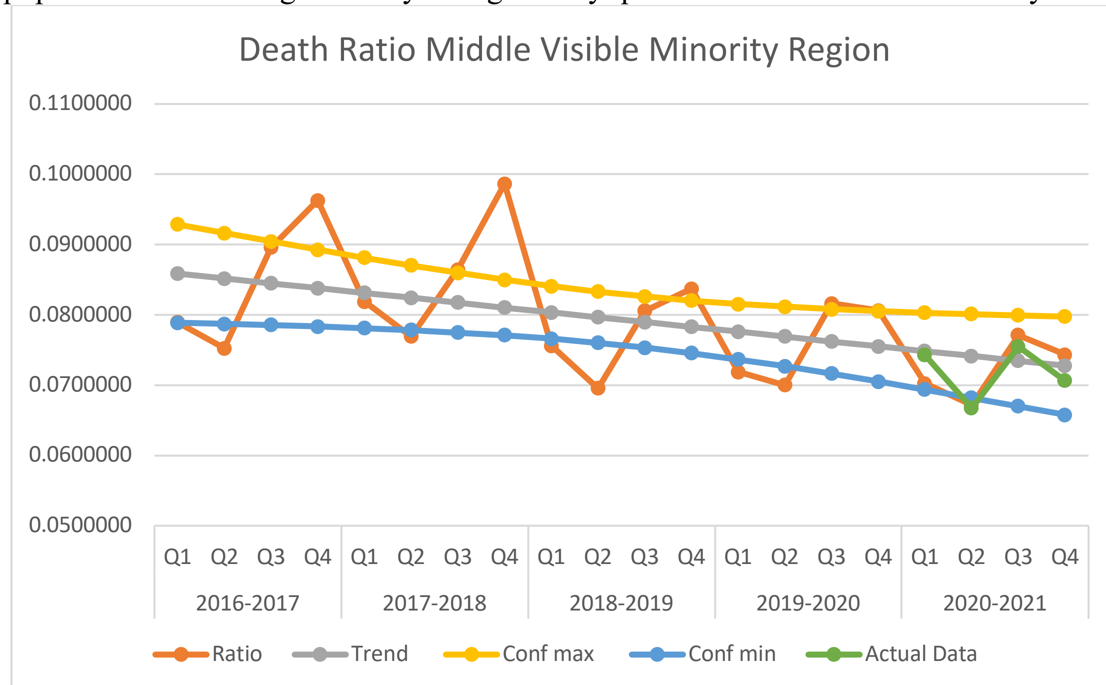

Figure 110: Death Ratios in Middle Visible Minority Regions.

f) Death ratio for residents in homes in peer groups with low numbers of visible minority populations did not significantly change in quarter one, two, and four and increased in quarter three of the 2020-2021 fiscal year. Changes are minor and results are not exceptional.

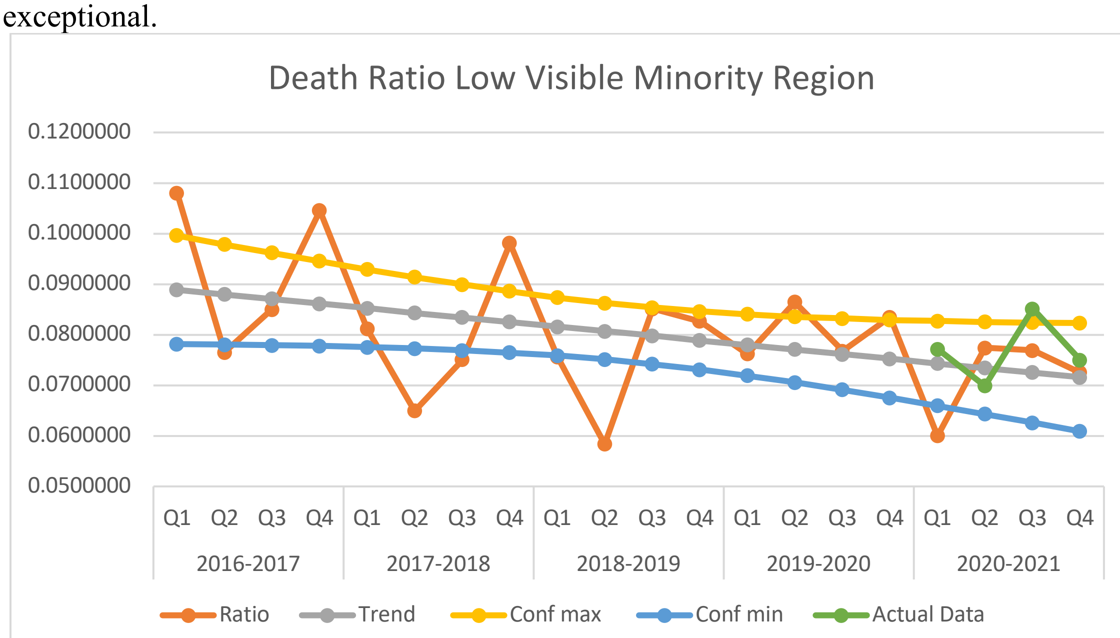

Figure 111: Death Ratios in Low Visible Minority Regions.

g) Death ratios for residents in LTC homes in peer groups with high population density increased in quarter one and three, decreased in quarter two, and did not significantly change in quarter four of the 2020-2021 fiscal year. The increase in the death ratio in quarter one is exceptional when compared to previous years. The health regions that comprise the peer groups in this analysis indeed had relatively high case rates. There may be an association between regions with high population density, and in turn high case rates, and case and death rates in the LTC homes in these regions.

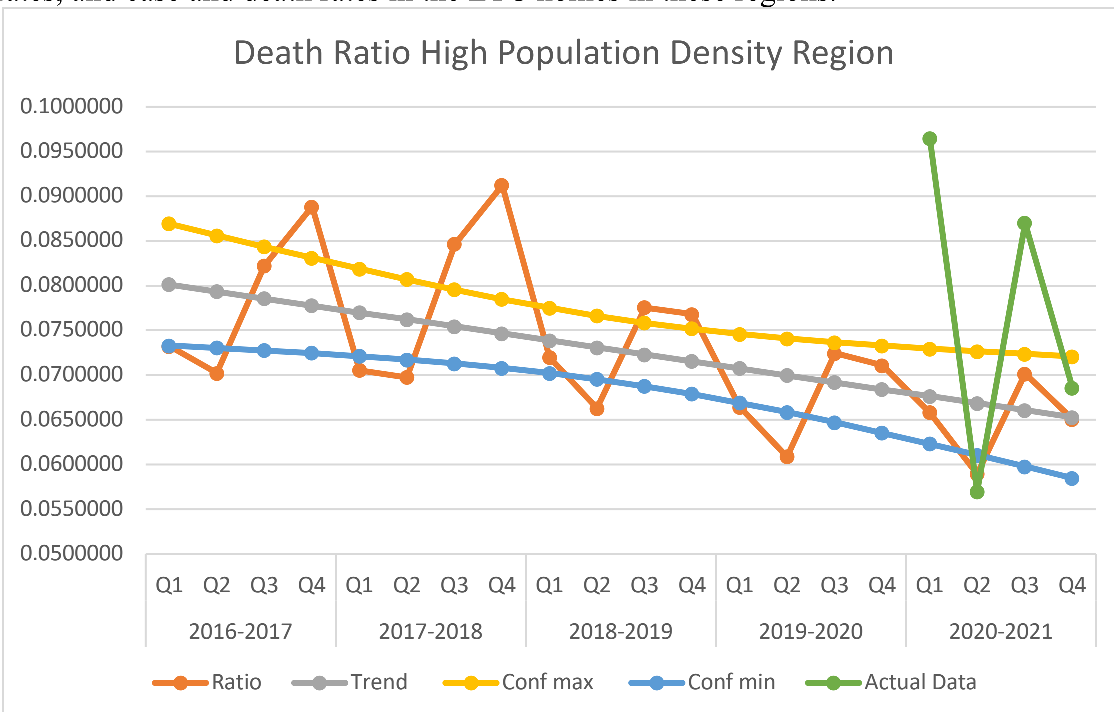

Figure 112: Death Ratios in High Population Density Regions.

h) Death ratios for residents in homes in peer groups with middle population density did not significantly change in any quarter of the 2020-2021 fiscal year.

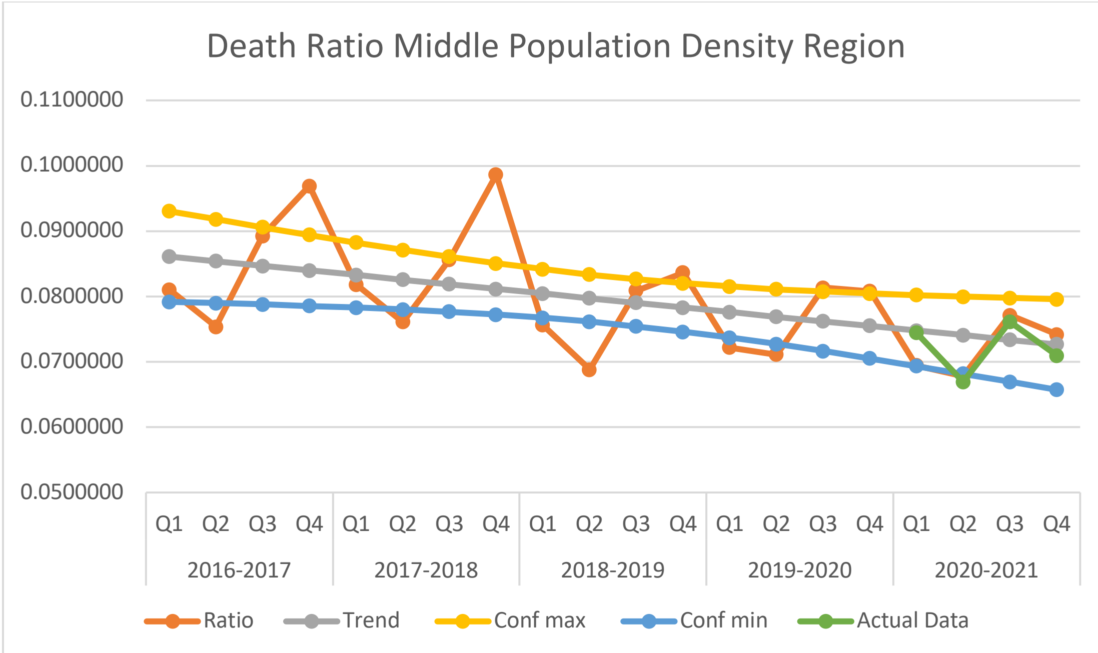

Figure 113: Death Ratios in Middle Population Density Regions.

i) Death ratios for residents in LTC homes in peer groups with low population density did not significantly change in quarter one, three, and four and decreased in quarter two of the 2020-2021 fiscal year. Changes were minor and not exceptional.

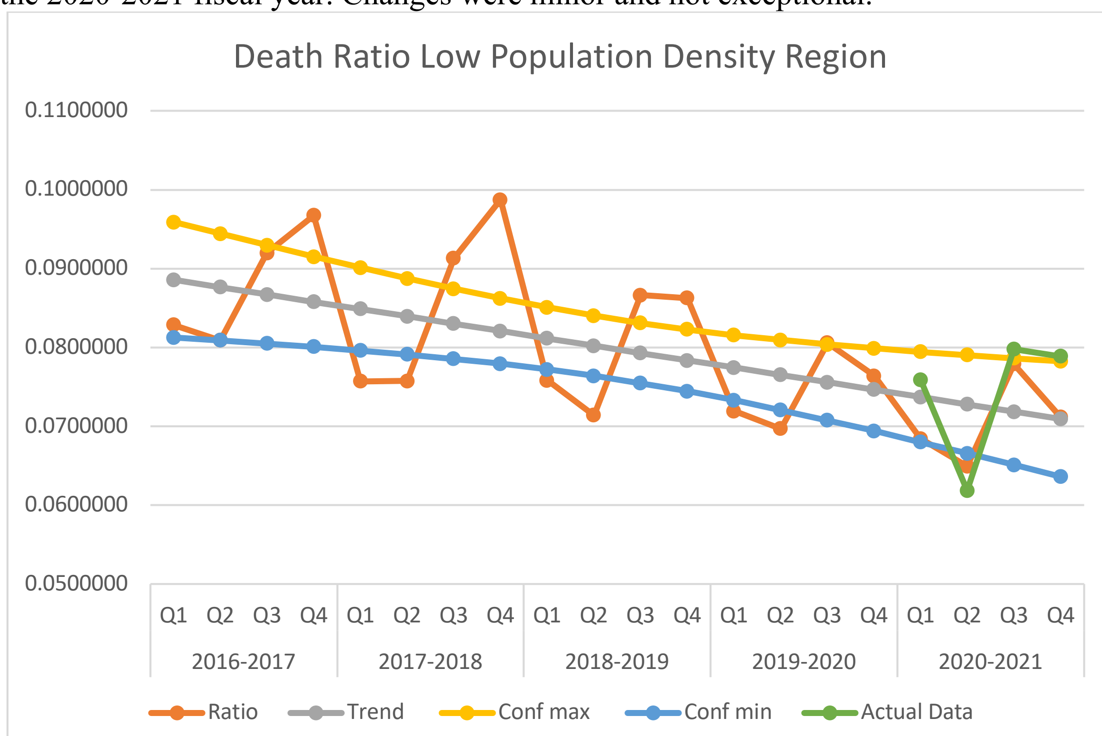

Figure 114: Death Ratios in Low Population Density Regions.

Finally, the results from the regression conducted to validate the findings on the association between the death ratio and high, medium, and low levels of population density, unemployment rate, and proportion of visible minorities in the population are as follows:

Quarter one:

Regression Statistics	
Multiple R	0.58786795
R Square	0.34558873
Adjusted R Square	0.23177807
Standard Error	0.01786019
Observations	28

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.002	0.006	0.327	0.747	-0.011	0.015
High Long-term Unemployment Rate	0.020	0.014	1.447	0.161	-0.009	0.050
Low Long-term Unemployment Rate	0.009	0.010	0.934	0.360	-0.011	0.030
High Visible Minority Population	-0.020	0.015	-1.262	0.220	-0.052	0.012
High Population Density	0.037	0.018	1.992	0.058	-0.001	0.075

High population density was associated with an increased difference in the expected and actual death ratios for quarter one (p=0.06). Otherwise, there were no associations between variables and death ratios.

Quarter two:

Regression Statistics	
Multiple R	0.46103975
R Square	0.21255765
Adjusted R Square	0.07561115
Standard Error	0.0124252
Observations	28

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.005	0.004	1.135	0.268	-0.004	0.014

High Long-term Unemployment Rate	-0.015	0.010	-1.505	0.146	-0.035	0.006
Low Long-term Unemployment Rate	0.009	0.007	1.237	0.229	-0.006	0.023
High Visible Minority Population	0.006	0.011	0.528	0.603	-0.017	0.028
High Population Density	-0.020	0.013	-1.529	0.140	-0.046	0.007

A high long-term unemployment rate is potentially associated with an increased difference in the expected and actual death ratios for quarter two (p=0.15). Additionally, high population density is also potentially associated with this increased difference (p=0.14). There were no associations between other variables and death ratios in quarter two.

Quarter three:

Regression Statistics	
Multiple R	0.40938895
R Square	0.16759931
Adjusted R Square	0.02283397
Standard Error	0.02170568
Observations	28

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.003	0.008	0.339	0.738	-0.013	0.019
High Long-term Unemployment Rate	-0.002	0.017	-0.088	0.931	-0.037	0.034
Low Long-term Unemployment Rate	0.017	0.012	1.441	0.163	-0.008	0.042
High Visible Minority Population	-0.002	0.019	-0.107	0.915	-0.041	0.037
High Population Density	0.001	0.022	0.031	0.975	-0.045	0.047

There were no associations between variables and death ratios in quarter two.

Quarter four:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.50218661
R Square	0.25219139

Adjusted R Square	0.12213772
Standard Error	0.01590852
Observations	28

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.004	0.006	-0.642	0.527	-0.015	0.008
High Long-term Unemployment Rate	0.011	0.013	0.855	0.402	-0.015	0.037
Low Long-term Unemployment Rate	0.023	0.009	2.662	0.014	0.005	0.042
High Visible Minority Population	0.001	0.014	0.095	0.925	-0.027	0.030
High Population Density	-0.015	0.016	-0.922	0.366	-0.049	0.019

A low long-term unemployment rate was associated with an increased difference in the expected and actual death ratios for quarter three (p=0.01). There were no associations between other variables and death ratios.

From this regression and the previous analysis on different socio-economic variables and death ratios, it can be said that there is potentially a relationship between high population density, a low rate of long-term unemployment and a high proportion of visible minority populations and an excess in observed mortality rates (relative to expectations), at least for some time periods.

Discussion

Overview:

This is the first study to comprehensively examine mortality due to COVID-19 in residential care facilities overall, and by multiple socio-demographic variables. Specifically, this study examined the number of deaths, active residents, admissions, discharges, and the mortality ratio in LTC homes in Canada from April 2016 to March 2021 by sex, age, province, and health region. Expected mortality data in the 2020-21 fiscal year, based on forecasts created from the previous four fiscal years, was compared with actual mortality data in the 2020-21 fiscal year. The same was done, separately, for the number of admissions, discharges, and active residents. Data was examined by quarters and when available, monthly. Further, mortality ratios were created (number of deaths divided by number of residents) for each quarter of the year under examination, this accounted for the decreases in admissions and discharges in 2020-21. In this study, where data fell outside the predicted confidence intervals for 2020-21 an increase or decrease was noted in the variable under examination. However, these changes were only considered exceptional if there were not similar or greater changes in previous years.

Overall, the number of deaths in LTC in Canada increased in quarter one and quarter three of 2020-21. However, in many cases, these changes were not exceptional in comparison to previous years. For instance, when looking at the increase in deaths in quarter three of 2020-2021, the peak in deaths is not exceptional compared to previous years (specifically, to quarter four of 2017-2018).

Most commonly, the number of active residents decreased in all quarters of the 2020-2021 fiscal year. Overall, the number of admissions decreased across quarters and months in 2020-2021 and this result holds for both sexes and all age categories. Admissions in LTC may have decreased in all quarters of the pandemic as a result of changes in admission practices that aim to limit the number of residents in facilities and in turn, mitigate spread of COVID-19 infections. Additionally, older adults and/or their families may have learned about and/or witnessed the plight of LTC due to COVID-19 and have been hesitant about admission to LTC. Interestingly, the greatest decrease in admissions occurred in May 2020. This is after April experienced the greatest increase in deaths compared to all years i.e., the number of admissions seemed to decrease the most after LTC was in the most dire state (in regard to mortality). Overall, the number of discharges did not change in quarter one and three and decreased in quarter two and four. Lastly, overall, trends in death ratios are similar to trends in deaths examined by total number and the variables of sex, age, and province.

<u>Excess Deaths:</u>

When looking at the data published by CIHI on the number of excess deaths in LTC in the first wave of the pandemic (March 2020 to June 2020)(28), and comparing this with the current study's data in this time frame, it can be said there is potentially an overestimation of excess mortality in the literature. Specifically, in quarter one (April 2020 to June 2020), I found 1,032 excess deaths while CIHI estimates excess deaths to be 2,223. Notably, the same number of provinces were included in both analyses. There is consideration, however, of the fact that the current study does not include March 2020 in the analysis (by the end of which cases were substantially increasing in Canada) and that the current study does not include resident deaths in hospital. Nevertheless, the discrepancy in both numbers may also be attributed to the differences in methodologies used by CIHI and this study, specifically in the definition of excess deaths. In this study, excess deaths were determined by finding the difference between the actual number of deaths in a quarter and the upper margin of the confidence interval calculated for expected deaths. This methodology accounts for variations in deaths by year and as such, it can be said mortality has indeed always been high in LTC and 2020-21 is not as exceptional as a year as otherwise depicted. For instance, when examining total deaths, mortality peaked at similar levels to the peaks in 2020-2021 in quarter four of 2017-2018.

When considering the general increases and decreases in the number of deaths in 2020-21, several interpretations and assumptions linked to the pandemic can still be made. Firstly, it is seen that death ratios in LTC exceptionally rose in many regions in quarter one of 2020-2021, and then declined in the second quarter. In some cases, the increase in quarter one coincides with high levels of case rates in the community. It is possible there is an association between a high number of community cases and LTC deaths. It was reported that COVID-19 cases among LTC staff were highly associated with outbreaks in LTC homes (39). As such, when cases were higher in the community, there may have been a greater likelihood that staff could become infected and in turn initiate outbreaks within homes. Additionally, Prairie provinces such as Alberta and Manitoba which experienced substantial increases in case and death rates in the community after the second quarter, and potentially due to misplaced confidence on their pandemic response, also had exceptionally high increases in deaths in quarter three in LTC homes. This further validates the potential association between community case rates and subsequent LTC deaths. Nevertheless, the connection between high levels of community cases and LTC deaths cannot be conclusively stated: the data in this study shows that high case rates in the community for specific health regions did not always result in higher death ratios in LTC. For example, Hamilton Niagara Haldimand Brant LHIN experienced a substantial increase in case rates among the general population between quarter three and four. However, the death ratios among LTC residents in this LHIN remained stagnant across these two quarters. Additional examples of these germane outliers are provided in the sections below. Therefore, case rates in the community may influence LTC death rates but not in all circumstances. It is also possible that the first increase in deaths resulted in lower deaths afterwards because many residents that were in the frailest conditions and of poorest health died first. The decrease in deaths in quarter four of 2020-2021 may reflect the advent of COVID-19 vaccines in LTC during this period and a subsequent decrease in cases and deaths due to increased immune protection in many residents. Additionally, it was reported that almost all homes had increased infection prevention and control measures in direct response to the pandemic over the course of 2020 (39). This may have reduced the number of cases, and subsequently deaths in LTC.

Another point of interest is the fact that the largest increases in excess deaths in 2020-2021 occur in different quarters from previous years. For instance, when looking at the death ratio by those aged 65-74, the peak in quarter one of 2020-2021 is not exceptionally higher than the peak in 2016-2017. The peak in 2016-2017 occurs in quarter four compared to quarter one in 2020-2021: quarter four occurs in the winter (January to March) and coincides with flu season in LTC. Another example is the following: while the number of deaths increased above the confidence interval for expected deaths in Ontario in quarter one of 2020-2021, the number of deaths increased above the interval for expected deaths in quarter four of 2018-2019. Quarter four of 2020-21 did not experience a significant change in many instances (e.g., when examining total number of deaths) and this may be attributable to the aforementioned idea that LTC homes had instated increased infection and prevention control measures.

In regard to the analysis by socio-economic factors, it can be seen that there is potentially a relationship between high population density, a low rate of long-term unemployment and a high proportion of visible minority populations and an excess in observed mortality rates (relative to expectations), at least for some quarters.

Analysis by Sex:

The number of deaths among females followed the same pattern of deaths among males in the analysis by quarter i.e., with increases and decreases by quarter. However, notably, the number of excess female deaths superseded the number of excess male deaths wherein there were 519 more excess female deaths than male deaths in 2020-2021 in LTC (when looking at the data by month). This is contrary to findings in many countries wherein males have experienced higher mortality rates, but in line with the findings from Canada wherein females have experienced a higher proportion of deaths due to COVID-19. Since LTC deaths comprised a large proportion of COVID-19 deaths, the trends by sex in Canada can be better understood i.e., the trends in Canada reflect the trends in LTC by sex. While this finding is established after examining data in relation to whether deaths fall within or above the predicted confidence intervals, it should be noted that the increase in female deaths was not exceptional in comparison to previous years. Female residents only experienced an exceptional increase in deaths in April 2020 and not even in all months of quarter one. On the other hand, male residents did experience an exceptional increase in deaths in quarter one and three of 2020-2021 and more specifically in April 2020, November 2020, December 2020, and January 2021.

Analysis by Province:

Ontario experienced the highest number of excess deaths in quarter one of 2020-2021 (deaths were exceptional) while Alberta and Manitoba experienced the highest number of excess deaths in quarter three of 2020-2021. Deaths in other provinces were not exceptional. Ontario experienced the greatest difference in the actual number of active residents and expected number of residents. This is in part attributable to the fact that this province also experienced the greatest decrease in admissions compared to previous years. However, what can be seen is that there was no significant difference in discharges in quarter one, in Ontario. For Alberta and Manitoba, the greatest increase (exceptional) in deaths occurred in quarter three of 2020-2021. Here, discharges increased exceptionally, and admissions decreased exceptionally. In turn, the number of active residents also decreased exceptionally in this period.

Analysis by Age:

Those in the oldest age bracket had lower levels of increases in deaths compared to those of younger age brackets throughout all quarters. It might be due to the fact that the 85+ experience very high mortality rates in any year, COVID-19 or not. Additionally, while there were exceptional changes in the number of deaths across age groups, there was no exceptional changes in the death ratio for any age group. The difference between what we see for deaths and death ratios means that age groups for which the increase in number of deaths was exceptional were also the age groups for which the decrease in number of residents was the lowest. Another point of interest in this discussion is that the life expectancy of residents when they first are admitted to LTC is two years and eight months (according to CIHI, for Ontario, in the late 2010s)(40). Many of those admitted at the age of 65 therefore would be expected to die in this period. It cannot be truly known from the current data whether and what the impact of COVID-19 was and how this impact was associated with age. Accordingly, as the relationship between age and mortality in LTC is not completely clear, further investigation in future research on this relationship is warranted.

Analysis by Health Region:

Death ratios only exceptionally increased for some health regions/ health authorities/ LHINs in quarter one of 2020-2021. Changes in other quarters were not generally exceptional. Death ratios for health regions are also not necessarily reflective of the trends in case and death rates in the general population of the respective jurisdiction. Examples of when community case rates in a health region/ authority/ LHIN were not reflective of the death ratios in LTC are as follows:

1. Toronto Central Health experienced a decrease in the death ratio in quarter two for LTC homes but a substantially high case rate in the community during this time (when comparing this LHIN to other LHINS in Ontario).

2. South Zone in Alberta had a high case rate in quarter one compared to other jurisdictions in Alberta and even Ontario. South Zone had a case rate of 428 per 100,000 people in quarter one among the general population and did not experience any significant increase in the death ratio in LTC residents in this period. However, in comparison, Champlain Health in Ontario had a case rate of 126 per 100,000 people in quarter one in the general population yet this LHIN experienced an exceptional increase in the death ratio for LTC residents in this period.
3. Central Zone in Alberta experienced a substantial increase in the case rate between quarter two and three in the general population. However, there is a decrease in the death ratio for LTC in this period.
4. Hamilton Niagara Haldimand Brant LHIN experienced a substantial increase in case rates among the general population between quarter three and four. However, the death ratios among LTC residents in this LHIN remained stagnant across these two quarters.

In many other instances, the level of case rates in the general population were reflective of the death ratios in the respective LTC homes in those regions.

Analysis By Socioeconomic Status:

Notably, low levels of long-term unemployment, high proportions of visible minorities, and high population density are potentially associated with higher excess death ratios among LTC homes in different regions. This mirrors the general trends in Canada wherein regions with higher population density and regions with racialized populations experienced high levels of outbreaks and consequently deaths from COVID-19. The case of unemployment is more surprising, as it has been observed that regions with lower income were more affected on average. It could be due to the fact that unemployment measures economic activity more than income and that regions with higher levels of economic activity were more prone to community spread than regions with slower economic activity. Nonetheless, and echoed throughout the results section, these trends are not completely clear given the fact that rates of cases in the community do not always coincide with increases in cases and subsequently deaths in LTC. As such, although the analysis by different socio-economic factors points to a potential association with specific socio-economic variables and deaths, no conclusive statements can be made on this association. There is indeed potentially a random aspect associated with the data that cannot yet be determined.

The results may prompt reflection on what the trade-offs are of placing LTC homes in rural areas (areas with low population density) as opposed to placing these homes in areas with high population density. On one hand, placing LTC homes in highly populated areas may facilitate greater access for residents with their families who may live close by and on the other hand, placing LTC homes in these areas may continue to result in high death rates in LTC. Such considerations merit further research.

Conclusion:

This study worked to create a more comprehensive understanding of the impact of COVID-19 on deaths in LTC. From the analyzed data, it can be said that although COVID-19 contributed to increased deaths in LTC in the 2020-21 fiscal year, this year was not exceptional. The number of deaths varied across sex, age, province, and health region. Specifically, males and those in the younger age brackets (65-84) were most affected. Additionally, although Ontario was exceptionally affected in quarter one, the Prairie provinces became the most affected in the third quarter of 2020-21. The current study was exploratory in nature and may work to guide future research.

Although this study expanded on the report released by CIHI on the impact of COVID-19 in LTC and incorporated methodology that accounted for trends in previous years, there still may limitations to the current study. The authors of this study would encourage feedback on additional methodologies that can be employed to better analyze the available data. Future research may involve inclusion of all LTC resident deaths, including those outside LTC to gain a more accurate understanding of COVID-19 in LTC. Additionally, future research may involve working to better understand the impact of sex, age, and socioeconomic variables of different regions on the death rates in LTC. Overall, there is a paucity of research on comprehensively understanding mortality in LTC. This may be attributable to the paucity of publicly available data on the subject matter. For instance, currently, there does not exist public data on the number of deaths of residents in LTC by specific groupings for any year. As such, we hope the current study elicits the importance of continuing research in this subject matter and for institutions and organizations to publicly release data on mortality by place of residence (to include LTC).

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Appendix 1.

Figure 1a: Total deaths by month.

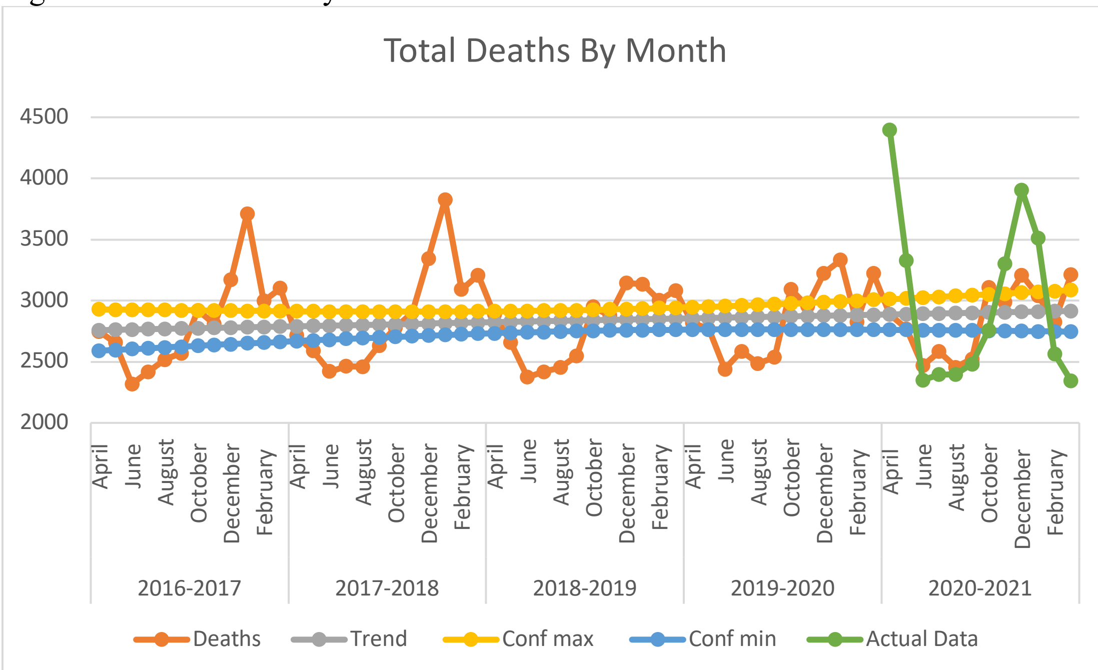

Figure 2a: Female deaths by month.

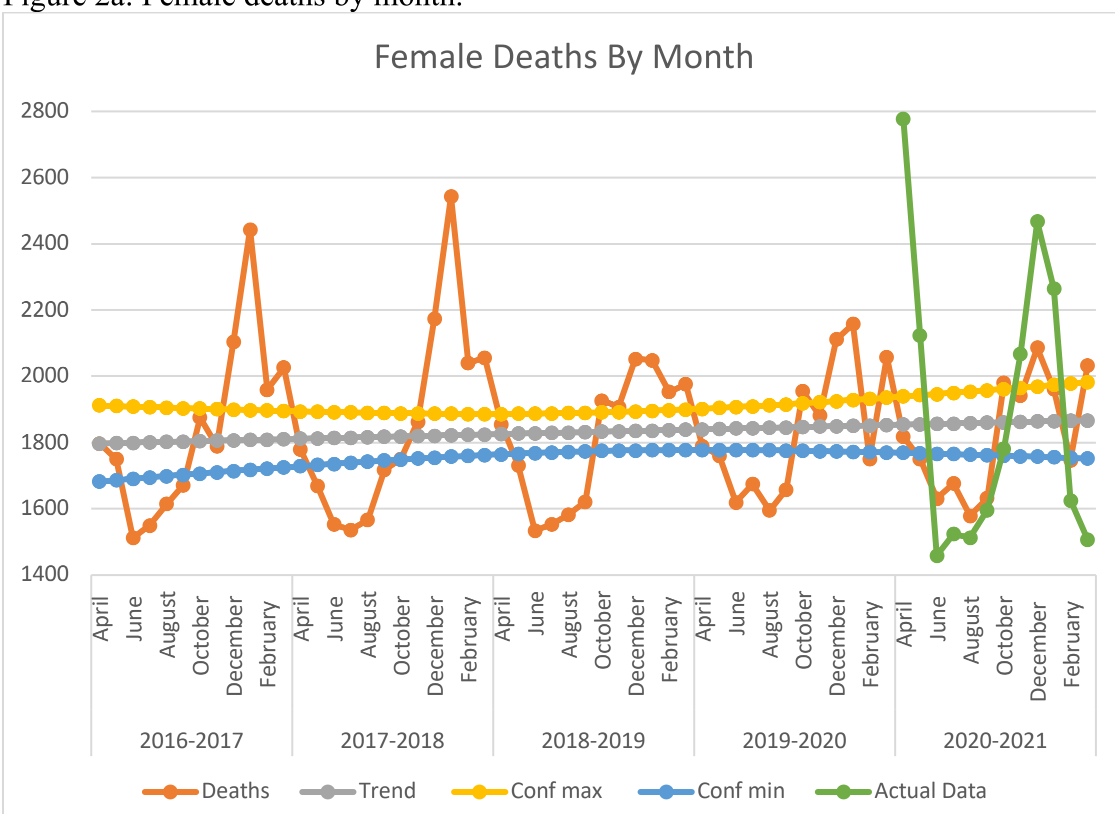

Figure 3a: Male deaths by month.

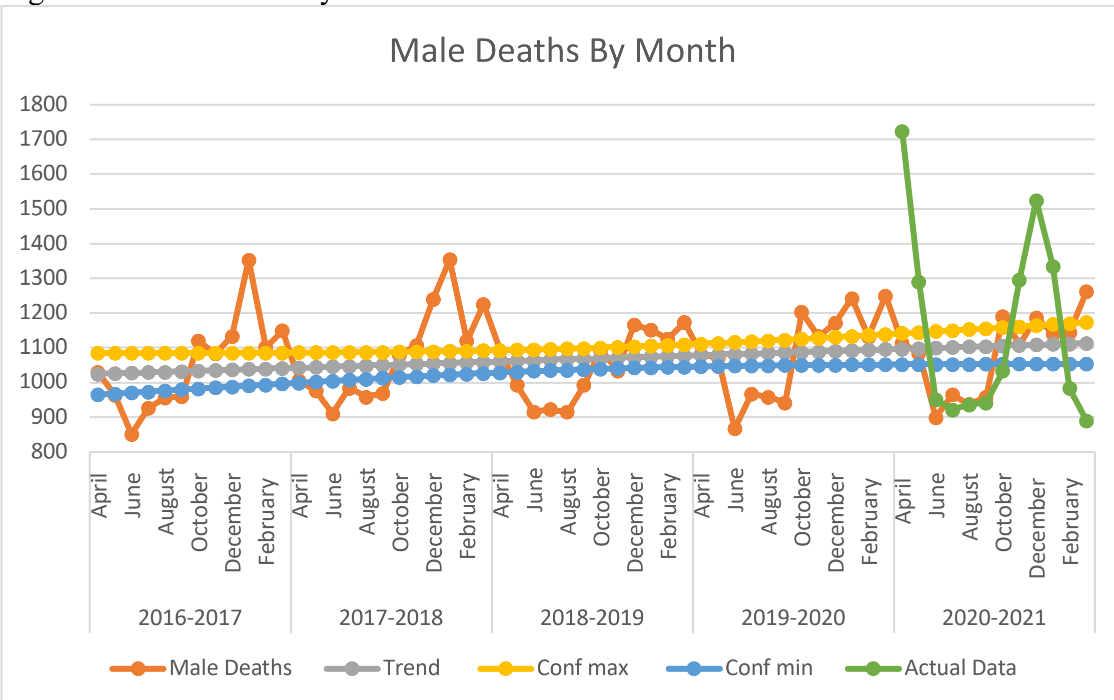

Figure 4a: Deaths in Ontario by Month.

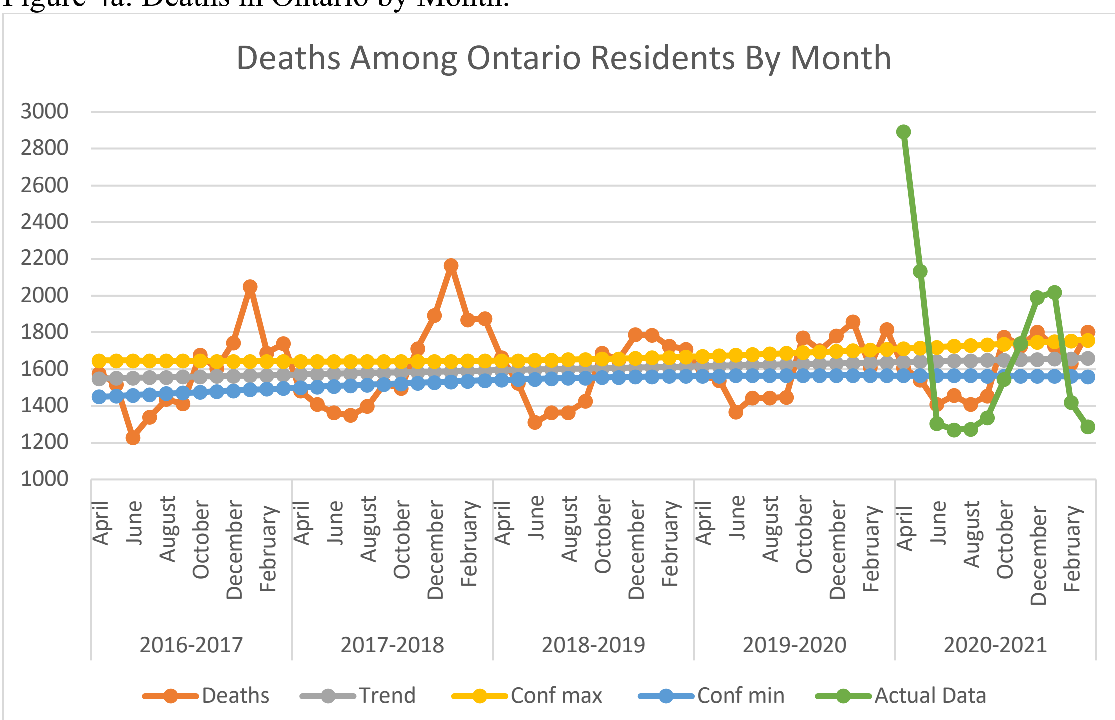

Figure 5a: Deaths in Alberta by Month.

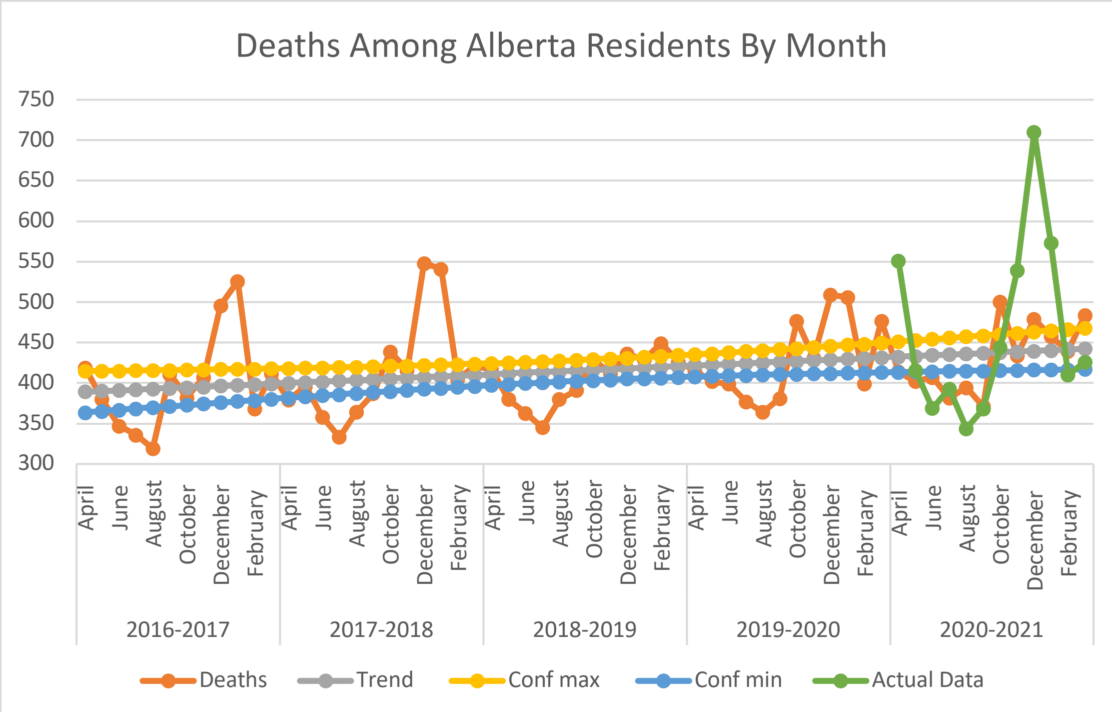

Figure 6a: Deaths in British Columbia by Month.

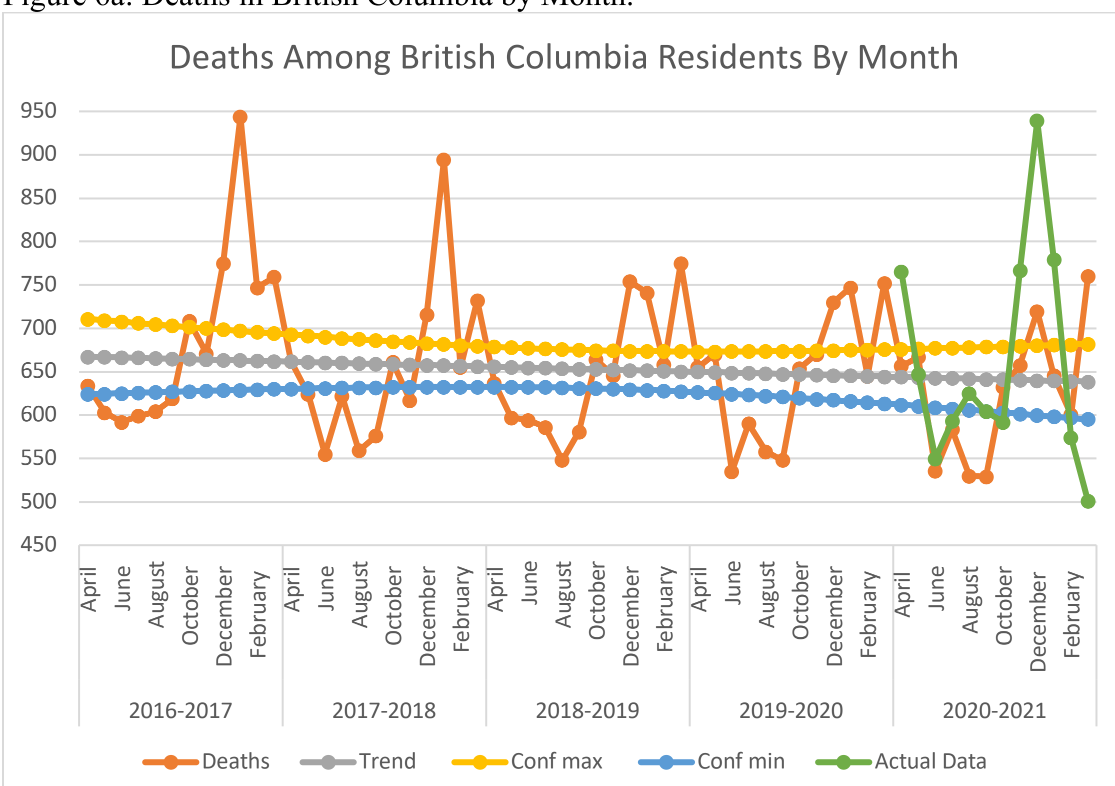

Figure 7a: Deaths in Manitoba by Month.

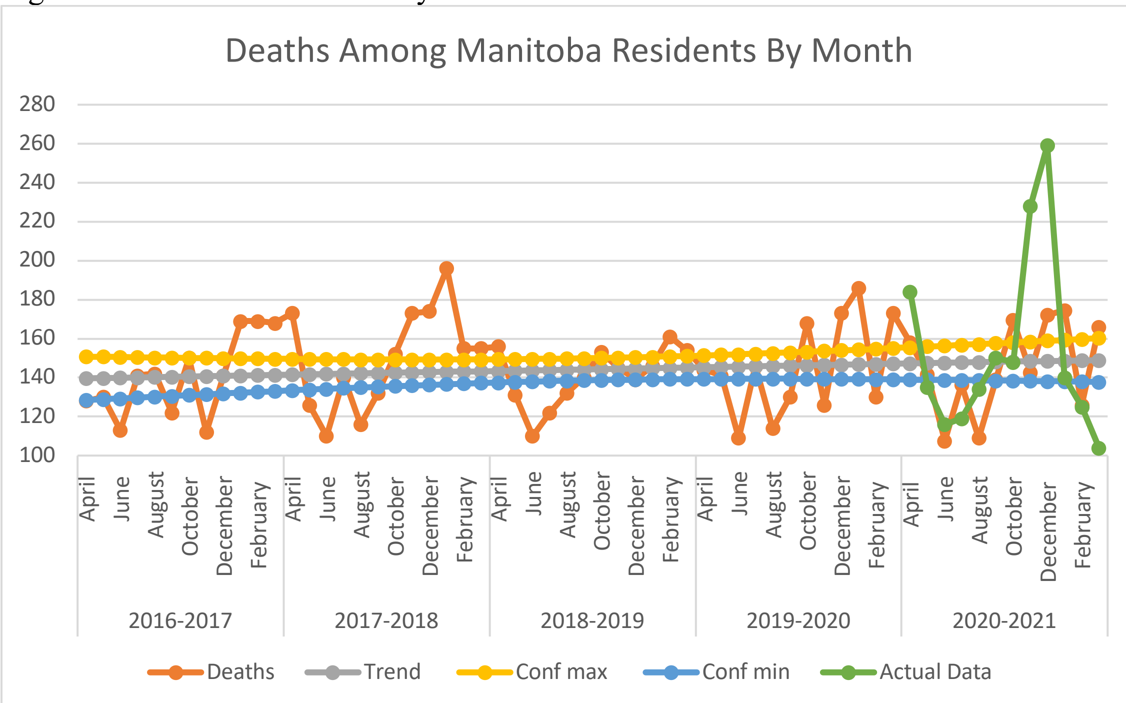

Figure 8a: Deaths in Newfoundland and Labrador by Month.

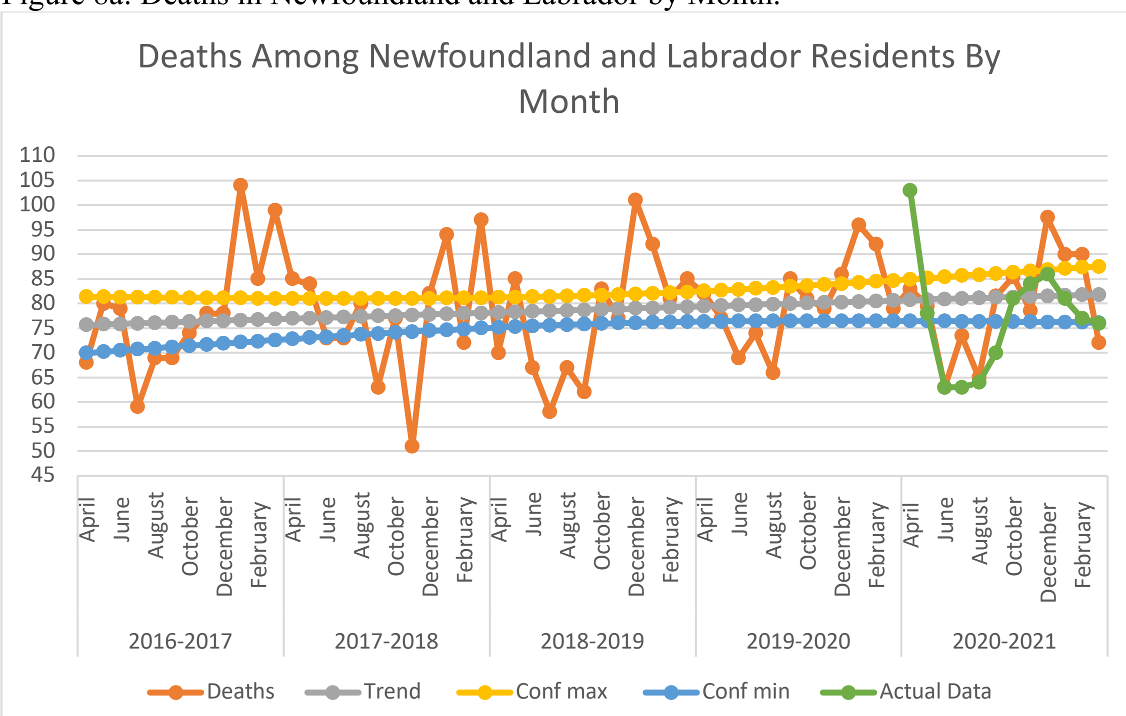

Figure 9a: Deaths among the 65-74 year age bracket by Month.

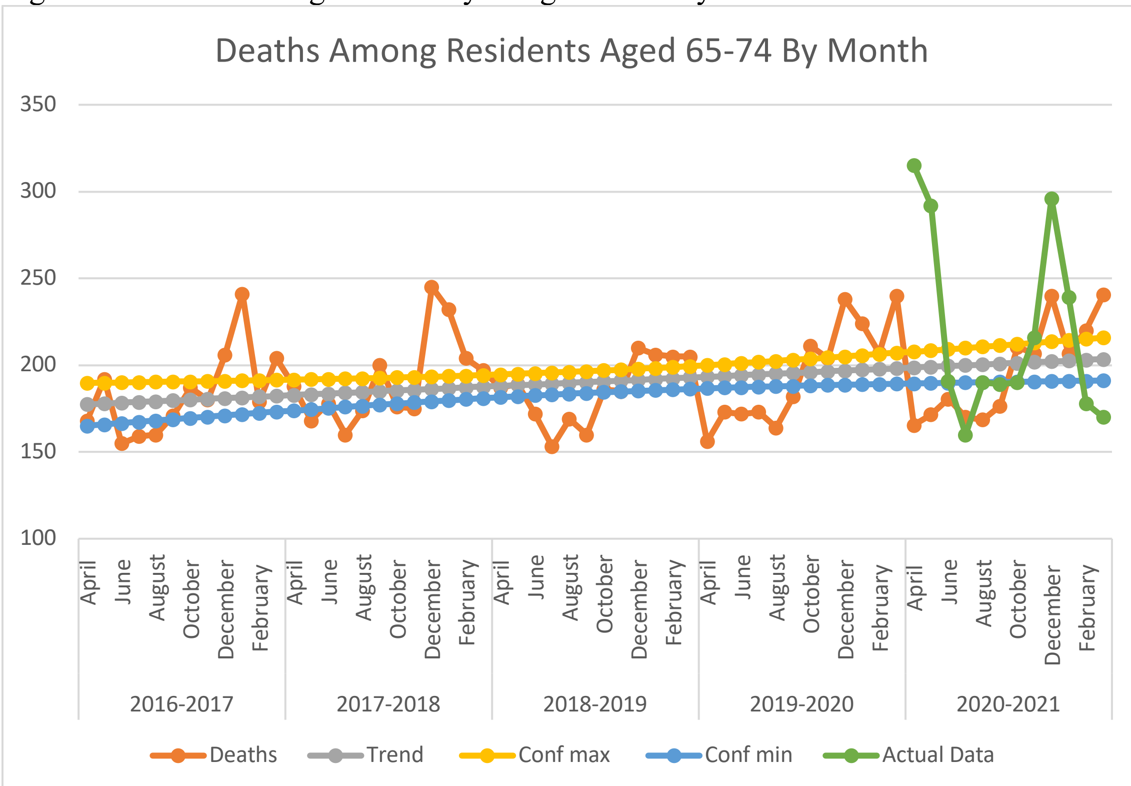

Figure 10a: Deaths among the 75-84 year age bracket by Month.

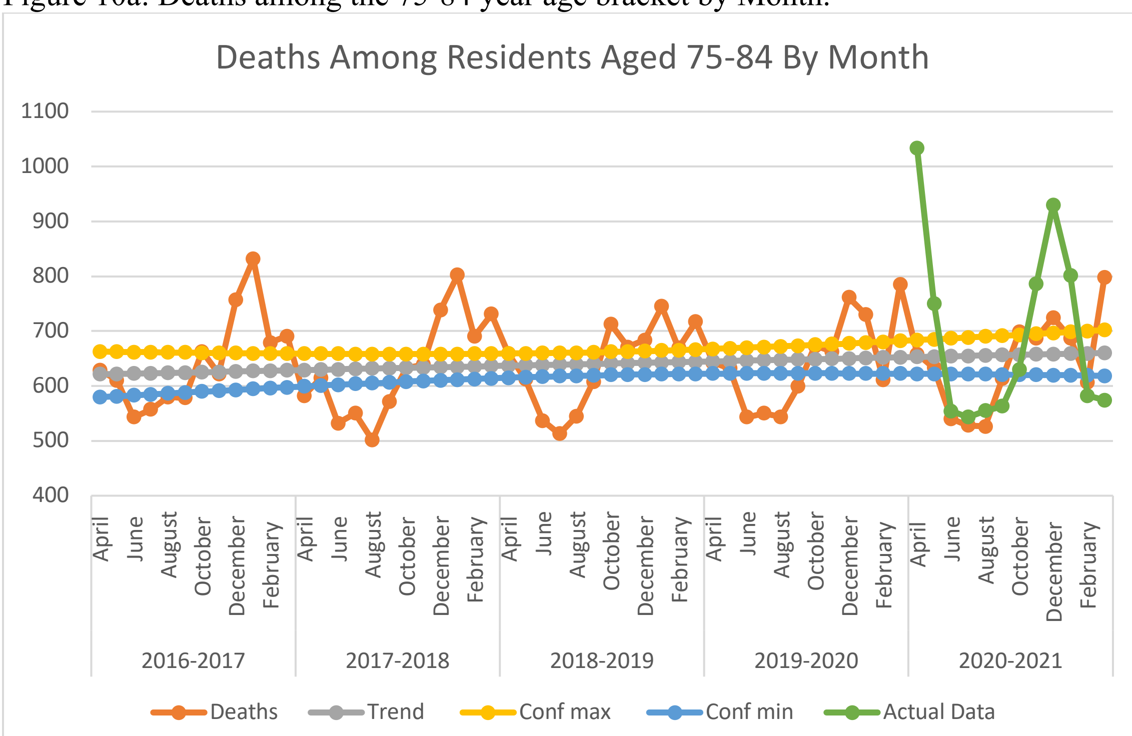

Figure 11a: Deaths among the 85-94 year age bracket by Month.

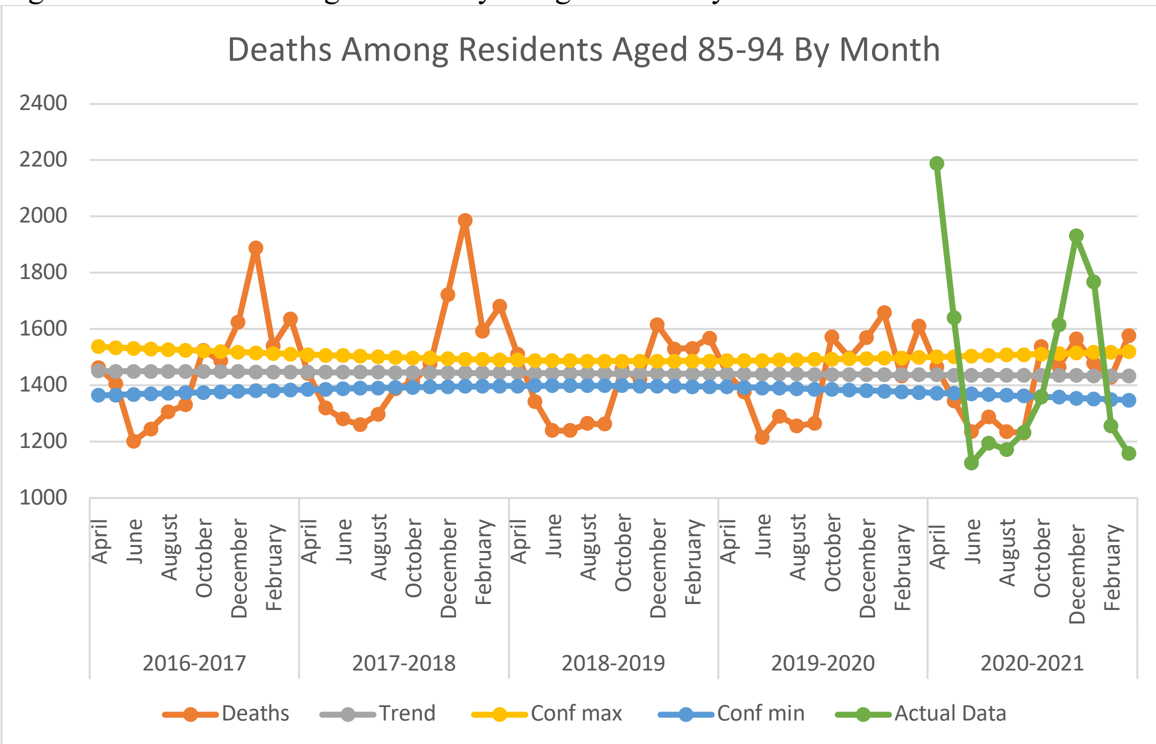

Figure 12a: Deaths in the 95+ age bracket by Month.

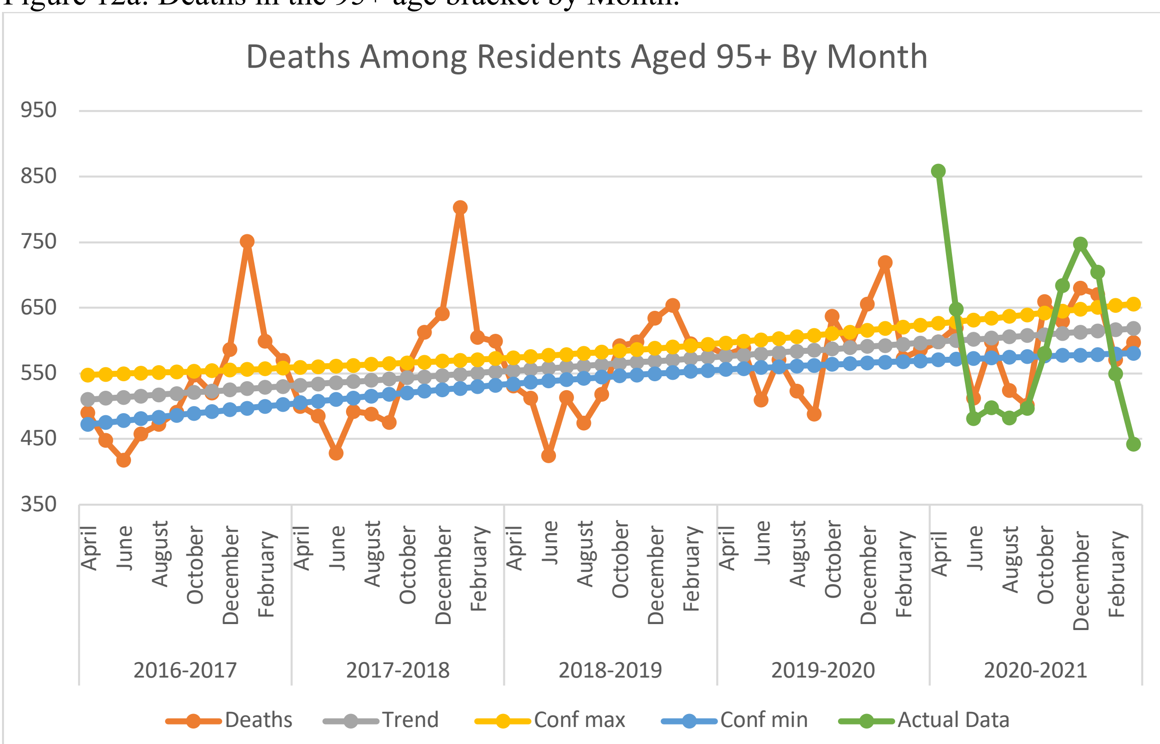

Figure 13a: Total Admissions by Month.

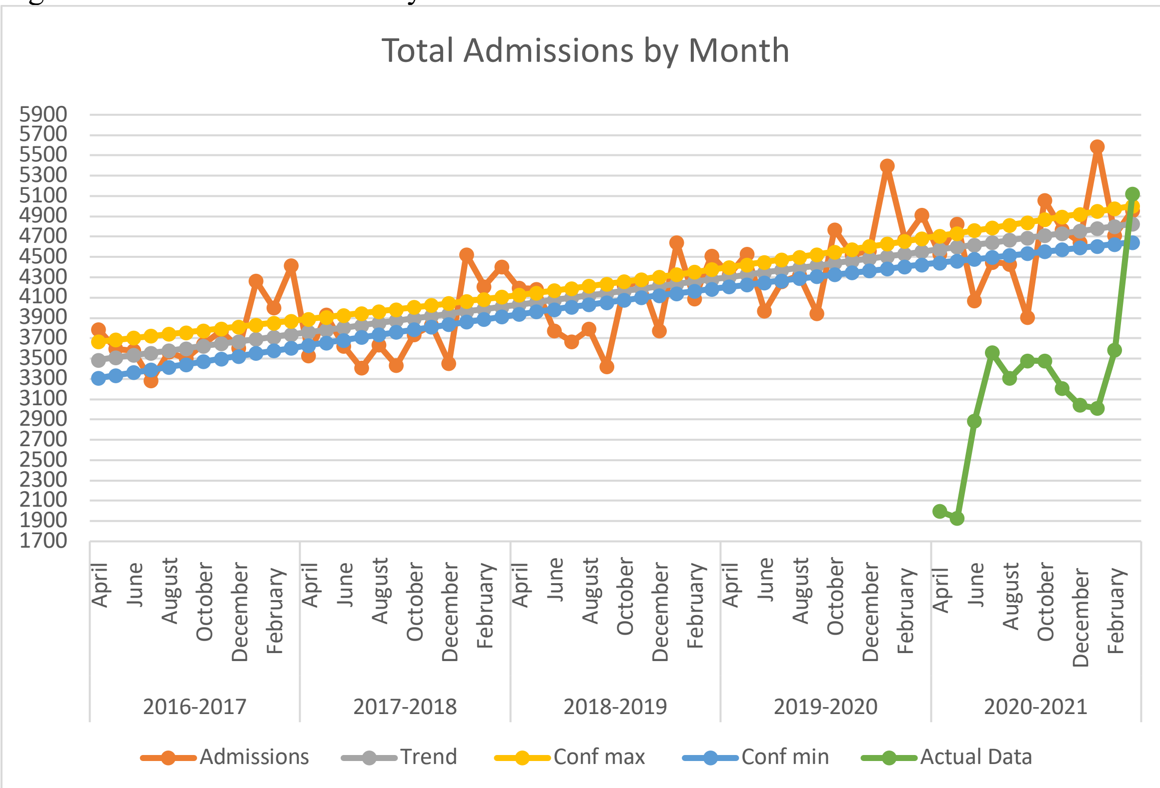

Figure 14a: Female admissions by Month.

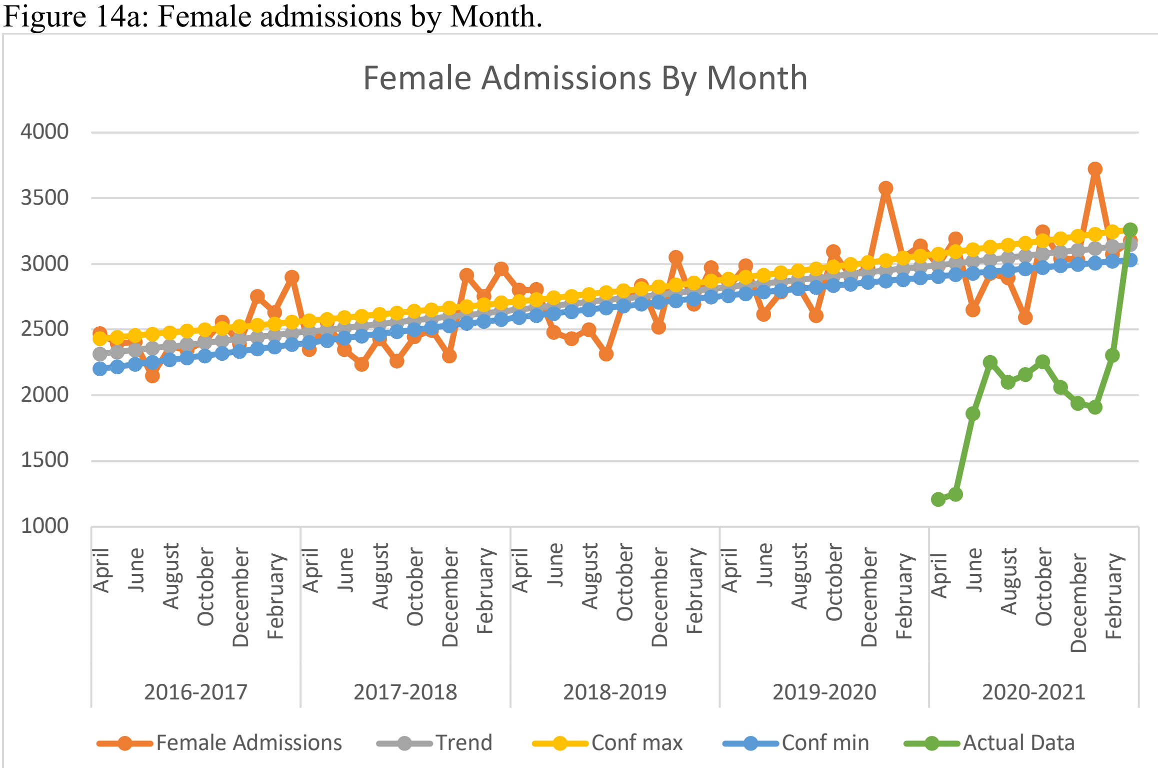

Figure 15a: Male admissions by Month.

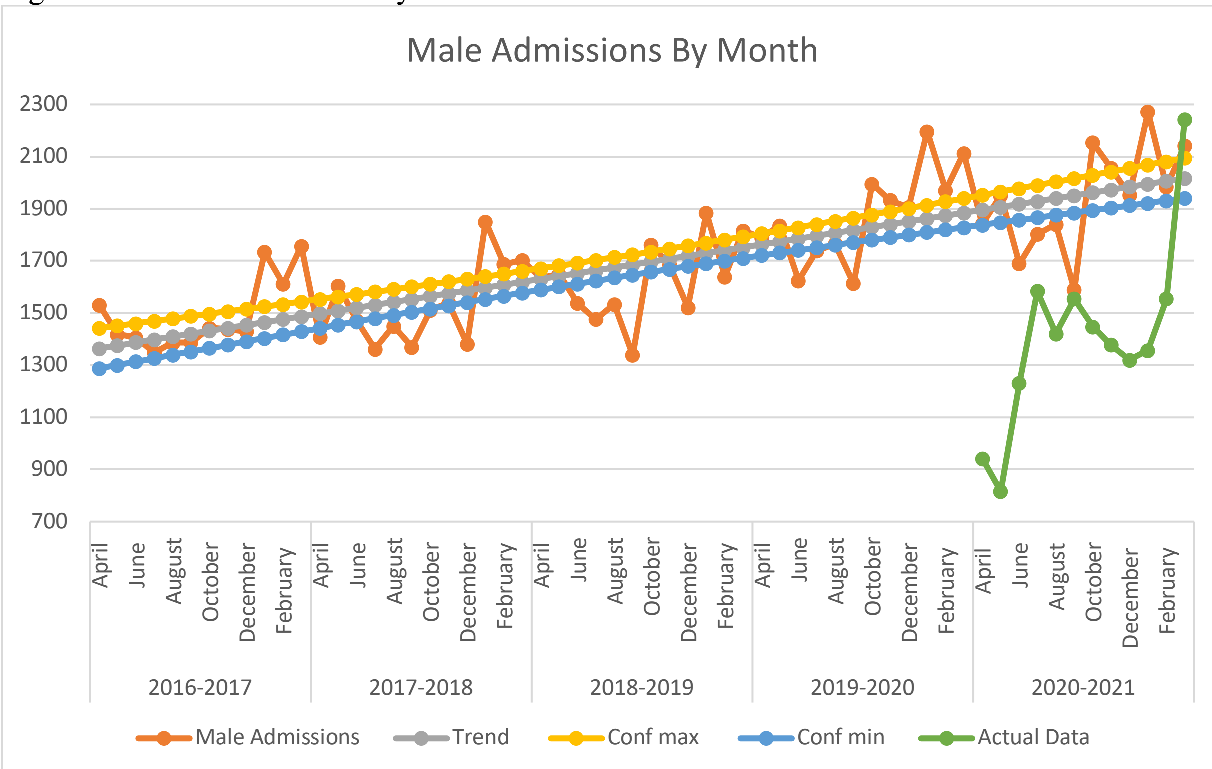

Figure 16a: Admissions in Ontario by Month

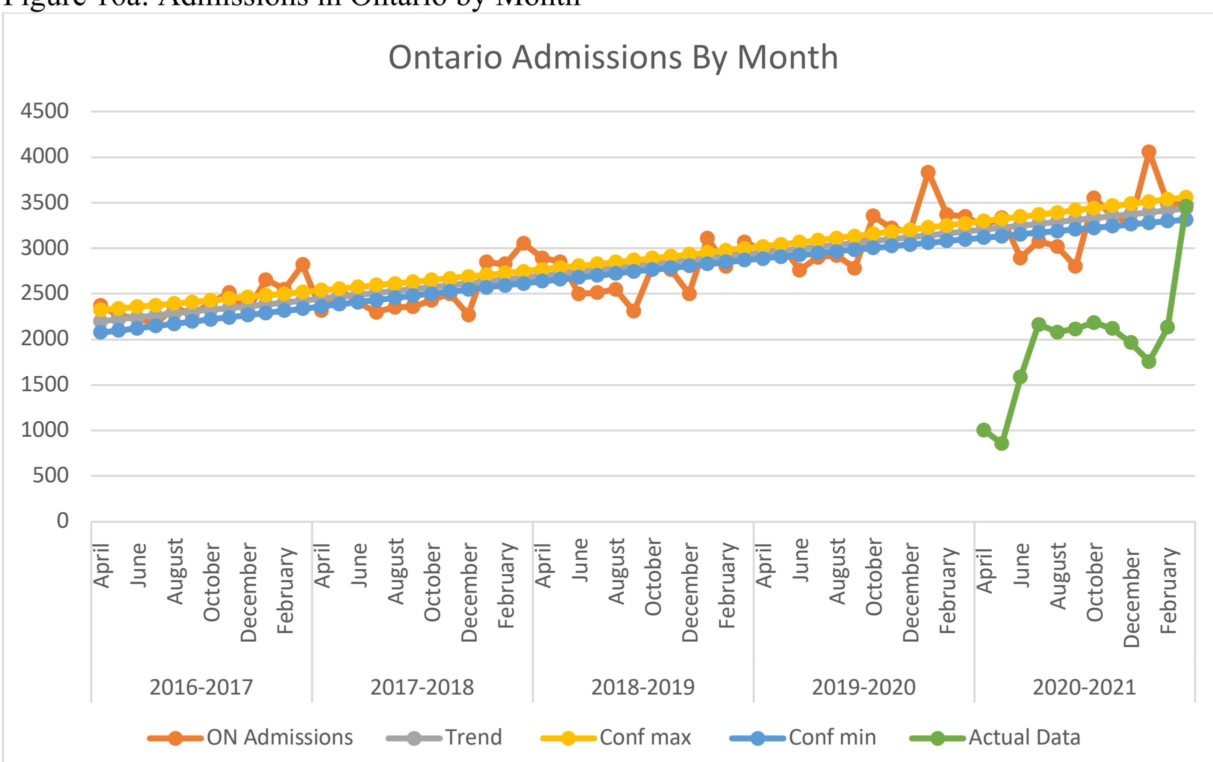

Figure 17a: Admissions in Alberta by Month.

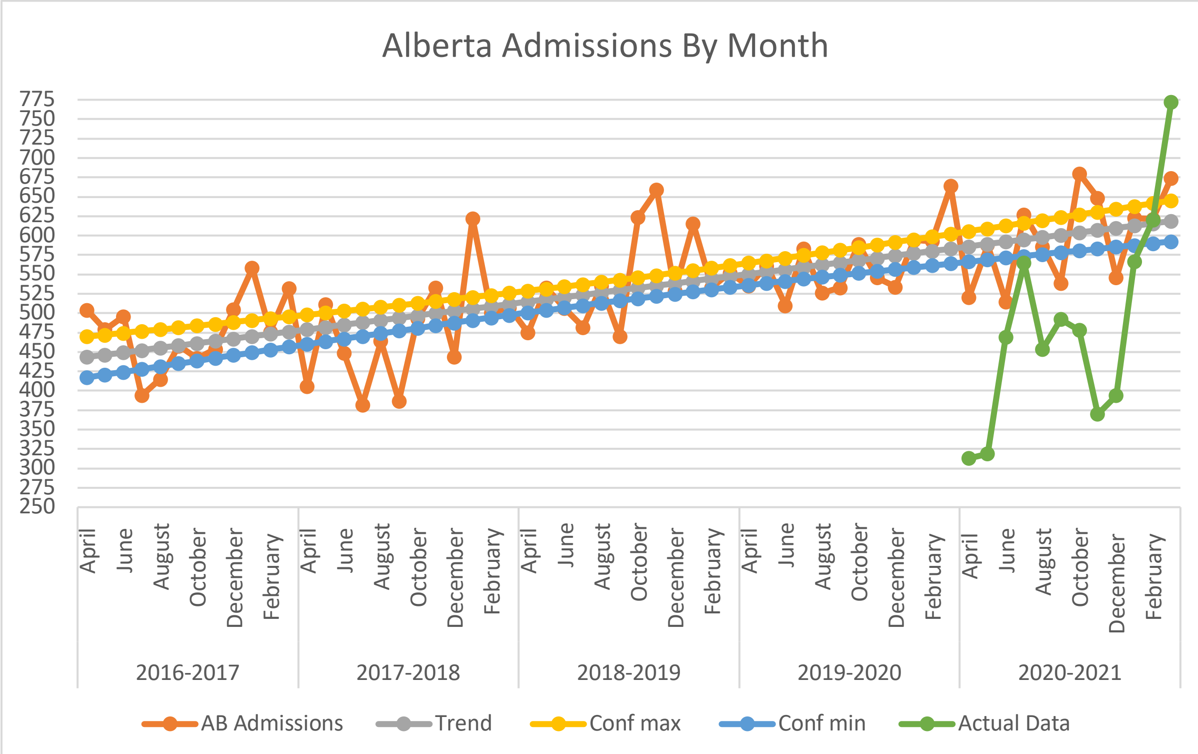

Figure 18a: Admissions in British Columbia by Month.

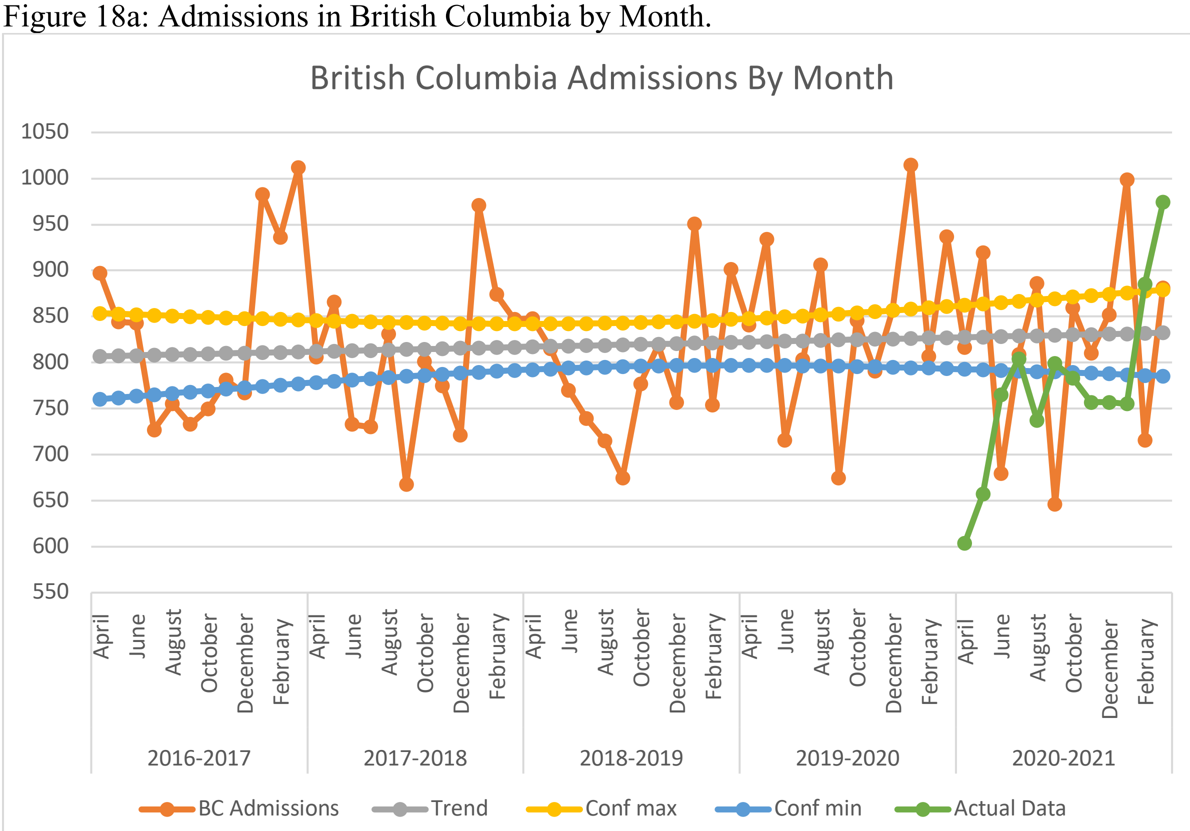

Figure 19a: Admissions in Manitoba by Month.

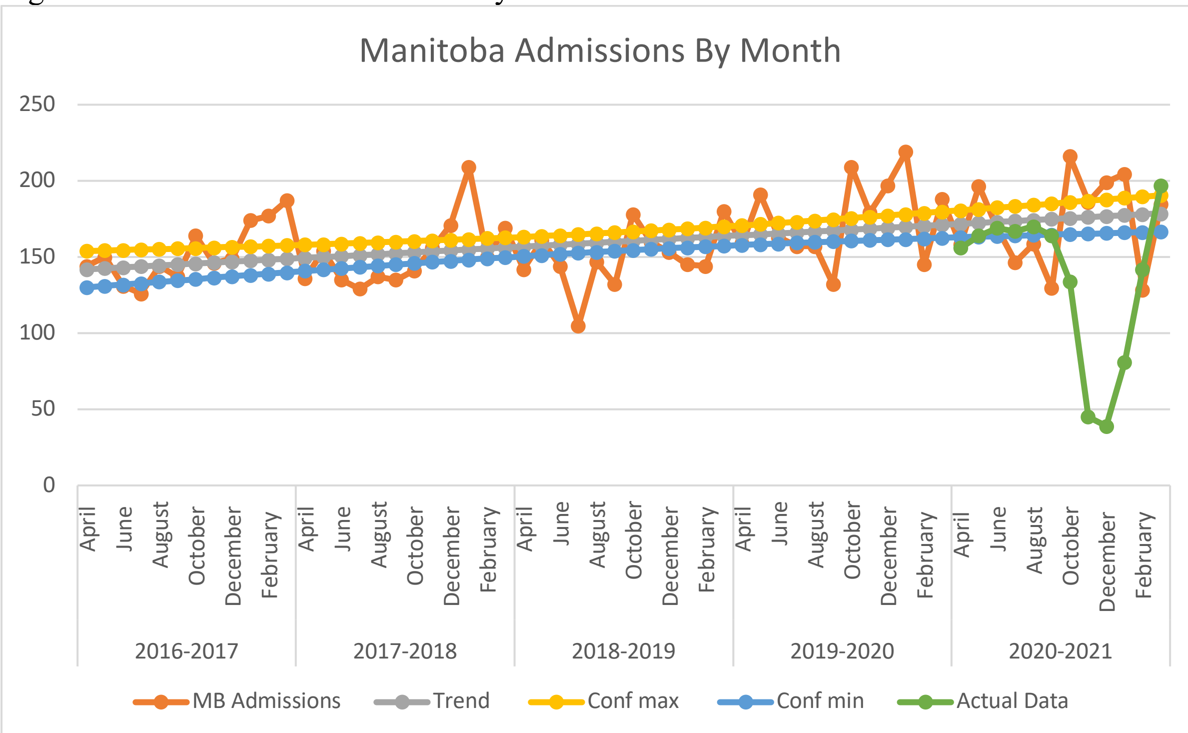

Figure 20a: Admissions in Newfoundland and Labrador in Month.

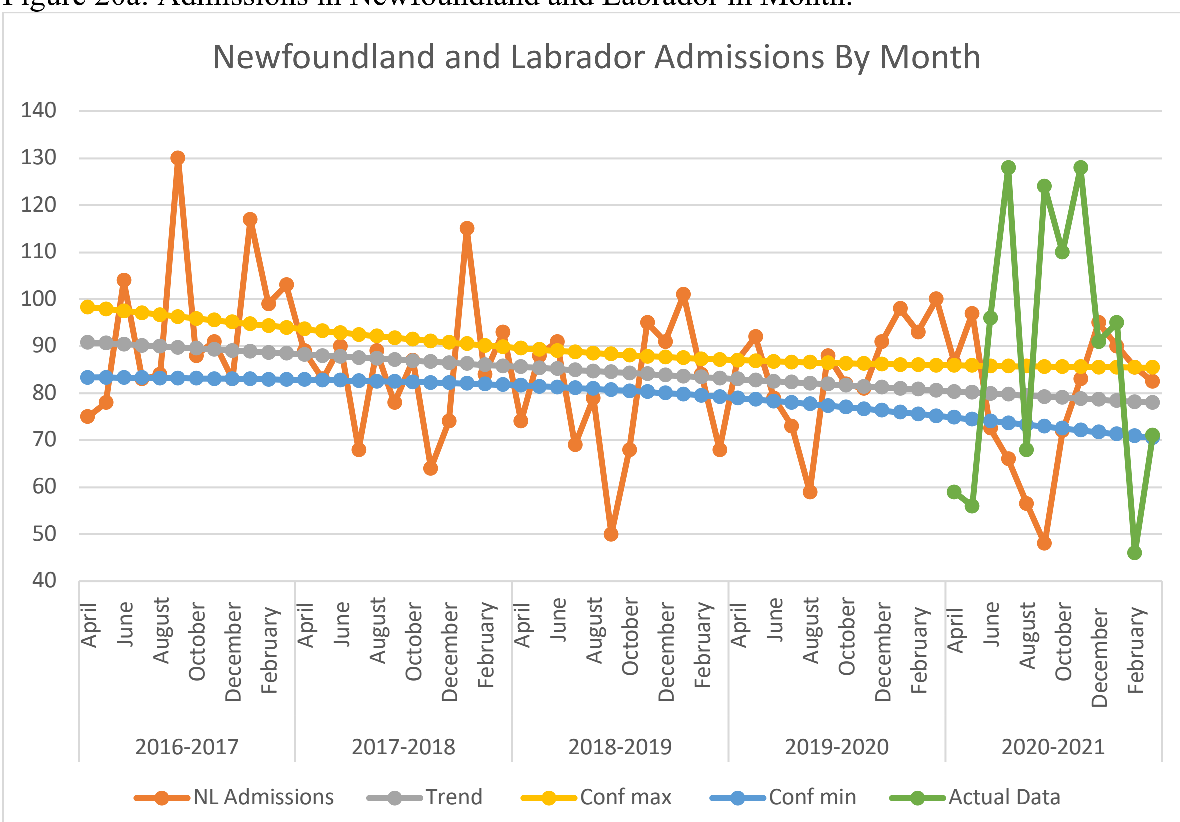

Figure 21a: Admissions in the 65-74 year age group by Month.

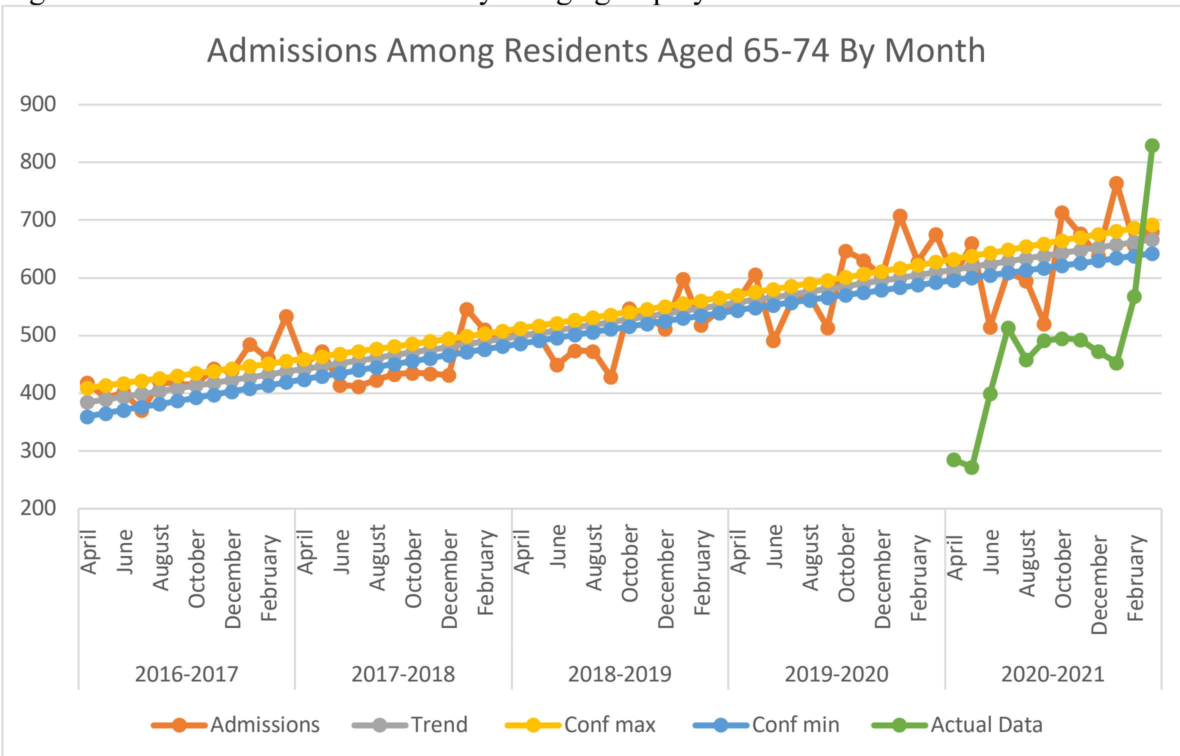

Figure 22a: Admissions in the 75-84 year age group by Month.

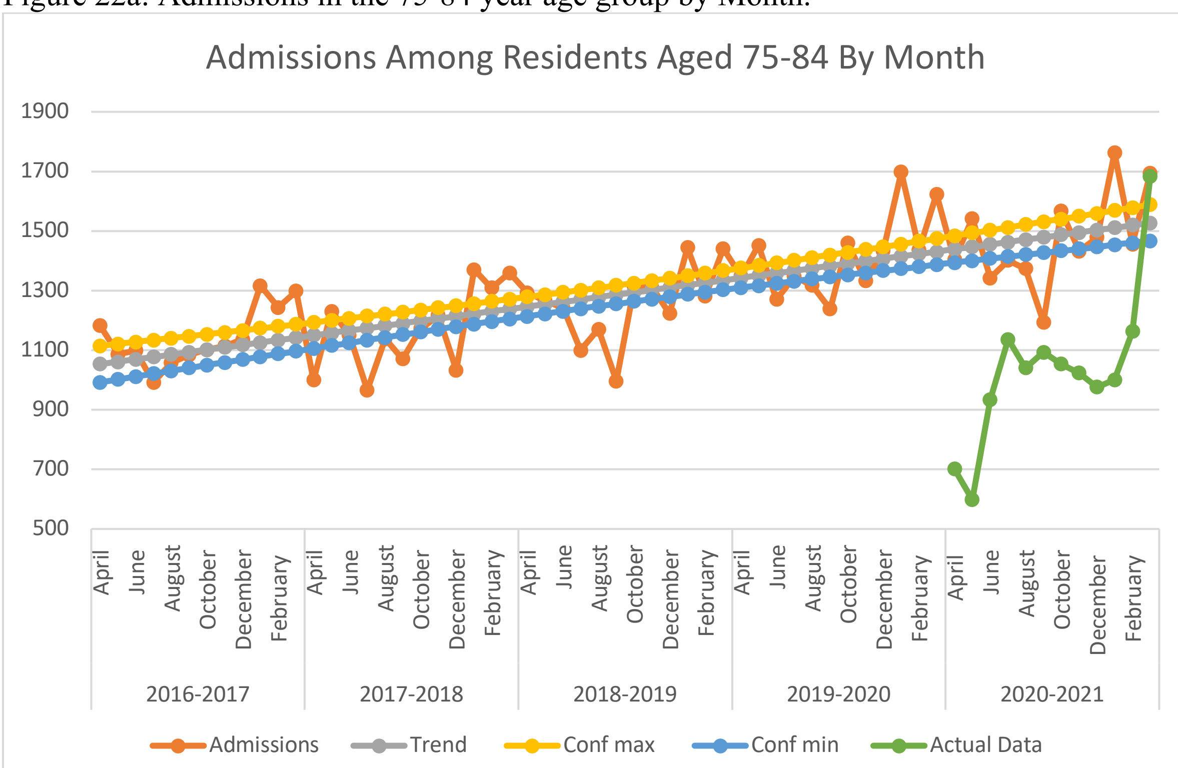

Figure 23a: Admissions in the 85-94 year age group by Month.

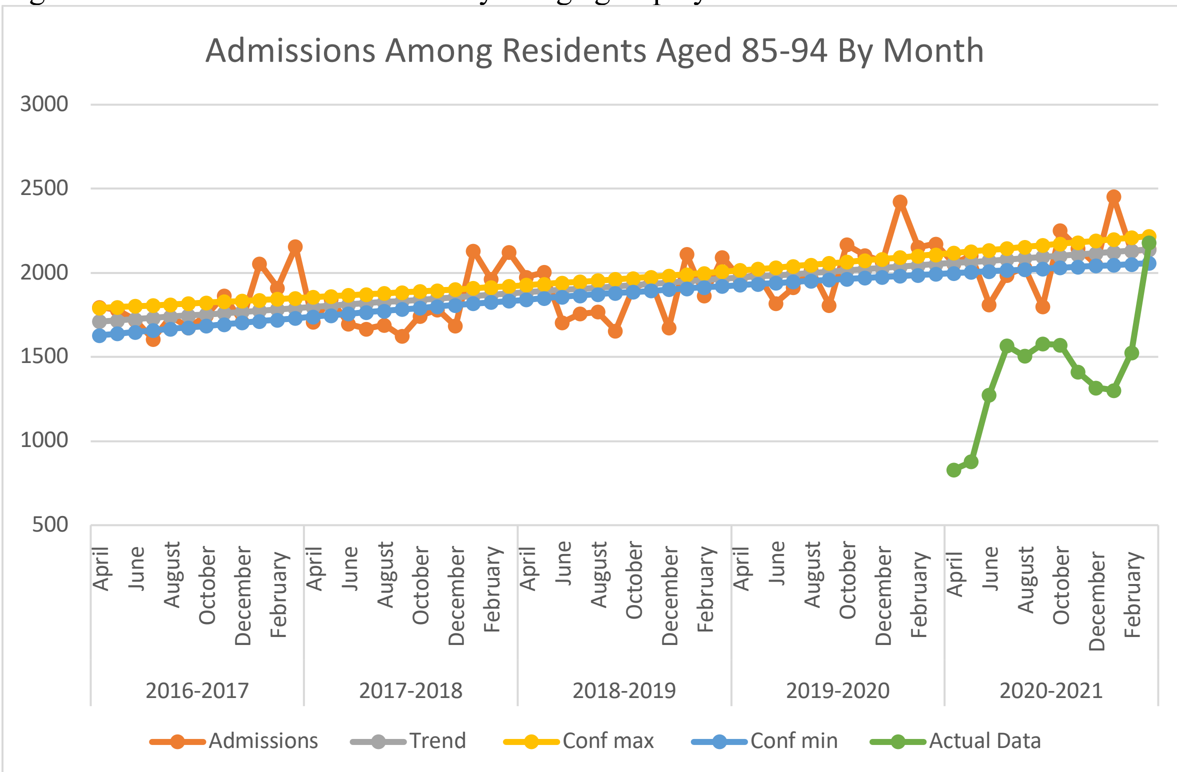

Figure 24a: Admissions in the 85+ age bracket by Month.