Respiratory Outbreaks Trends in Toronto Healthcare Institutions Across the COVID-19 Pandemic*

The Response of Coronavirus and Other Respiratory Diseases to COVID-19 Pandemic Policies

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Through the analysis of Outbreaks in Toronto Healthcare Institutions (2019-2025), this paper seeks to identify the trends in respiratory infections in Toronto healthcare institutions during the implementation and later lifting of COVID-19 preventative policies. Through data visualization this analysis finds that while reported Coronavirus outbreaks have decreased since the pandemic, non-Coronavirus respiratory outbreaks such as Influenza, Parainfluenza (PIV), Respiratory Syncytial Virus (RSV), Metapneumovirus (MPV), and Rhinovirus (RV) outbreaks have risen from the lower levels they were at during the pandemic. Concurrently, Coronaviruses have become a lesser percentage of respiratory causative agents in outbreaks. Given different respiratory diseases require different treatment, testing, and prevention, these findings are relevant for informing healthcare facilities of steps to take to mitigate and manage outbreaks.

1 Introduction

On January 25, 2020, the first case of COVID-19 was reported in Canada, in a healthcare facility in Toronto (Cheese 2025). Around two months later on March 17, Doug Ford declared a state of emergency for Ontario, and the closure of facilities such as schools. Additionally, mask mandates, social distancing guidelines, and vaccine cards were all put into place to mitigate the spread of the disease. Later around 2022, these restrictions began to lift. Schools went back in person, etc, etc, etc. (Comartin and Ilunga 2022). As the restrictions lift, it

*Code and data are available at: [https://github.com/EveHughes/Donaldson-Paper].

becomes important to characterize the effect they hold upon respiratory diseases both as a whole, and specific diseases.

Previously, in 2021, research was conducted to examine the effects of covid protocol on other respiratory diseases, finding evidence for a decrease in disease during covid protocol(Groves et al. 2021). However, there is a lack of literature examining the effects of the lifting of protocol on these same diseases, and examining the general trends. This research aims to fill that gap, and identify how diseases have reacted to the lifting of covid protocol in relation to both their pre covid (2019), and during covid (2020-2022 ish) levels. Doing such can inform policy that encourages disease-specific preventative measures, and promotion of vaccines to prevent increased outbreaks.

This analysis first examines the trends in the overall number of outbreaks and respiratory outbreaks each year to better understand how the number of outbreaks has been varying over the years and identify general trends. Then, it looks at coronavirus, Influenza (A & B), Parainfluenza, Respiratory Syncytial Virus (RSV), Metapneumovirus, and Rhinovirus. Finally, it examines the trends in percentage of respiratory outbreaks with covid as an agent. Through the data visualization, it was found that while coronavirus outbreaks have been falling since their covid levels, other respiratory diseases have been seeing a subsequent increase in cases post pandemic. Additionally, the percentage of respiratory outbreaks with covid as an agent has been decreasing since the pandemic. So, while an emphasis on covid specific protocols is important, preventative measures for other respiratory diseases, such as RSV vaccines, that were overshadowed during the pandemic should be further encouraged (Canada 2024).

In the sections that follow are a description of the data, visualization of the data and discussion of the results.

2 Data

2.1 Raw Data

Outbreaks in Toronto Healthcare Institutions data is provided by Toronto Public Health., and is obtained from the OpenData Toronto Portal. The dataset is updated weekly on Thursdays with data as of the Wednesday at 2pm.(Health 2025).

The dataset consists of data from years 2016-2025 inclusive, with each containing instances of outbreaks in toronto healthcare institutions.

"Under the Ontario Health Protection and Promotion Act (HPPA), healthcare institutions (hospitals, long-term care homes and retirement homes) are required to monitor staff and patients/residents for signs and symptoms of gastroenteric (e.g., nausea, vomiting, diarrhea, fever) and respiratory (e.g., cough, runny nose, sore throat, fever) infections. Healthcare institutions must also actively look for, detect and report suspected and/or confirmed outbreaks to their local public health unit"

For every record there is an id number, institution name, institution address, outbreak setting (type of facility), type of outbreak, causative agent-1, causative agent-2, date outbreak began, date outbreak ended, and whether the outbreak is currently active. Below is a preview of this information:

The type of outbreak is listed as Respiratory, Enteric, or Other. By the Ministry of Health, a respiratory outbreak is constituted by "Two cases of acute respiratory infections (ARI) within 48 hours with any common epidemiological link (e.g., unit, floor), at least one of which must be laboratory-confirmed; OR Three cases of ARI (laboratory confirmation not necessary) occurring within 48 hours with any common epidemiological link (e.g., unit, floor). (Health 2023).

Healthcare facilities include ….

Causative Agent-1 is either a specific agent (ie: Coronavirus), or "Unable to identify". Causative Agent-2 is either a specific agent, or "None".

Below is an example of the raw data from 2019:

_id	Type of Outbreak	Causative Agent-1	Causative Agent-2
1	"Respiratory"	"Coronavirus"	""
2	"Respiratory"	"Influenza A (H1)"	""
3	"Respiratory"	"Influenza A (Not subtyped)"	""
4	"Respiratory"	"Influenza A (H1)"	""
5	"Respiratory"	"Influenza A (H1)"	""

2019 Raw Data

For this analysis, the variables of interest are the yearly number of outbreaks for Influenza (A & B), Parainfluenza, Respiratory Syncytial Virus (RSV), Metapneumovirus, and Rhinovirus. Over 2019-2024.

2.2 Analysis Data

To simulate, test, download, and clean the Outbreaks in Toronto Healthcare Institutions (2019-2024), the statistical programming language Python was used (Python Core Team 2019). Specific libraries that assisted the analysis include `numpy` (Harris et al. 2020), `matplotlib` (Hunter 2007), and `polars` (Vink and Polars Contributors 2025).

For each year, the number of cases were aggregated, and were aggregated within each respective category. The diseases of interest were: Coronavirus Influenza (A & B), Parainfluenza, Respiratory Syncytial Virus (RSV), Metapneumovirus, and Rhinovirus. Instances of coronavirus and covid-19 were grouped together under the title of "coronavirus", given covid is

caused by a coronavirus. Influenza A & B were additionally grouped together under the title "Influenza".

Below is a sample of the cleaned data:

Year	Coronavirus	Other	Unknown	Total Agents
2019	2	202	75	279
2020	414	105	20	539
2021	359	25	2	386
2022	987	118	13	1118
2023	735	287	41	1063

A line plot on a polar axis

Year	Corona	Flu	RSV	MPV	RV	PIV	Respiratory	Total
2019	2	121	43	22	15	16	257	317
2020	414	46	21	22	12	7	519	553
2021	359	1	2	1	19	1	385	394
2022	987	47	32	7	30	5	1107	1133
2023	735	44	60	31	112	39	1016	1066

A line plot on a polar axis

Below are the summary statistics for the cleaned yearly count data:

statistic	Corona	Flu	RSV	MPV	RV	PIV	Respiratory	Total
"mean"	519.33	59.17	31.83	19.33	47.17	23.33	706.67	749.17
"std"	340.47	42.7	19.63	12.85	44.39	27.46	363.05	368.54
"min"	2.0	1.0	2.0	1.0	12.0	1.0	257.0	317.0
"25%"	359.0	44.0	21.0	7.0	15.0	5.0	385.0	394.0
"50%"	619.0	47.0	33.0	22.0	30.0	16.0	956.0	1032.0
"75%"	735.0	96.0	43.0	31.0	95.0	39.0	1016.0	1066.0
"max"	987.0	121.0	60.0	33.0	112.0	72.0	1107.0	1133.0

A line plot on a polar axis

3 Results

3.1 Overall Cases:

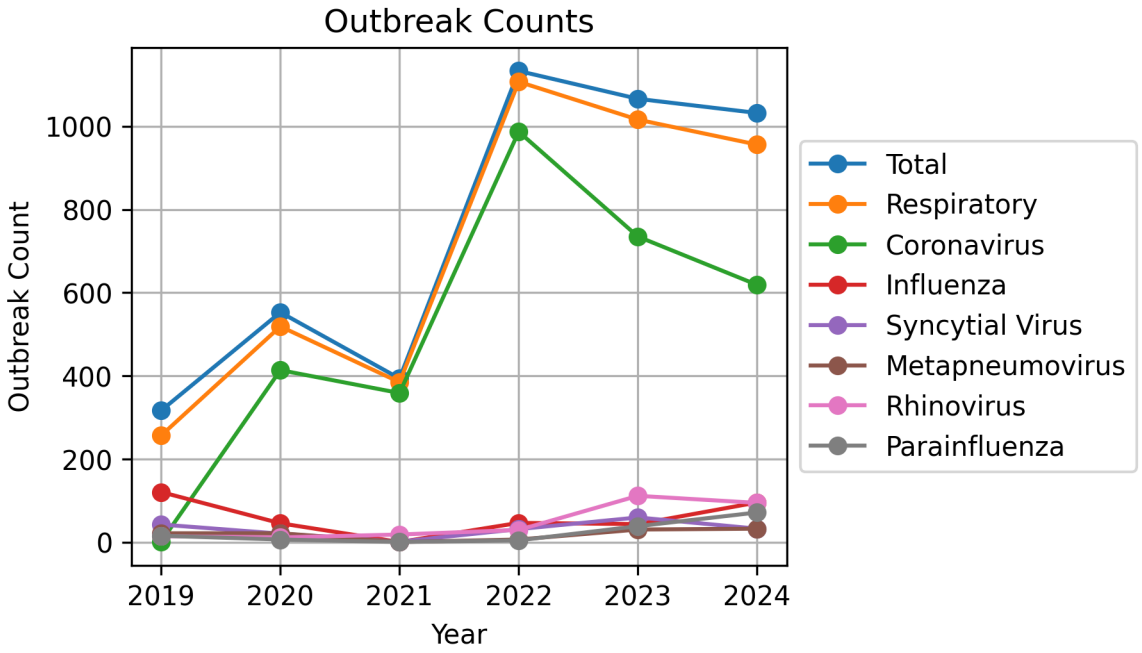

Figure 1: A line plot on a polar axis

We see that the total number of cases fluctuates with the number of respiratory cases, with number of outbreaks increasing since 2019 to 2022, and beginning to decrease afterwards.

The number of coronavirus cases also fluctuates with the number of respiratory cases and total cases, following the same trend described above.

3.2 Makeup of Respiratory Outbreaks

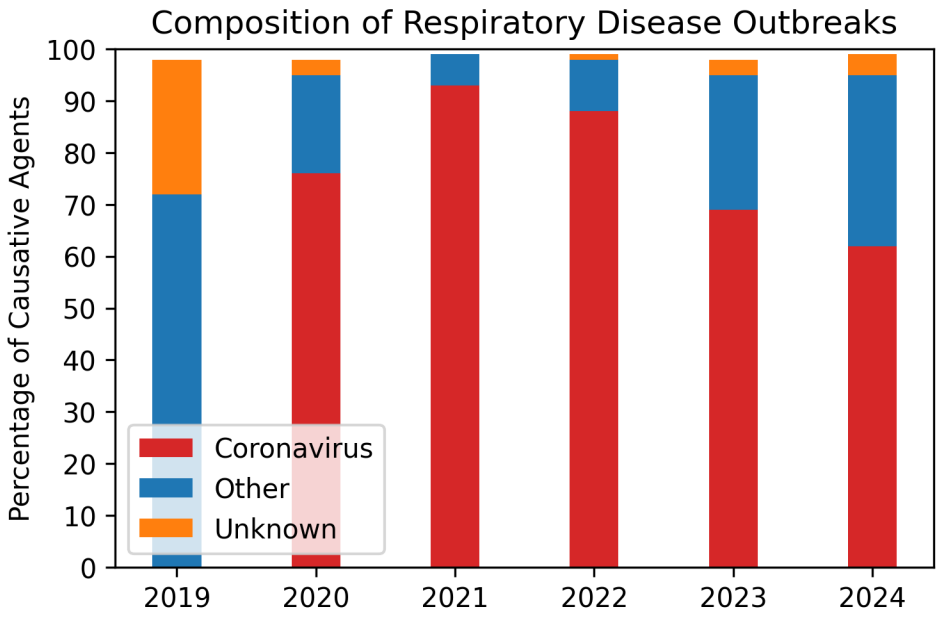

Figure 2: Makeup of Respiratory Outbreaks from 2019-2024 inclusive

It becomes evident that since the end of the pandemic, the proportion of Coronavirus outbreaks compared to non-coronavirus outbreaks has been steadily decreasing.

3.3 Non-Covid Respiratory Outbreaks

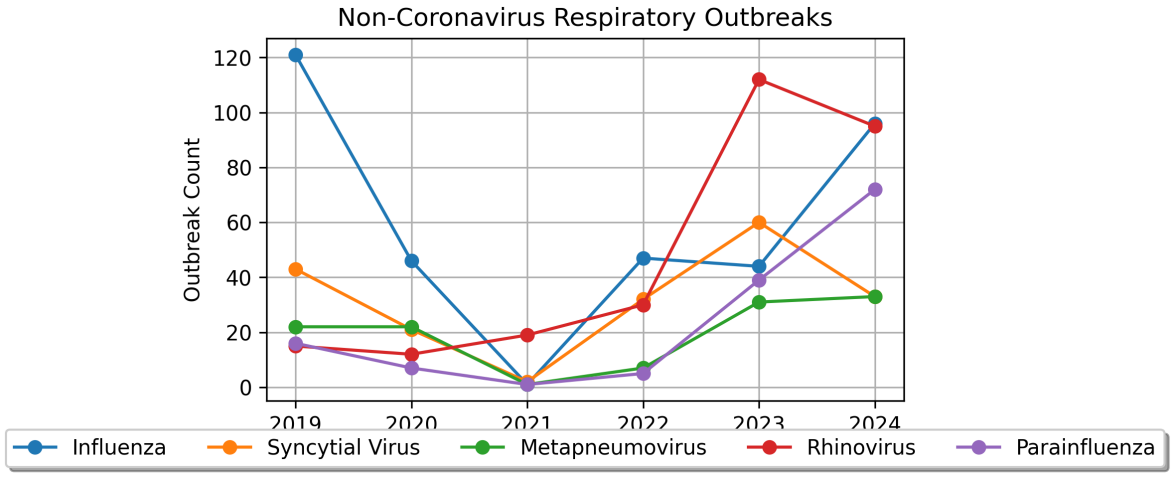

Figure 3: A line plot on a polar axis

We see the number of Influenza (A & B), Parainfluenza, Respiratory Syncytial Virus (RSV), Metapneumovirus, and Rhinovirus outbreaks all generally fell to lower levels during the pandemic (2020-2021). Post pandemic (2022-2024), all, with the exception of Influenza, have resurged to greater than pre-pandemic (2019) levels. Influenza outbreaks have also increased since the pandemic, but remain at a lower level comparative to 2019.

4 Discussion

It becomes apparent that given coronaviruses continue to comprise the greatest proportion of respiratory disease outbreaks in healthcare facilities in Toronto, and coronavirus outbreak trends match those of total respiratory outbreaks from, and total outbreaks from 2019-2024 that coronavirus outbreaks remain the biggest driver of disease outbreaks in Toronto. However, since the pandemic we have seen a decrease in both coronavirus cases, and percentage composition of all agents, indicating that its impact, while still pertinent, is decreasing.

Simultaneously, other respiratory infections including Influenza, Parainfluenza, RSV, Metapneumovirus, and Rhinovirus have been experiencing a significant increase in outbreak cases. Though respiratory infections such as Influenza are well known to the public, those such as RSV are known to a much lesser extent with only 40% of adults having heard of RSV, and 30% who would definitely get the RSV vaccine. Compared to Influenza, this is a much lesser. (Health 2023). It is important to note that while these respiratory infections are less deadly

than covid (Grangier 2024), many of these healthcare facilities are long term healthcare facilities, whose populations are more susceptible to these viruses (Centers for Disease Control and Prevention 2024).

Altogether, this suggests a slightly greater emphasis should be placed on non-covid respiratory diseases, specifically RSV given it is the only one of the above which has a vaccine available which is not widely known, and outbreak numbers have risen in recent years post-pandemic. By campaigning for increased RSV vaccinations, when outbreaks do occur in healthcare facilities, they will be less deadly.

4.1 Weaknesses and next steps

The main limitation of this study is the scale. All data is at the scale of healthcare facilities, thus must remain in the context of such. Extension of these results to the general Toronto population may be misrepresentative, thus to confirm the same trends hold in the general public further research should be conducted with data coming from the general population.

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