

Unveiling Toronto's Respiratory Landscape*

Analyzing Post-COVID-19 Infection Trajectory and Rhinovirus Surges through 2020 and 2023 Datasets

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This research investigates the impact of COVID-19 on respiratory infections in Toronto, utilizing datasets in 2020 and 2023. Through analysis of simulated data on respiratory infection rates, with a focus on Rhinovirus, a noticeable surge in respiratory ailments post-pandemic is revealed. Statistical examinations comparing infection rates offer insights into the changing dynamics of respiratory health. This study contributes towards understanding the lasting effects of COVID on respiratory well-being in the city, providing a crucial foundation for public health interventions.

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*Code and data supporting this analysis are available at: https://github.com/Hailey-Jang/PostCOVID_Respiratory_Problems.git

1 Introduction

In response to the global landscape following the COVID-19 pandemic, this study thoroughly explores its impact on public health, specifically concentrating on respiratory infections in Toronto. Through a meticulous examination of simulated data spanning 2020 to 2023, the research provides a nuanced understanding of the trajectory post the initial pandemic wave, with a specific focus on the prevalence of Rhinovirus. The results highlight a significant increase in respiratory ailments, with Rhinovirus emerging as a notable contributing factor.

Amidst global efforts to address the aftermath of the transformative COVID-19 pandemic, a noticeable gap exists in understanding long-term consequences, especially concerning respiratory health trends in urban populations. This paper aims to fill this gap by presenting a comprehensive analysis based on simulated data, scrutinizing respiratory infection rates in Toronto. The data section meticulously outlines data collection and analysis procedures, while the results section succinctly articulates key findings. The ensuing discussion contextualizes these findings within the broader framework of public health, shedding light on the evolving dynamics of respiratory health in a post-COVID-19 era.

As societies globally grapple with the intricate challenges posed by the aftermath of COVID-19, this study addresses the critical need for insights into enduring impacts on respiratory health, particularly in urban settings. Beyond empirical contributions, the study strives to play a proactive role in shaping future policies and basic infection control in real-life situations, serving as a guide for fortifying community health in the wake of unprecedented global events.

2 Data

All the data used in this study were sourced from the Toronto Open Data portal (Gelfand 2022). The dataset, titled ‘Outbreaks in Toronto Healthcare Institutions’ serves as the foundation for our analyses.

For the purpose of data analysis, simulation, cleansing, and visualization, the statistical programming language R was judiciously employed (R Core Team 2022). Additionally, to facilitate these analytical processes, a suite of specialized R packages was utilized, including but not limited to here (Wickham 2023) and the comprehensive tidyverse suite (Wickham et al. 2019).

2.1 Respiratory Infections in 2020

Examining reports on respiratory outbreaks in Toronto healthcare institutions from 2020 to 2023 unveils intriguing patterns that provide valuable insights into the dynamic nature of infectious diseases. In Figure 1, which represents the year 2020, a consistent trend emerges, showcasing that respiratory infections consistently surpass Enteric illnesses. Out of 553 reported cases, 519 are respiratory, constituting approximately 93.85% of the total cases. Enteric outbreaks rank as the second most common with 33 cases, making up about 5.97%. There is only 1 case categorized as Other, representing 0.18%, and no cases are listed under Others. This underscores the persistent challenges posed by respiratory health issues, with respiratory outbreaks significantly outnumbering other types. Considering the early onset of the COVID-19 outbreak, the prevalence of respiratory outbreaks in this year aligns with historical expectations.

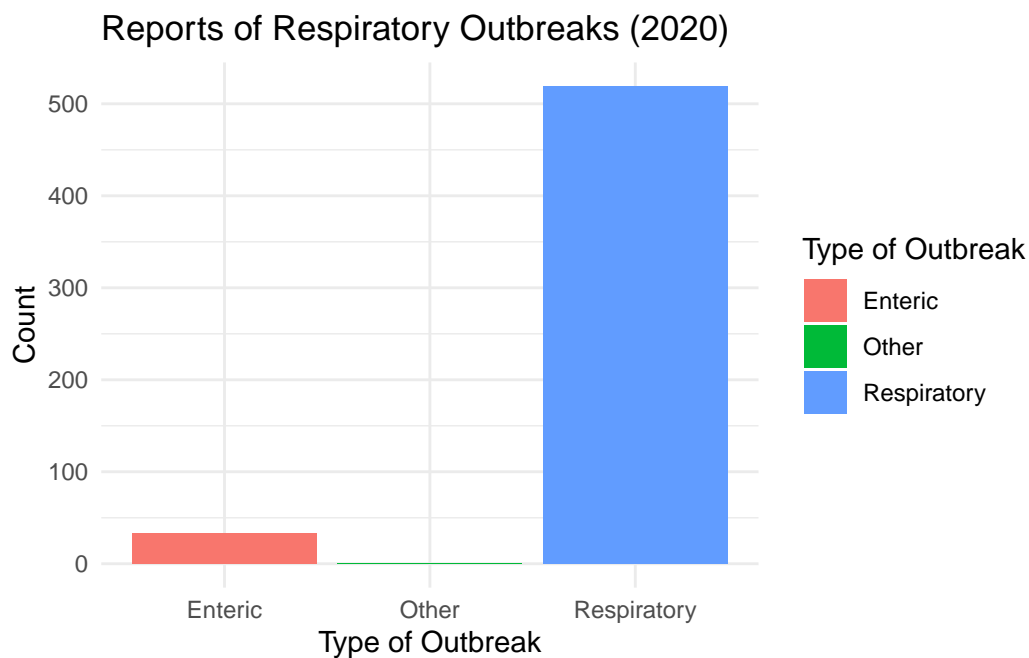


Figure 1: Reports of Respiratory Outbreaks (2020)

2.2 Respiratory Infections in 2023

In contrast, Figure 2, representing the post-COVID period in 2023, unfolds a more complex narrative. While the underlying trend of respiratory infections surpassing Enteric illnesses persists, there is a significant increase in the frequency of respiratory outbreaks compared to the previous year. In the dataset, respiratory cases total 1016, with only three cases listed under 'Others'. There are also 47 cases of Enteric illnesses, signifying that almost 100% of the

outbreaks are of a respiratory nature. This notable surge in respiratory infection rates may be attributed to various factors, including the lingering effects of the COVID-19 pandemic. The classification of 2023 as post-COVID implies a potential connection between the ongoing impact of the pandemic and the heightened prevalence of respiratory infections.

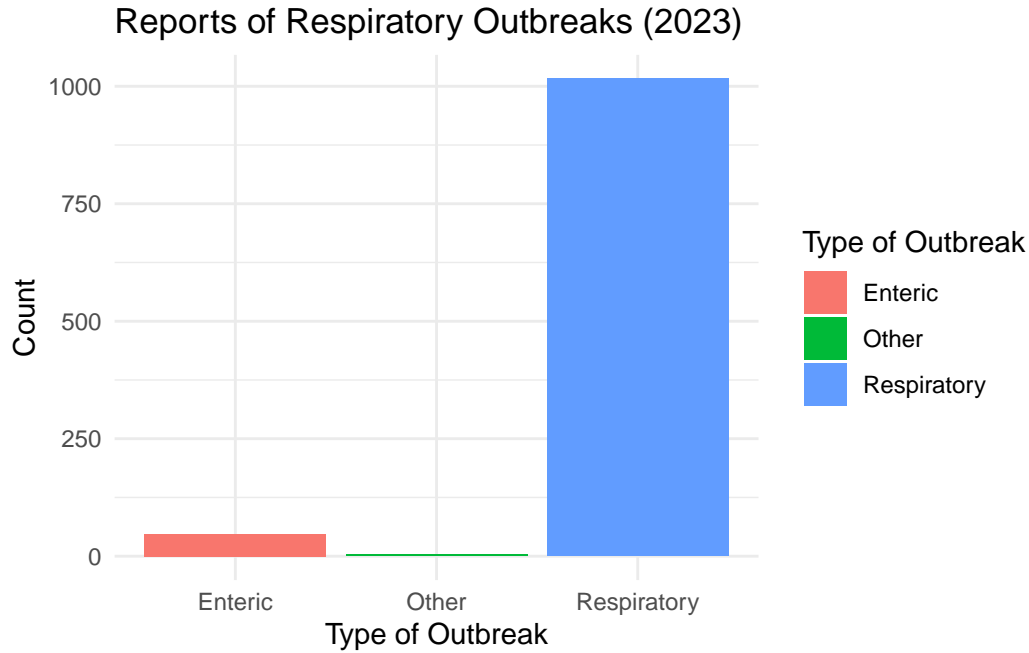


Figure 2: Reports of Respiratory Outbreaks (2023)

2.3 Prevalence of Respiratory Infections

The analysis of respiratory infection trends in the aftermath of the COVID-19 pandemic reveals a noticeable increase in the overall prevalence of respiratory infections throughout the year 2023, presenting a distinct contrast with the preceding year, 2020. This notable rise extends beyond pre-pandemic norms, signifying a substantial transformation in the landscape of respiratory health, as highlighted in (Maison et al. (2023)). Consequently, there is a compelling need for an in-depth exploration of potential contributing factors and the development of adaptive public health strategies to effectively address the evolving challenges within the realm of respiratory infections.

3 Results

3.1 Rhinovirus

In delving deeper into the landscape of respiratory outbreaks in Toronto healthcare institutions, a crucial aspect of our analysis involves identifying the specific viruses that contribute most significantly to these incidents. Understanding the predominant viral agents responsible for respiratory infections is pivotal for targeted preventive measures, effective treatment strategies, and informed public health interventions. In this exploration, we aim to unravel the intricate network of viral contributors, shedding light on the specific viruses that exert a substantial impact on the respiratory health dynamics within these healthcare settings.

The graphical representation, (Figure 3), comparing the rates of causative agents for respiratory outbreaks in Toronto healthcare institutions in 2020 and 2023 provides insightful observations. Notably, the data underscores a significant shift in the prominence of Rhinovirus as a causative agent between the two years. In 2023, Rhinovirus emerges as the predominant viral contributor, reporting a notably higher incidence compared to its occurrence in 2020. Specifically, in 2023, Rhinovirus stands out as the most frequently reported causative agent for respiratory outbreaks, with 77 documented cases. This substantial increase is particularly noteworthy when contrasted with its presence in 2020, where Rhinovirus was reported merely seven times.

Comparatively, in 2020, Respiratory syncytial virus took precedence as the leading causative agent, reporting 19 cases, followed closely by Influenza A with 18 cases. However, the dynamic shift in 2023, with Rhinovirus surpassing these previously dominant agents, suggests an evolving pattern in the prevalence of respiratory viruses. The observed rise in Rhinovirus cases may be indicative of changing epidemiological factors, altered patient demographics, or other environmental influences that warrant further investigation.

4 Discussion

4.1 Rhinovirus in 2023

The resurgence of Rhinovirus (RV) in 2023, especially when compared to other respiratory viruses following the relaxation of social distancing measures, requires careful scrutiny. At the core of this resurgence is Rhinovirus's unique protein capsid, which confers heightened resistance to ethanol-containing disinfectants—an attribute not shared by viruses with lipid envelopes. The efficacy of facemasks in filtering out Rhinovirus is notably compromised due to its smaller size compared to influenza virus and coronavirus, potentially contributing to the observed resurgence.

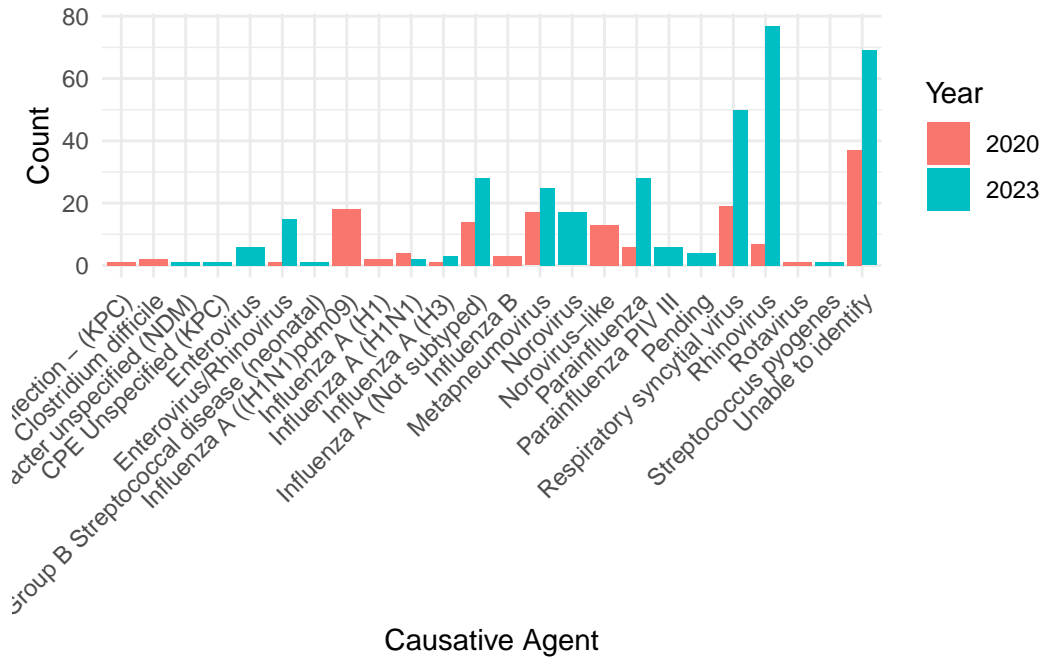


Figure 3: Rates of Causative Agents (2020 vs. 2023)

The implementation of social-distancing measures, restrictions on social gatherings, and intensified hygiene protocols in response to the March 2020 COVID-19 outbreak significantly reduced exposure opportunities to Rhinovirus and other infectious agents, leading to a substantial reduction in both respiratory viral infections and healthcare utilization for asthma. However, the complexity of this dynamic becomes apparent with the specific resurgence of Rhinovirus infections following the fall 2020 reopening of schools. In contrast to other respiratory viruses that remained subdued, Rhinovirus exhibited a significant uptick in prevalence.

The noticeable impact of social interventions on Rhinovirus underscores the significance of its intrinsic attributes, particularly its diminutive size and capsid coat. According to Kreger (Kreger and Hershenson (2022)), these characteristics may contribute to its reduced susceptibility to masking agents and disinfectants. Ordinary breathing and speech generate a large amount of potentially infectious aerosols, with particles from human exhalation flows like coughing, sneezing, and breathing forming a two-phase buoyant jet emerging from the mouth and nose. Even after COVID-19, the use of disinfectants and sanitizers remains crucial in preventing the resurgence of Rhinovirus in our daily lives.

5 Conclusion

The examination of Rhinovirus resurgence after social distancing measures reveals a complex interplay of factors, highlighting the unique characteristics of Rhinovirus and the intricacies of viral interference. The varied impact of social measures on different respiratory viruses emphasizes the need for tailored public health strategies to address specific vulnerabilities.

Understanding these dynamics becomes crucial for mitigating the impact of respiratory infections and optimizing public health interventions in the post-COVID era. This exploration not only deepens our understanding of Rhinovirus resurgence but also emphasizes the urgent requirement for adaptive strategies in the ongoing battle against respiratory infections in healthcare settings. The insights gained from this analysis can inform the development of more targeted and resilient public health measures, fostering a comprehensive and effective approach to safeguard community health amid evolving infectious challenges.

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