Respiratory Outbreak 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 data (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 that 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. Mask mandates, social distancing guidelines, and vaccine cards were all implemented to mitigate the spread of the disease. Later, around 2022, these restrictions slowly began to lift. On March 14, 2022, vaccination requirements were lifted, on March 21, 2022, social distancing regulations were lifted, and on April 27, 2022, all remaining COVID-19 regulatory policies and restrictions

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

expired(Comartin and Ilunga 2022). Given that changes in outbreak count and type heavily impact healthcare facilities, it becomes important to characterize the effect of the lifting of COVID-19 regulations on respiratory diseases as a whole, as well as specific respiratory diseases.

Previously, in 2021, research was conducted to examine the effects of COVID-19 protocol on non-Coronavirus respiratory diseases, finding evidence for a decrease in disease during the restrictions (Groves et al. 2021). However, there is a lack of literature examining the effects of lifting the protocol on these same respiratory diseases. This paper aims to improve upon that deficit and identify how diseases have reacted to the lifting of COVID-19 protocol in relation to both their pre-pandemic (2019) and pandemic (2020-2022) 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 the percentage of respiratory outbreaks with COVID-19 or Coronavirus as an agent.

Through the data visualization, it was found that while Coronavirus outbreaks have been falling since their pandemic levels, other respiratory diseases have been seeing a subsequent increase in cases post-pandemic. Additionally, the percentage of respiratory outbreaks with COVID-19 or Coronavirus as an agent has decreased 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 what follows is a description of the data (Section 2), a visualization of the data (Section 3), and an analysis of the visualization (Section 4).

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 (Health 2025). The dataset consists of data from years 2016-2025 inclusive, with each containing instances of outbreaks in Toronto healthcare institutions during that year.

Each record includes 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. Table 1 contains a preview of this information.

Table 1: 2019 Raw Data Preview

_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)"	""

Healthcare facilities are defined as any institution that provides a healthcare service, including hospitals and long-term care homes.

According to the Ontario Ministry of Health, a respiratory outbreak is defined as "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).

The type of outbreak is categorized as Respiratory, Enteric, or Other. Respiratory outbreaks refer to outbreaks that affect the respiratory system. Enteric outbreaks refer to outbreaks that affect the gastrointestinal tract.

Causative Agent-1 is either a specific agent (ie: Coronavirus), or marked as "Unable to identify". Causative Agent-2 is either a specific agent or marked as " ".

For this analysis, the variables of interest are the yearly number of outbreaks for Coronavirus/COVID-19, Influenza (Flu), Parainfluenza (PIV), Respiratory Syncytial Virus (RSV), Metapneumovirus (MPV), and Rhinovirus (RV) over the years 2019-2024.

2.2 Analysis Data

2.2.1 Yearly Outbreak Count

To simulate, test, download, and clean the Outbreaks in Toronto Healthcare Institutions (2019-2024), the 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 for each causative agent was aggregated. The causative agents of interest were: Coronavirus, Influenza, Parainfluenza (PIV), Respiratory Syncytial Virus (RSV), Metapneumovirus (MPV), and Rhinovirus (RV). Instances of Coronavirus and

COVID-19 were grouped together under the category “Coronavirus”. Influenza A and Influenza B were additionally grouped together under the category “Influenza”. Table 2 shows the data, and Table 3 shows the summary statistics.

Table 2: Yearly Outbreak Count

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

Table 3: Yearly Outbreak Count Summary Statistics

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

It is important to note that in Table 2, non-Coronavirus respiratory causative agents in 2021 had extremely low outbreak counts. While this could be representative of genuinely surpressed levels of other respiratory outbreaks due to increased COVID-19 cases, it could be indicative of a reporting issue. Further research should be conducted to clarify, though such research is beyond the scope of this paper.

2.2.2 Composition Respiratory Disease Causative Agents

Additionally, for each year, the total number of non-null respiratory causative agents was aggregated, as well as the number of Coronavirus causative agents, non-Coronavirus respiratory causative agents, and unknown respiratory causative agents. Table 4 shows the cleaned data, and Table 5 shows the summary statistics.

Table 4: Count of Respiratory Disease by Coronavirus, Non-Coronavirus, or Other

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
2024	619	332	45	996

Table 5: Respiratory Disease Composition Summary Statistics

statistic	Coronavirus	Other	Unknown	Total Agents
”mean”	519.33	178.17	32.67	730.17
”std”	340.47	117.06	26.46	371.59
”min”	2.0	25.0	2.0	279.0
”25%”	359.0	105.0	13.0	386.0
”50%”	619.0	202.0	41.0	996.0
”75%”	735.0	287.0	45.0	1063.0
”max”	987.0	332.0	75.0	1118.0

3 Results

3.1 Overall Cases:

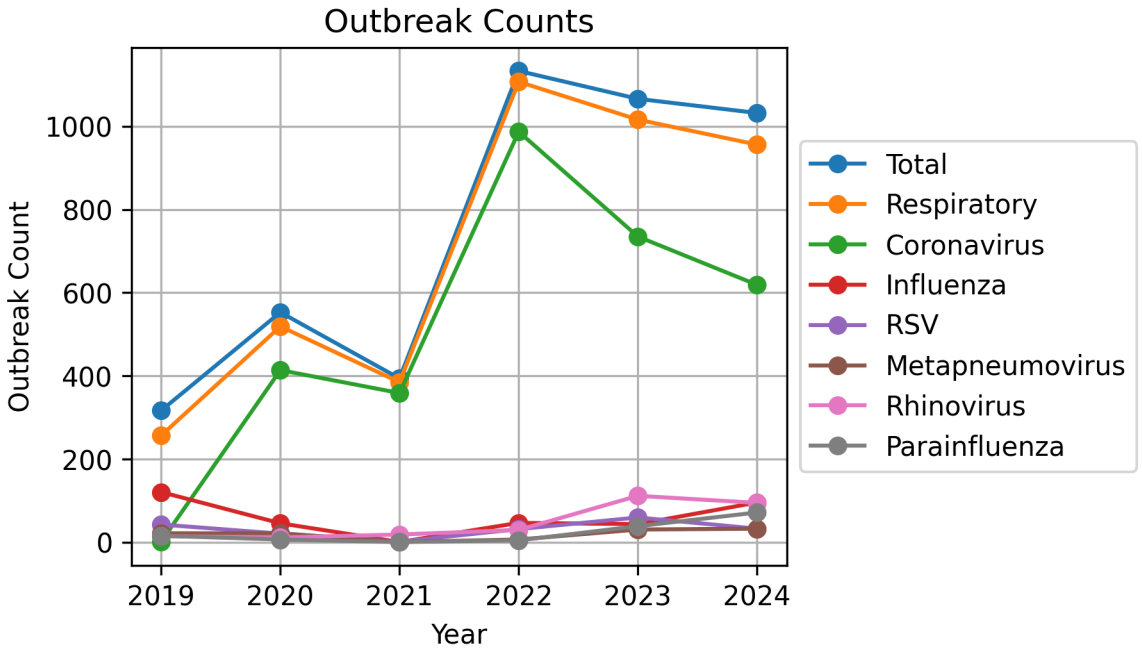

Figure 1: Yearly Outbreak Count

Figure 1 showcases that the annual total number of outbreaks fluctuates with the annual number of respiratory outbreaks. The count of both of these has increased from 2019 to 2022, and began to decrease afterwards. Additionally, the number of Coronavirus outbreaks also fluctuates with the number of respiratory outbreaks and total outbreaks, following the same trend described above.

3.2 Makeup of Respiratory Outbreaks

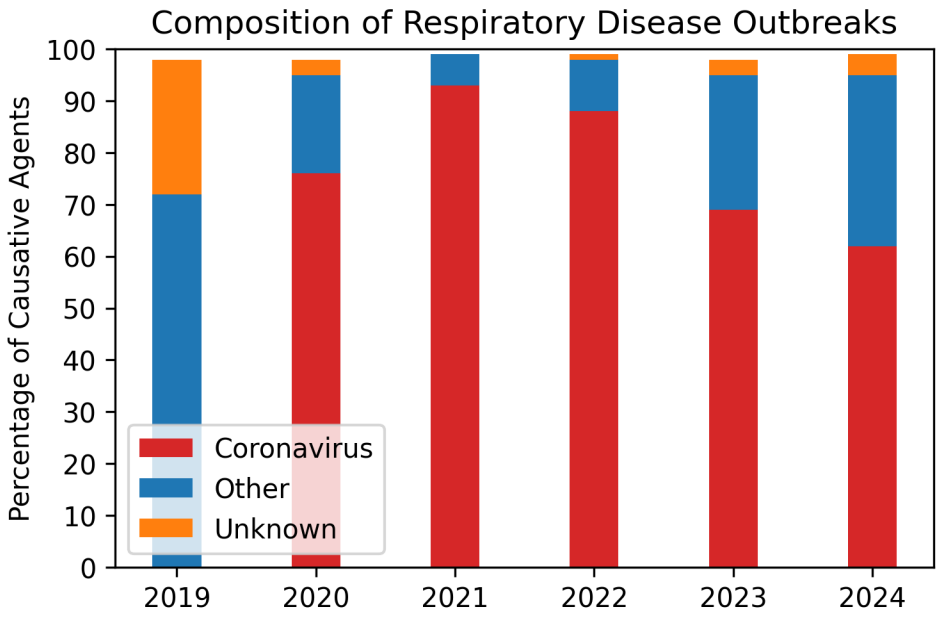

Figure 2: Makeup of Respiratory Outbreaks from 2019-2024 inclusive

From Figure 2, 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

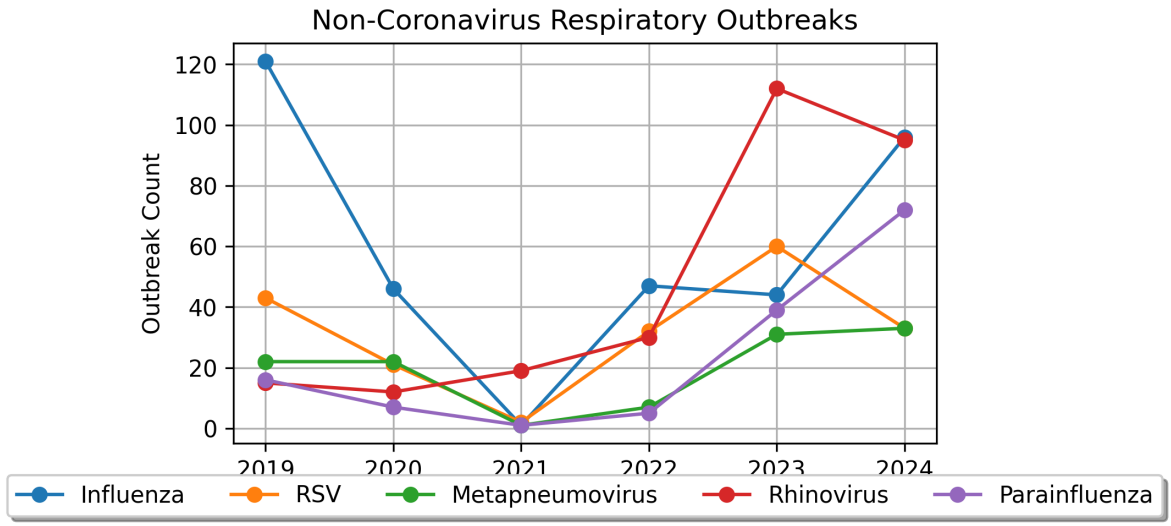

Figure 3: Non-Coronavirus Outbreaks

From Figure 3, it can be observed that the number of Influenza, Parainfluenza, Respiratory Syncytial Virus, 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 their 2019 pre-pandemic level.

4 Discussion

It is apparent that Coronavirus outbreaks remain the most prominent driver of outbreaks in Toronto healthcare facilities post-pandemic. They continue to comprise the greatest proportion of respiratory disease outbreaks in healthcare facilities in Toronto, and since pandemic times, trends in the Coronavirus outbreak count align with those of total respiratory outbreaks and total outbreaks. However, since the pandemic, the annual number of Coronavirus outbreaks and percentage of Coronavirus outbreaks comprising total respiratory outbreak agents has declined, indicating that their impact is diminishing.

Simultaneously, Influenza, Parainfluenza, RSV, Metapneumovirus, and Rhinovirus have been experiencing an increase in outbreak cases post-pandemic. While Influenza is well known, the public is much less familiar with other respiratory outbreak agents, particularly RSV. Only 40% of adults report having heard of RSV, and only 30% would definitely get the RSV vaccine.

Comparatively, 43% of adults got an Influenza vaccine in the 2023-2024 season (Health 2023). It is important to note that while non-Coronavirus respiratory infections, such as RSV, are less deadly than Coronavirus (Grangier 2024), many of the healthcare facilities experiencing outbreaks are long-term healthcare facilities whose populations are more susceptible to these infections (Centers for Disease Control and Prevention 2024).

The lack of knowledge surrounding non-Coronavirus and Influenza respiratory causative agents, their rising outbreak numbers, and susceptibility of the healthcare institution population suggests a greater emphasis should be placed on them. RSV in particular should be given a greater emphasis, given it is the only one of the non-Coronavirus and non-Influenza respiratory agents with a vaccine available. By increasing awareness of RSV and encouraging RSV vaccinations, RSV outbreaks will be less likely to occur in healthcare facilities, and when they do occur, they will be less severe.

4.1 Weaknesses and next steps

The main limitation of this study is the restriction of focus to healthcare facilities. All data is from healthcare facilities, hence, findings must remain in the context of healthcare facilities. The extension of these results to the general Toronto population may be misrepresentative. Thus, to confirm the same trends hold in general, further research should be conducted with data coming from the general Toronto public.

Additionally, as mentioned in Section 2.2.1, the extremely low reported outbreak counts of non-Coronavirus causative agents in 2021 point to potential issues with the validity of the data. Further research should be conducted to determine the cause of these low numbers and assess the validity of the dataset.

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