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Beyond Flu: trends in respiratory infection outbreaks in Ontario healthcare settings from 2007 to 2017, and implications for non-influenza outbreak management.

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Public Health Ontario Rounds

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Objectives

- To provide an overview of viral respiratory pathogens commonly associated with outbreaks in Ontario healthcare settings
- To provide an overview of pathogen-specific respiratory infection outbreak trends in Ontario from 2007-2017
- To outline considerations for pathogen-specific outbreak management
- To review the impact of COVID-19 infection control practices on non-COVID outbreaks in healthcare settings in 2020

Burden of Respiratory Outbreaks in Ontario Healthcare Settings

- Outbreaks of viral respiratory infections occur frequently in healthcare settings
- Outbreaks have implications for resident/patient admission and transfer
- Vulnerable resident/patient populations may be at increased risk for complications and death due to infection
- Common pathogens associated with viral respiratory outbreaks include influenza, enterovirus/rhinovirus and more recently, SARS-CoV-2
- Secondary complications associated with influenza and other common pathogens include pneumonia and worsening of chronic lung disease, heart disease or other underlying medical conditions
- SARS-CoV-2 is more infectious than influenza and has a higher case fatality rate

Viral Respiratory Pathogens

Viral Pathogens Associated with Respiratory Infection Outbreaks

- Influenza A and B
- Respiratory syncytial virus (RSV)
- Parainfluenza virus
- Rhinovirus
- Enterovirus
- Seasonal coronaviruses
- SARS-CoV-2
- Human metapneumovirus (hMPV)
- Adenovirus

Ontario. Ministry of Health and Long-Term Care. Infectious diseases protocol: appendix A: disease-specific chapters: respiratory infection outbreaks in institutions and public hospitals [Internet]. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2021 Feb 25]. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/respiratory_outbreaks_chapter.pdf [1]

Comparison of Viral Respiratory Pathogens

Pathogen	Incubation Period	Communicable Period (usual)	R_0
Influenza	1-4 days	1 day before to 5-10 days following onset	1.27
RSV	3-7 days	3-7 days	3.0
Parainfluenza virus	2-6 days	Up to 10 days (children)	--
Rhinovirus	2-4 days	1-3 weeks	--
Enterovirus	3-10 days	3-10 days	--
hMPV	4-9 days	Up to 2 weeks	--
SARS-CoV-2	1-14 days	2 days before to 10 days following onset	3.32*

* Newer variants may have different estimates of R_0

Source:Ontario. Ministry of Health and Long-Term Care. Control of respiratory infection outbreaks in long-term care homes, 2018. Toronto, ON: Queen's Printer for Ontario; 2018. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/reference/RESP_Infectn_ctrl_guide_LTC_2018_en.pdf

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Key features of influenza, SARS-CoV-2 and other common respiratory viruses [Internet]. Toronto, ON: Queen's Printer for Ontario; 2020 [cited 2021 Feb 25]. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/ipac/2020/09/key-features-influenza-covid-19-respiratory-viruses.pdf?la=en

Comparison of Common Viral Respiratory Pathogen Symptoms

Symptom	Influenza	Rhinovirus	RSV	SARS-CoV-2
Fever	Yes	No/mild	Yes	Yes
Cough	Yes	Yes	Yes	Yes
Runny nose	Yes	Yes	Yes	Yes
Body aches	Yes	Yes	Yes	No
Loss of taste/smell	No	No	No	Yes
Shortness of breath	Uncommon	Uncommon	Yes	Yes

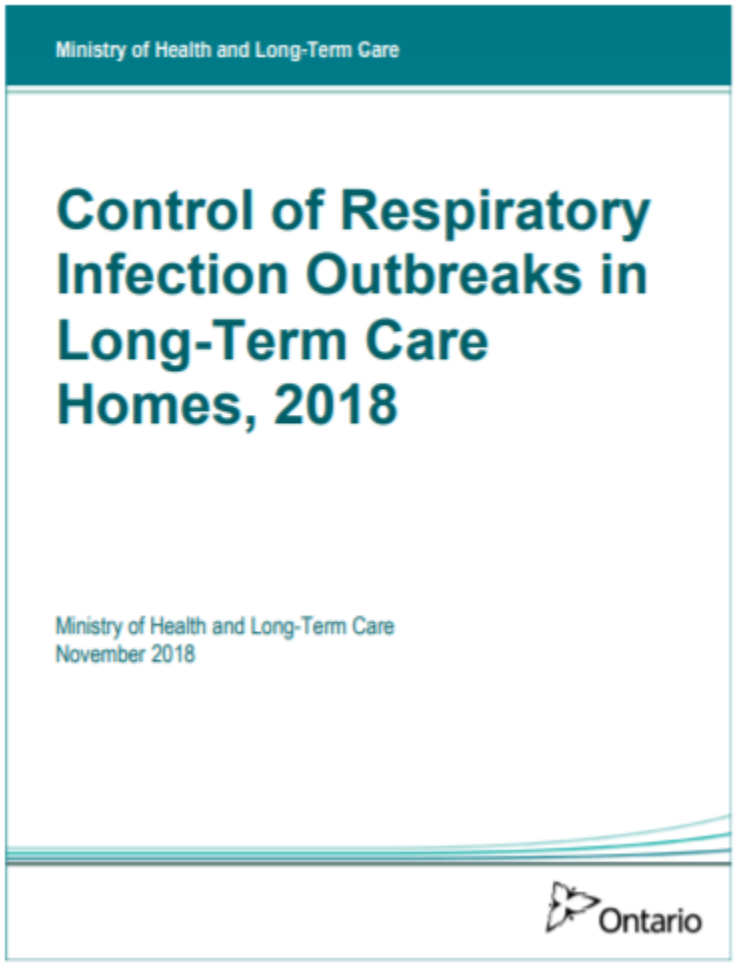
Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Key features of influenza, SARS-CoV-2 and other common respiratory viruses [Internet]. Toronto, ON: Queen's Printer for Ontario; 2020 [cited 2021 Feb 25]. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/ipac/2020/09/key-features-influenza-covid-19-respiratory-viruses.pdf?la=en

Ontario. Ministry of Health. COVID-19 reference document for symptoms [Internet]. Version 7.0. Toronto, ON: Queen's Printer for Ontario; 2020 [cited 2021 Feb 25]. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/2019_reference_doc_symptoms.pdf

Viral respiratory outbreak detection and management

Outbreak Management

- Public Health Units refer to the "*Control of Respiratory Infection Outbreaks in Long-Term Care Homes, 2018*" document.
- Document is applied to outbreaks in both LTCH and RH
- Most outbreak management guidance is specific to the management of outbreaks due to influenza
- Minimal specific outbreak management guidance for outbreaks due to other pathogens



Source: Ontario. Ministry of Health and Long-Term Care. Control of respiratory infection outbreaks in long-term care homes, 2018. Toronto, ON: Queen's Printer for Ontario; 2018. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/reference/RESP_Infectn_ctrl_guide_LTC_2018_en.pdf [2]

Outbreak Roles and Responsibilities

Public Health Units

- Confirm the existence of outbreaks, and declare outbreaks over
- Assist with outbreak prevention, detection and management
- Communicate with settings, regulatory bodies and the public
- Provide education to prevent and manage outbreaks
- Assist with infection prevention and control policies and procedures
- Report outbreak data on diseases of public health significance to Public Health Ontario and to the Ministry of Health

Ontario. Ministry of Health and Long-Term Care, Population and Public Health Division. Institutional/facility outbreak management protocol, 2018. Toronto, ON: Queen's Printer for Ontario; 2020. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/protocols_guidelines/Inst_Fac_Outbreak_Protocol_2018_en.pdf

Roles and Responsibilities Continued…

Public Health Ontario

- Provide scientific and technical advice to healthcare stakeholders, including LTC/RH and hospitals
- Conduct surveillance for diseases of public health significance

Public Health Ontario Laboratory

- Conduct testing for various infectious diseases, including diseases of public health significance
- Performs laboratory surveillance

Respiratory Infection Outbreak Definitions

Respiratory outbreaks in institutions (including long-term care homes (LTCH), retirement homes (RH)) and public hospitals are reportable to local public health units.

Suspect Respiratory Infection Outbreak

- Two cases of ARI occurring within 48 hours with any common epidemiological link (e.g., unit, floor); **OR**
- One laboratory-confirmed case of influenza

Confirmed Respiratory Infection Outbreak

- 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)

Ontario. Ministry of Health and Long-Term Care. Infectious diseases protocol: appendix B: provincial case definitions for diseases of public health significance: respiratory infection outbreaks in institutions and public hospitals. Toronto, ON: Queen's Printer for Ontario; 2019 [cited 2021 Feb 25]. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/respiratory_outbreaks_cd.pdf

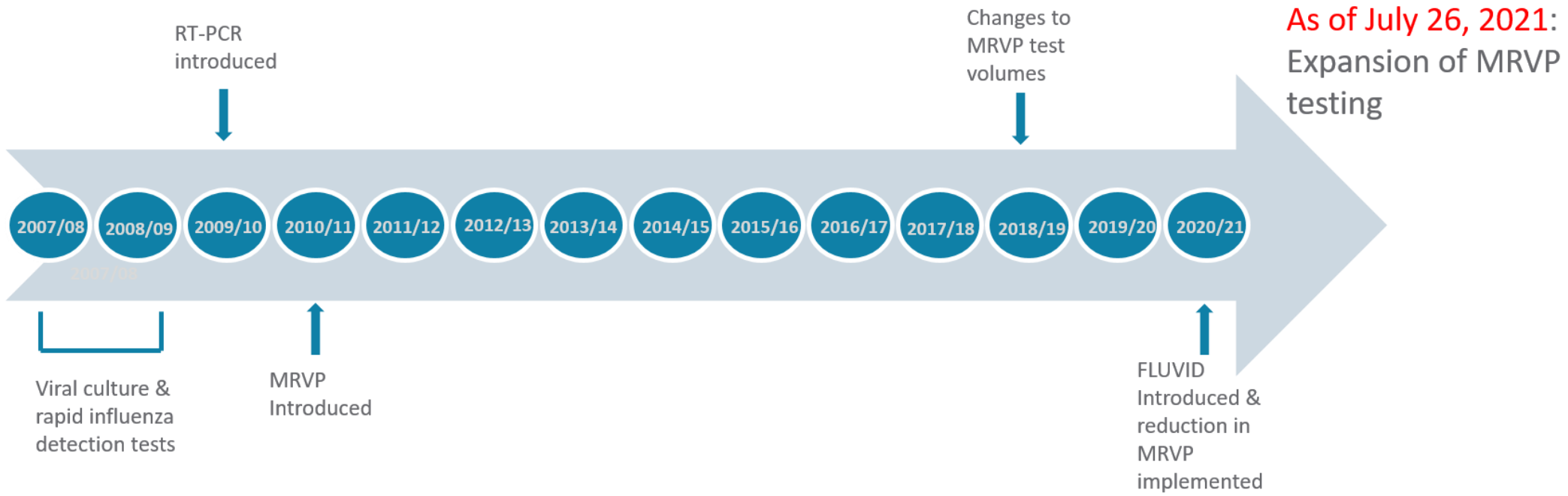
Testing during outbreaks

- Nasopharyngeal swab collected from ill residents/patients
- Swabs submitted to laboratory for testing
- Specimens tested at Public Health Ontario Lab for influenza and other respiratory viruses
- A suspect or confirmed respiratory outbreak may be declared without waiting for confirmatory laboratory testing results
- Identification of causative pathogens is encouraged

As a result of COVID-19 pandemic:

- Test all patients/residents (symptomatic, asymptomatic contacts) in the outbreak for SARS-CoV-2, and order respiratory virus testing on the first 4 symptomatic patients

Key Changes to Laboratory Testing Methods at the PHOL



MRVP = Multiplex respiratory virus PCR that detects Influenza A/B, rhinovirus (or rhinovirus/enterovirus), RSV, parainfluenza, adenovirus, hMPV and coronaviruses.
FLUVID = MRVP panel that detects influenza A, influenza B, SARS-CoV-2, and respiratory syncytial virus (A + B)

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Labstract – December 2020: respiratory virus testing update [Internet]. Toronto, ON: Queen's Printer for Ontario; 2020 [cited 2021 Feb 25]. Available from: https://www.publichealthontario.ca/-/media/documents/lab/lab-sd-121-respiratory-viral-testing-algorithm-enhanced-surveillance-update.pdf?la=en

Identification of Viral Respiratory Pathogens

Pre-COVID-19 (i.e. prior to 2020)

- Max of 4 specimens collected from ill residents/patients in an outbreak tested by rapid influenza test followed by MRVP assay

In 2020/2021

- All patients/residents in an outbreak tested for SARS-CoV2
- Max of 4 specimens collected from ill residents/patients in an outbreak tested using the FLUVID assay.
- MRVP
- Rapid influenza testing performed only if >24-hour delay in PCR testing

Respiratory Viral Testing as of July 26, 2021

Patient Setting[1]	Testing Available By Request
Hospitalized (all inpatients)[2]	SARS-CoV-2 and MRVP[4,5,6] *OR* FLUVID[3,4] followed by MRVP[4,5,6] *(Both combinations will provide testing for the same viruses.)*
Remote communities	SARS-CoV-2 and MRVP[4,5,6] *OR* FLUVID[3,4] followed by MRVP *(Both combinations will provide testing for the same viruses.)*
Institutional and other public health unit declared respiratory infection outbreaks (including school outbreaks)	*Up to 4 outbreak specimens[7]:* Influenza rapid testing[8] (will be done if PCR testing is delayed >24 hours) SARS-CoV-2 and MRVP[4,5,6] *OR* FLUVID[3,4] followed by MRVP[4,5,6] Additional specimens will be tested for SARS-CoV-2 only.[7]
Institutions (non-outbreak) (e.g. long-term care homes, correctional facilities, congregate living settings)	SARS-CoV-2 and MRVP[4,5,6] *OR* FLUVID[3,4] followed by MRVP[4,5,6]

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Labstract – July 2021: respiratory virus testing update [Internet]. Toronto, ON: Queen's Printer for Ontario; 2021 [cited 2021 Aug 05]. Available from: https://www.publichealthontario.ca/en/laboratory-services/test-information-index/virus-respiratory

Trends in viral respiratory outbreaks in Ontario healthcare settings: 2007-2017

Overview of Viral Respiratory Infection Outbreaks: 2007-2017

Objectives

- To examine pathogen-specific trends in respiratory outbreaks
- To determine whether median attack rates and outbreak duration, and overall case fatality rates differed for pathogen-specific outbreaks in different healthcare settings.

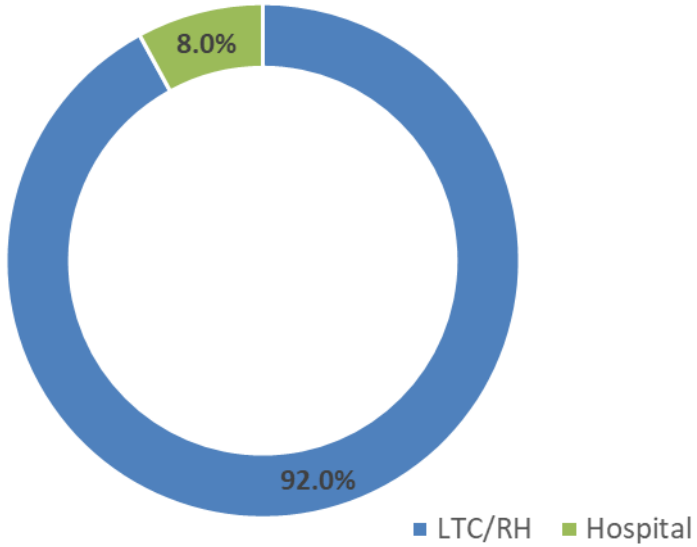
Data Analysis

- Confirmed outbreaks reported in healthcare settings between September 1st 2007 & August 31st 2017 were extracted from iPHIS on December 17, 2018.
- Respiratory outbreak seasons were defined as September 1st to August 31st of the following year based on the outbreak reported date or the outbreak created date if missing (n=67).
- Outbreaks due to enterovirus, rhinovirus or enterovirus/rhinovirus were collapsed into a single category “entero/rhinovirus”, and influenza viruses (A, B, or A and B) were collapsed into a single category “influenza”. Outbreaks where more than one pathogen was detected were classified as “multiple”. Outbreaks where no specific pathogen was identified were classified as unknown.
- Outbreaks with missing or invalid data were excluded from case fatality rate, outbreak duration or attack rate calculations.

Results

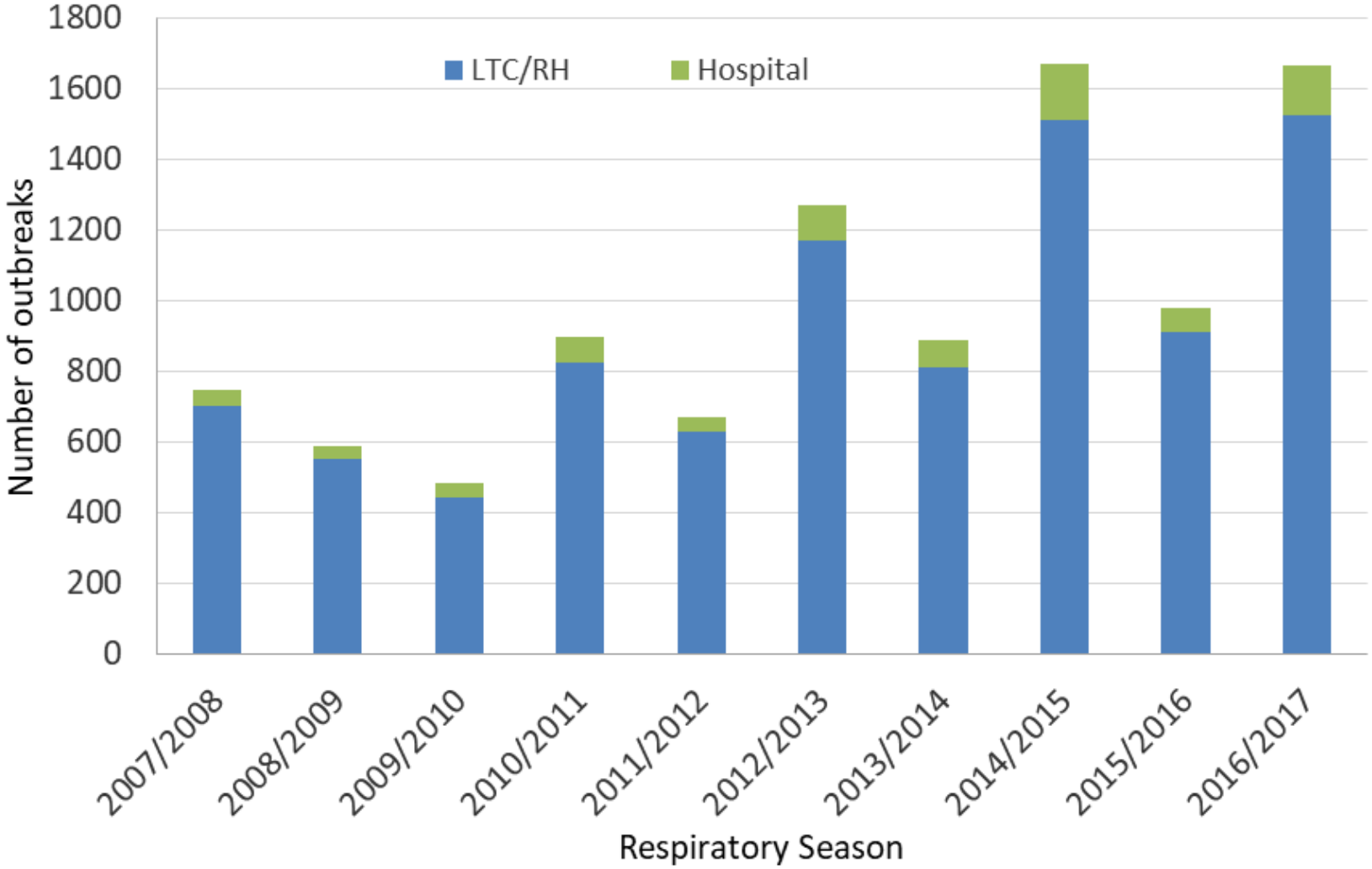
- 9,870 respiratory outbreaks reported from 2007-2017
- 61.6% and 86.8% of hospitals and LTC/RH reported 1 or more respiratory outbreaks, respectively

Proportion of Respiratory Outbreaks by Healthcare Setting: Ontario, 2007/08 to 2016/17



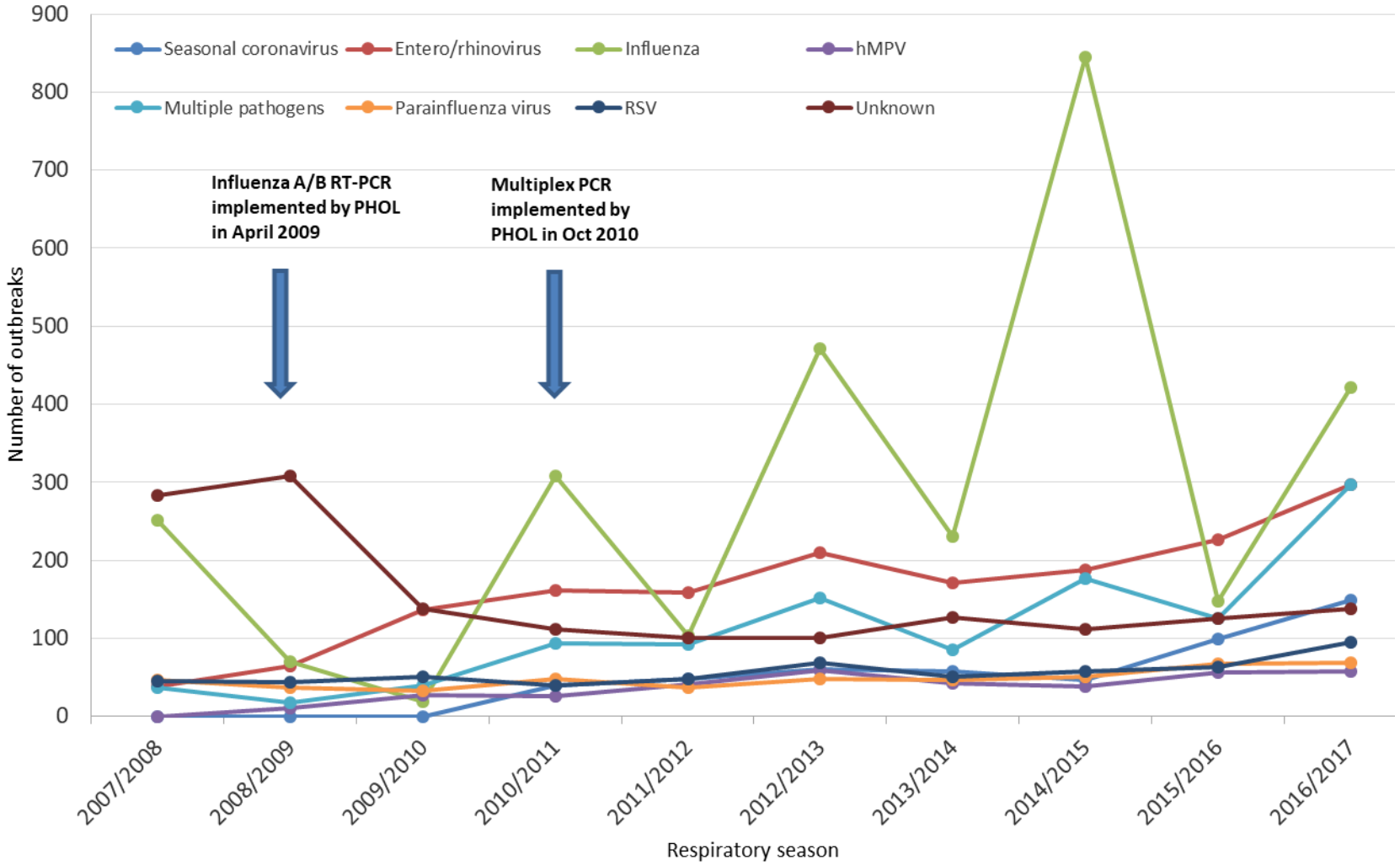
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2017 Dec 27].

Number of Respiratory Outbreaks by Healthcare Setting: Ontario 2007/08 – 2016/17 (n=9,870)



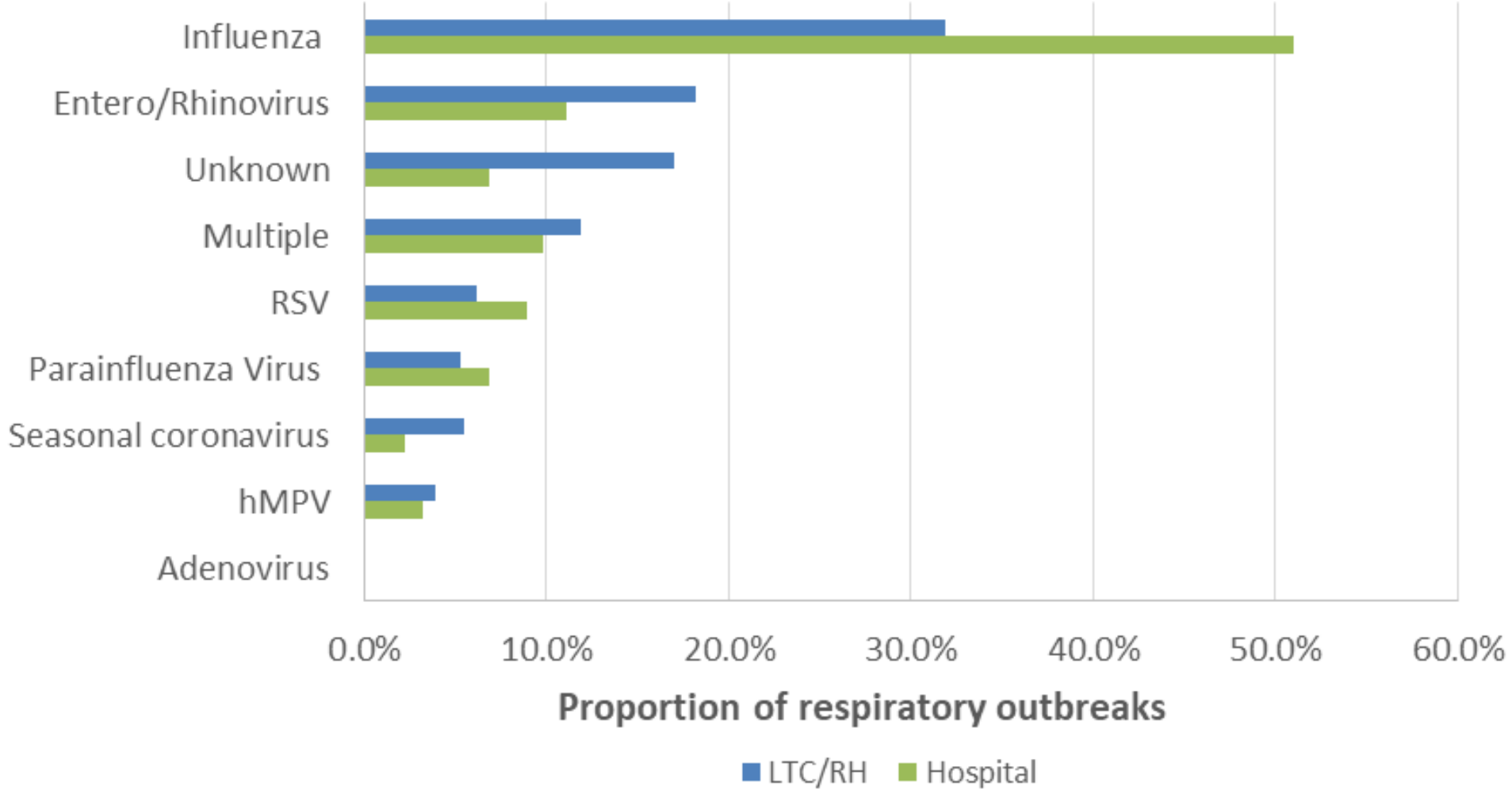
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Confirmed Respiratory Outbreaks in Healthcare Settings by Pathogen and Season: Ontario, 2007/08 to 2016/17 (n=9,870)



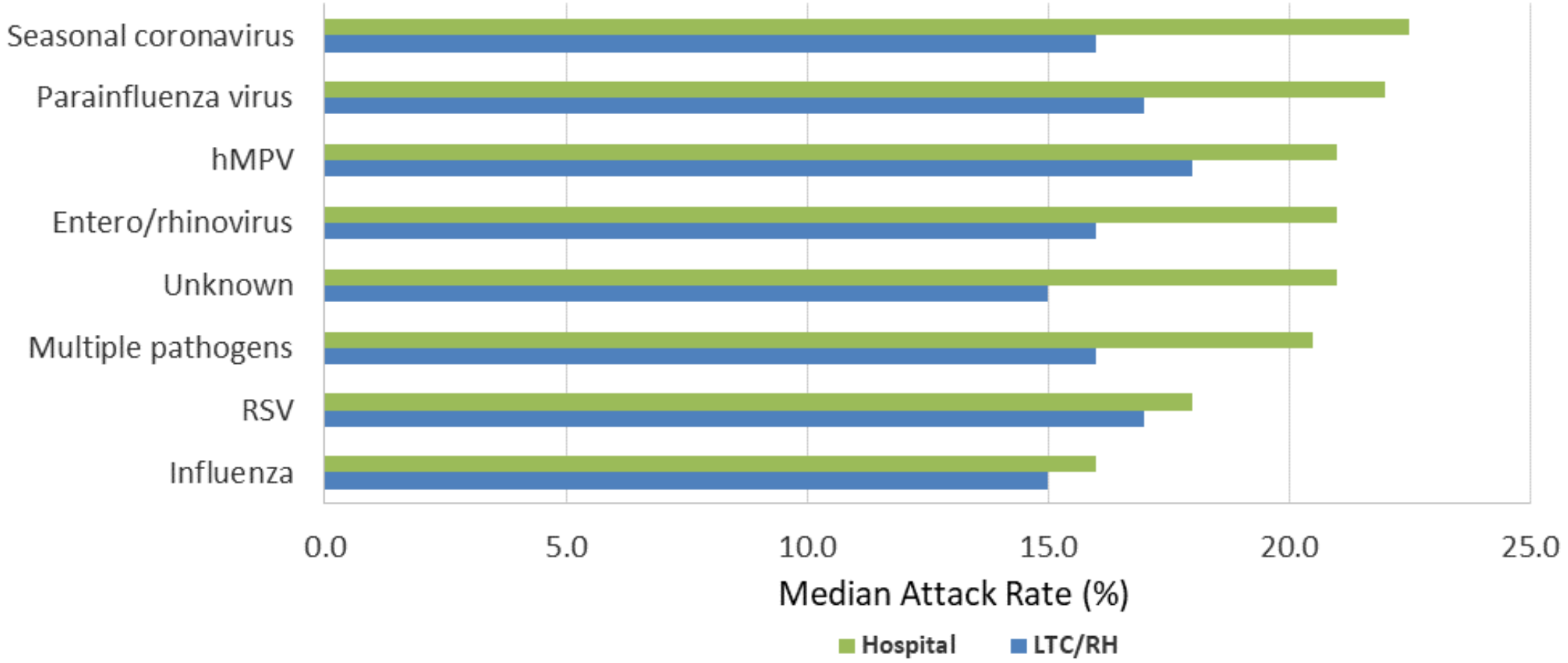
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Proportion of Respiratory Outbreaks by Healthcare Setting and Pathogen: Ontario, 2007/08 - 2016/17 (n=9,870)



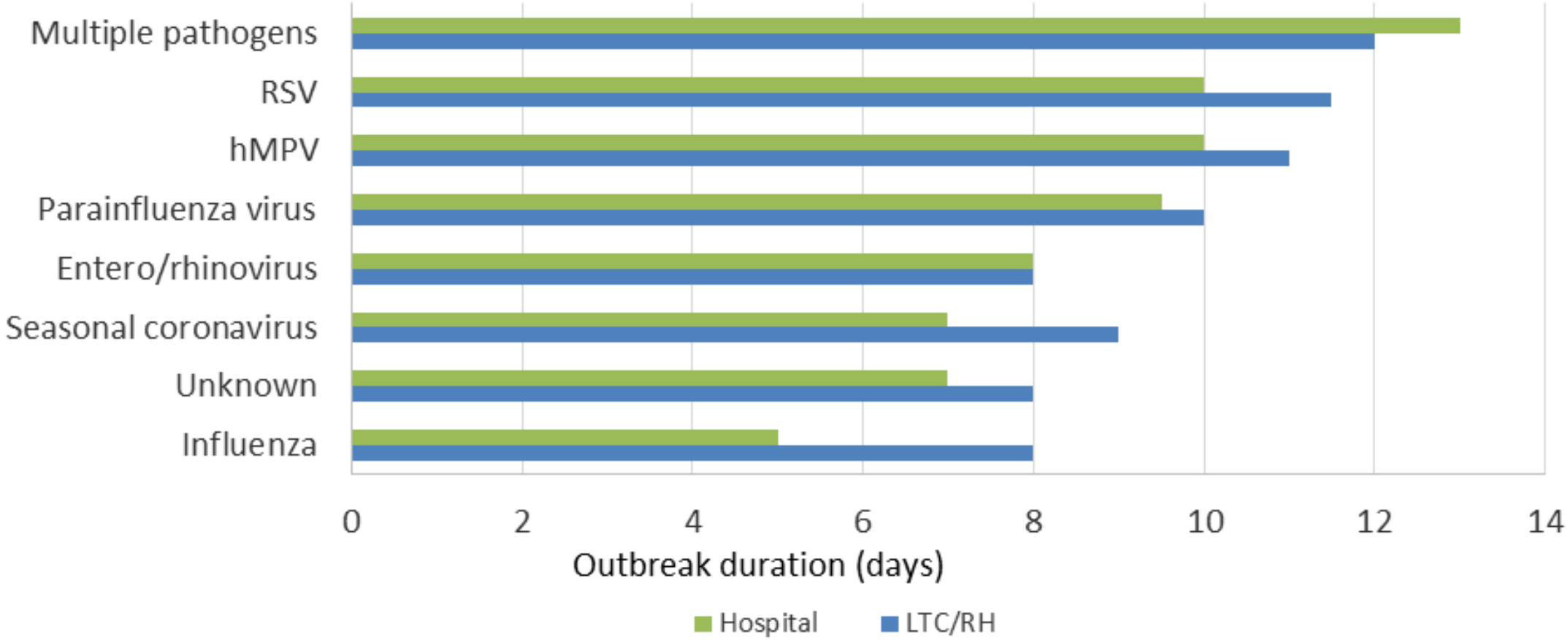
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Median Resident/Patient Attack Rates by Pathogen and Healthcare Setting: Ontario, 2007/08 to 2016/17 (n=9,610)



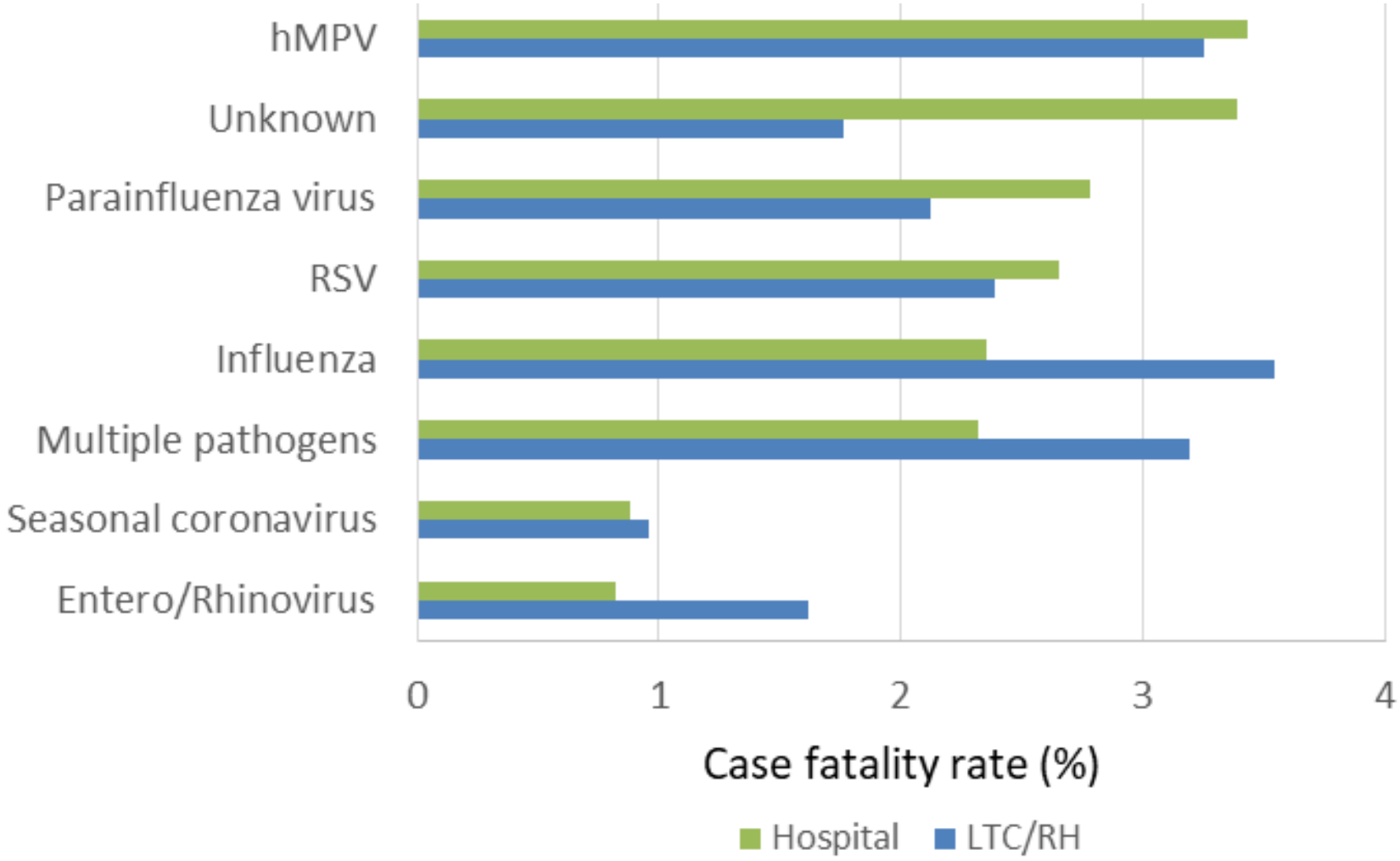
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Median Outbreak Duration (days) by Pathogen and Healthcare Setting: Ontario, 2007/08 to 2016/17 (n=9,161)



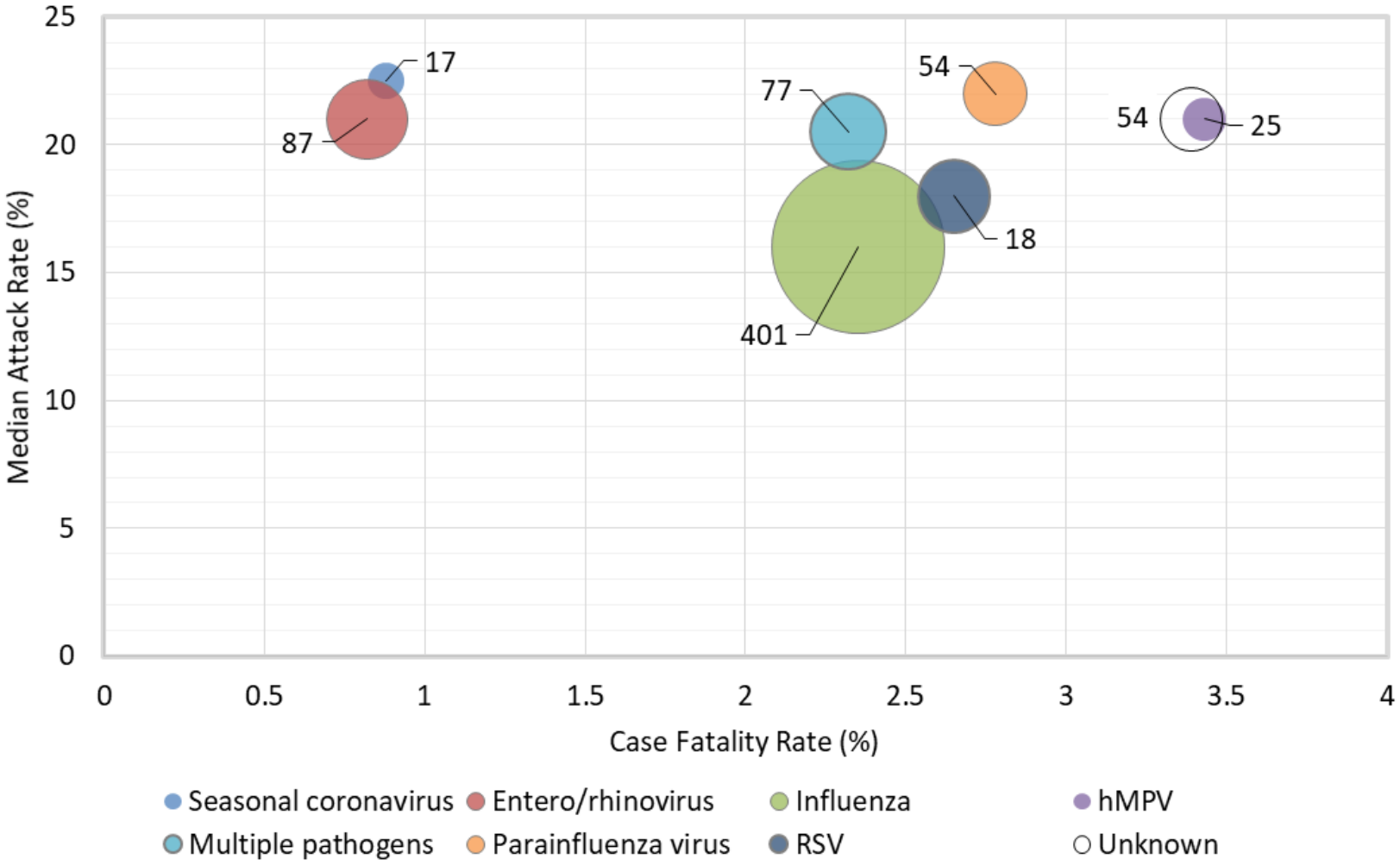
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Case Fatality Rates (%) by Pathogen and Healthcare Setting: Ontario, 2007/08 to 2016/17 (n=9,844)



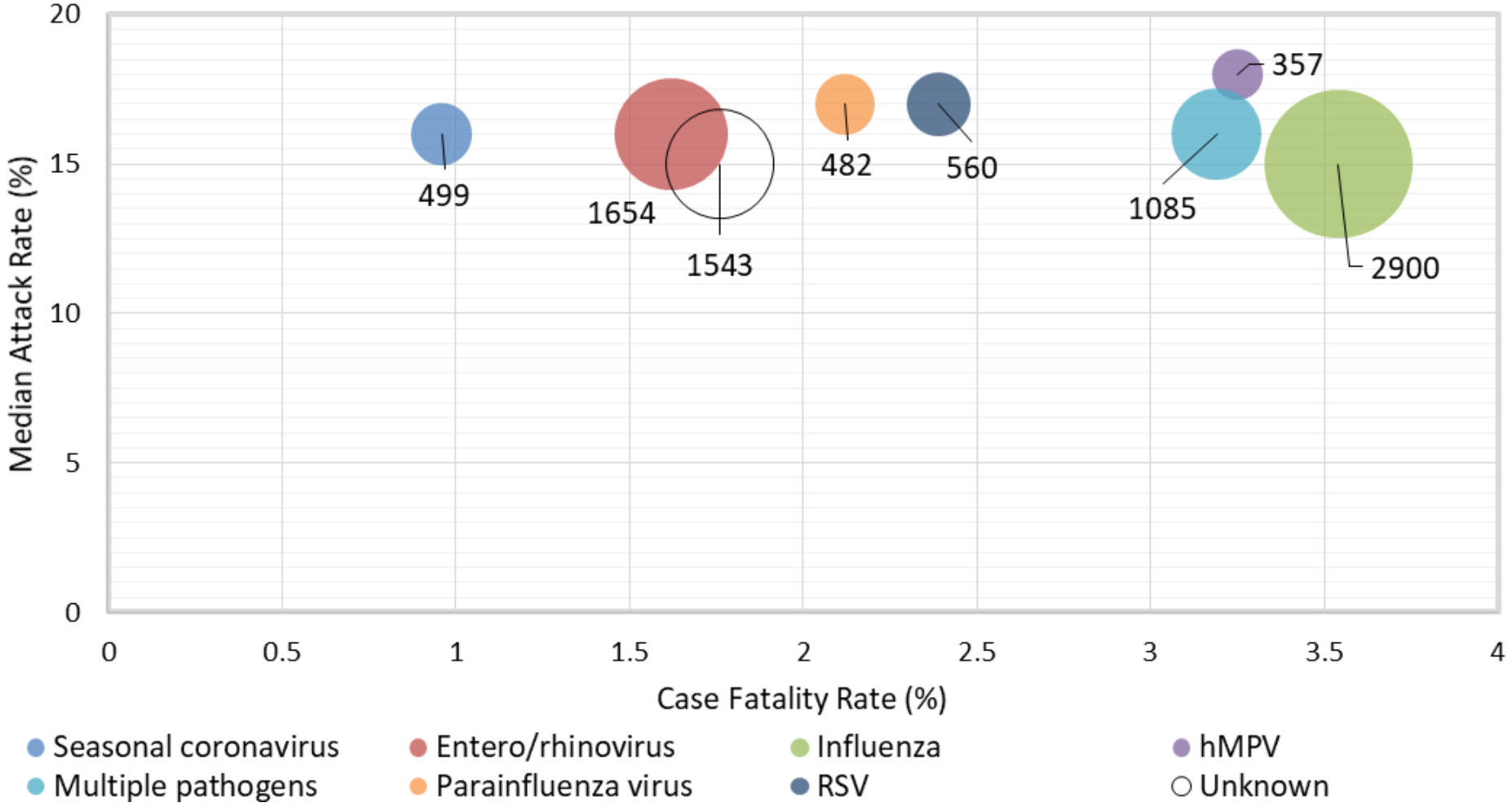
Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Summary of Hospital Outbreaks by Pathogen, Number, Attack Rate and Case Fatality Rate: Ontario, 2007/08 to 2016/17



Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Summary of LTC/RH Outbreaks by Pathogen, Number, Attack rate and Case Fatality Rate: Ontario, 2007/08 to 2016/17



Source: Ontario. Ministry of Health and Long-Term Care. Integrated Public Health Information System (iPHIS) [database]. Toronto, ON: Queen's Printer for Ontario; 2017 [data extracted 2018 Dec 27].

Study Limitations

- Differences in the number of outbreaks in each facility type may be due to differences in reporting and facility size
- Changes in specimen testing have occurred over time

Key Findings

- Influenza outbreaks were generally associated with shorter duration
- Influenza outbreaks had the lowest attack rates in both settings
- Availability of seasonal influenza vaccine and antivirals for both treatment and prophylaxis likely contributed to shortened outbreak duration and low attack rates.
- hMPV outbreaks were associated with some of the highest case fatality rates in both settings
- hMPV outbreaks had the highest attack rate in LTC/RH
- Stricter control measures for hMPV outbreaks could potentially contribute to reduced attack rates and case fatality rates.

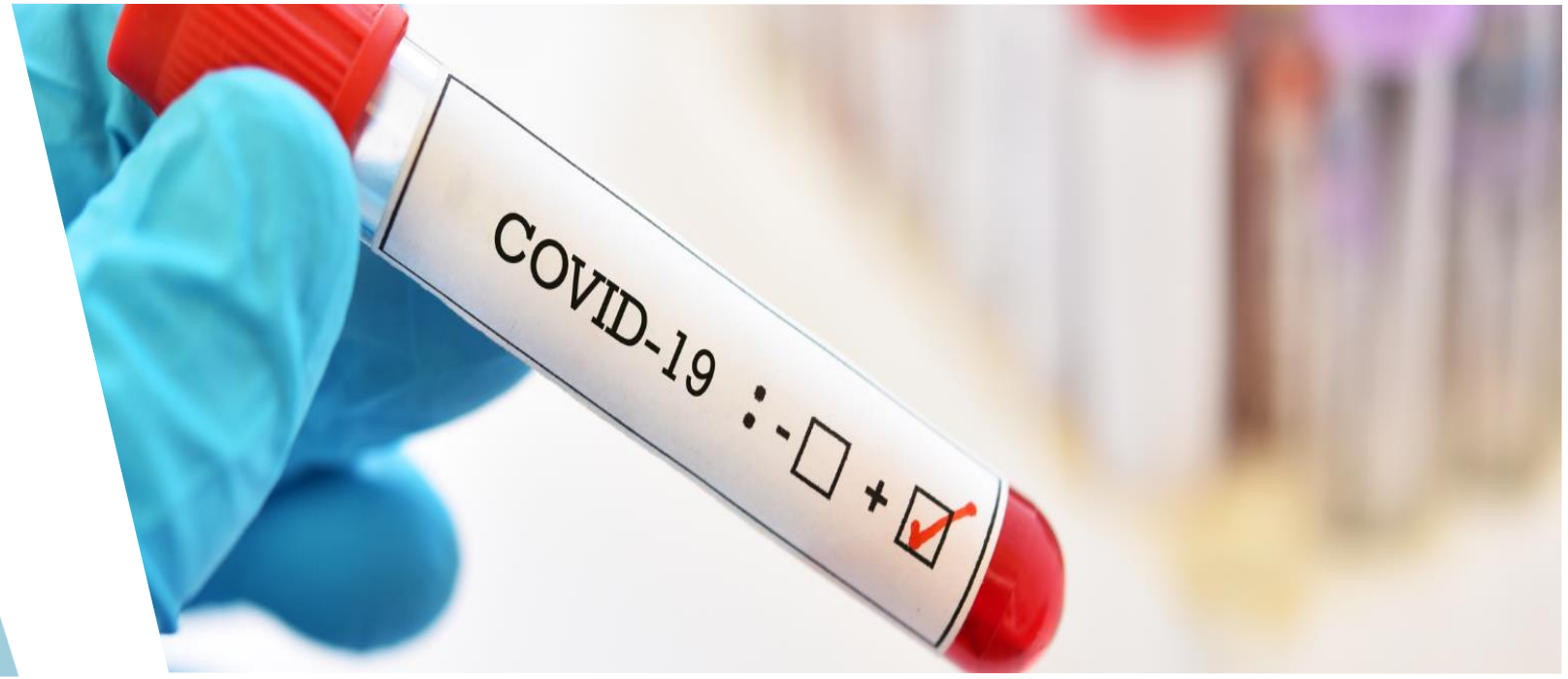
Considerations for Outbreak Guidance

- Changes in specimen testing over time have led to a greater ability to detect non-influenza outbreaks
- The ability to differentiate between different pathogens in an outbreak may be helpful for outbreak management and control.
- Consideration should be given to the varying degree with which individual pathogens are associated with morbidity and mortality.

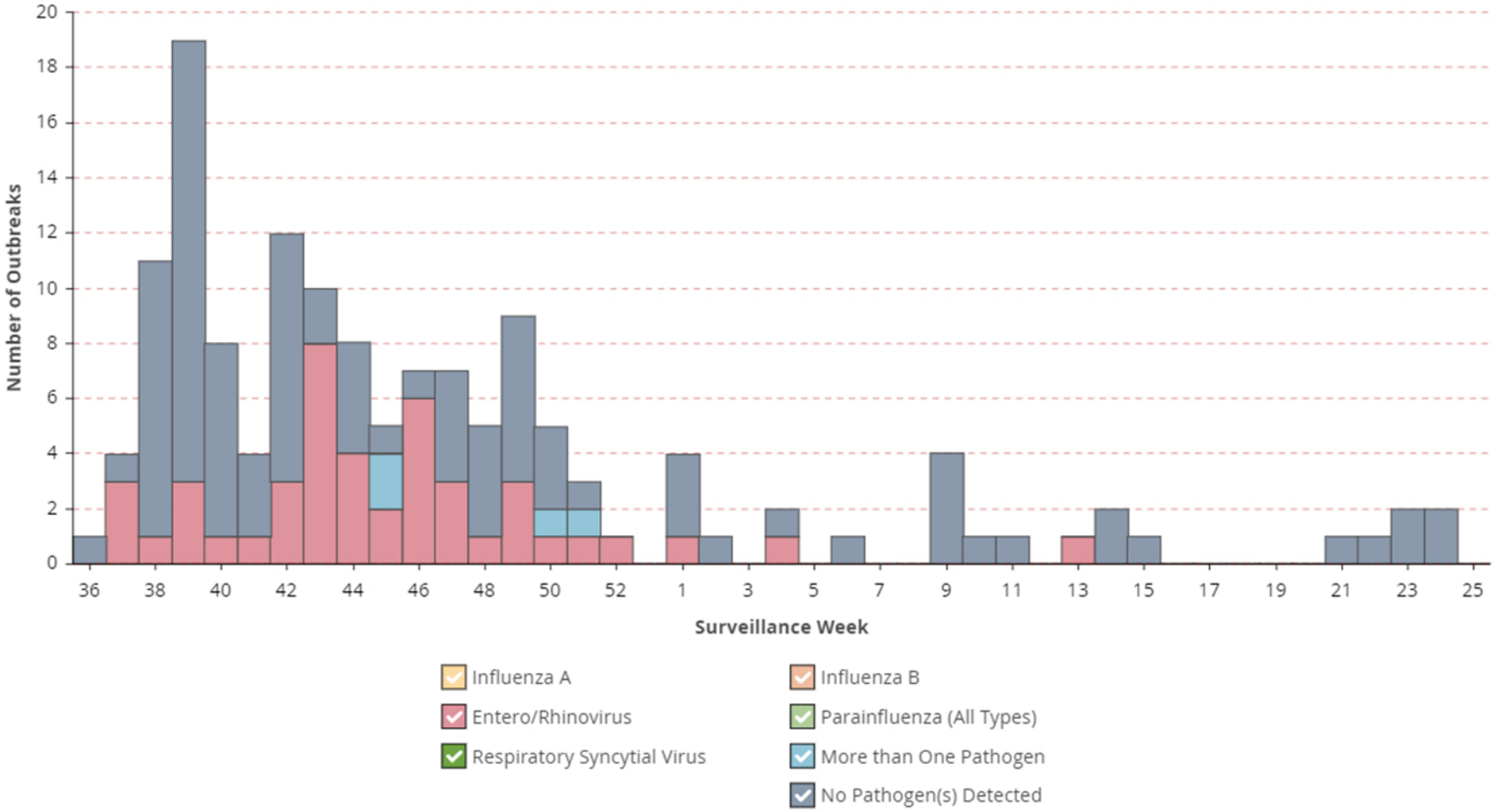
Considerations for Future Resource Development

- Current Ontario respiratory outbreak guidance advises that most outbreaks may be declared over 8 days after symptom onset in the last identified patient/resident cases.
- Management of all outbreaks as if these are influenza outbreaks could result in outbreak measures being lifted too soon.
- Early identification of causative pathogens could facilitate implementation of more permissive/restrictive outbreak control measures.
- Development of pathogen and setting-specific outbreak management guidance could result in shorter outbreaks and lower attack/case-fatality rates.

Impact of COVID-19 on viral respiratory outbreak trends

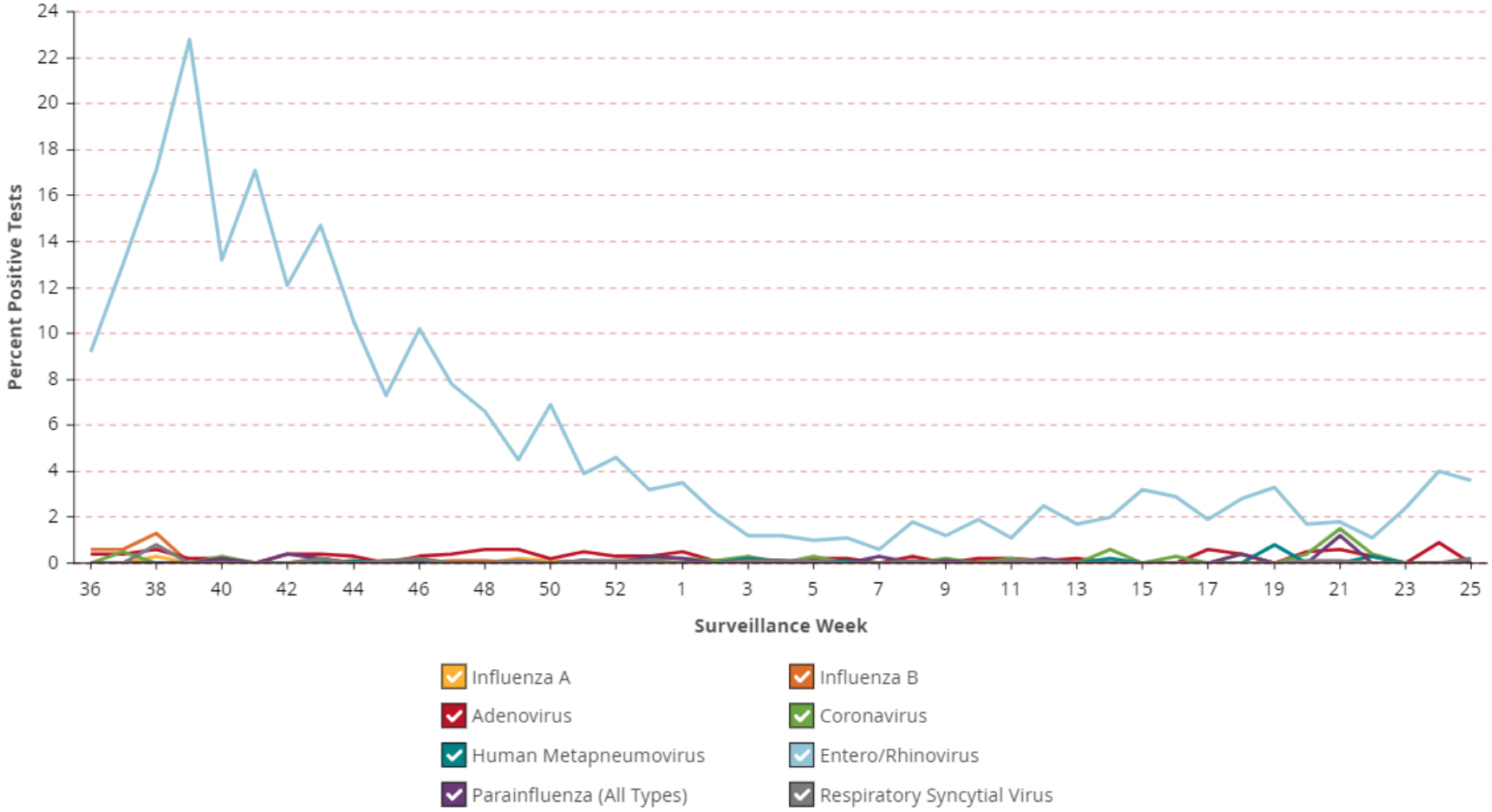


Number of institutional respiratory infection outbreaks by viral pathogen detected by surveillance week (excludes SARS-COV-2): Week 36, 2020 to Week 25, 2021



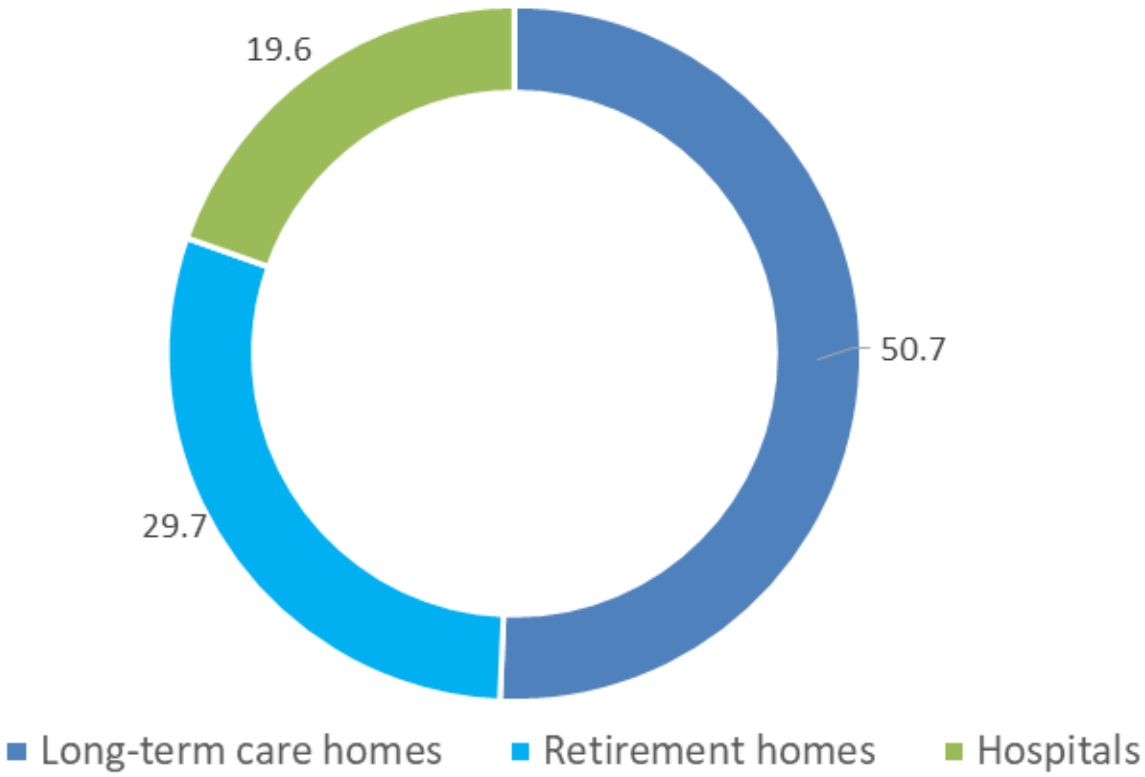
Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Ontario Respiratory Pathogen Bulletin: influenza percent positivity with number of tests [Internet]. Toronto, ON: Queen's Printer for Ontario; 2021 [cited 2021 Jul 06]. Available from: https://www.publichealthontario.ca/en/data-and-analysis/infectious-disease/respiratory-pathogens-weekly

Percent of Viral Respiratory Pathogens Detected Among Specimens Tested for that Pathogen by all Testing Methods (excludes SARS-COV-2): Week 36, 2020 to Week 25, 2021



Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Ontario Respiratory Pathogen Bulletin: percent of respiratory viral pathogens detected among specimens tested for that pathogen by all testing methods [Internet]. Toronto, ON: Queen's Printer for Ontario; 2021 [cited 2021 Jul 06]. Available from: https://www.publichealthontario.ca/en/data-and-analysis/infectious-disease/respiratory-pathogens-weekly

Proportion of COVID-19 Outbreaks by Healthcare Setting*: Ontario, January 15, 2020 to July 5, 2021 (n=2,933)

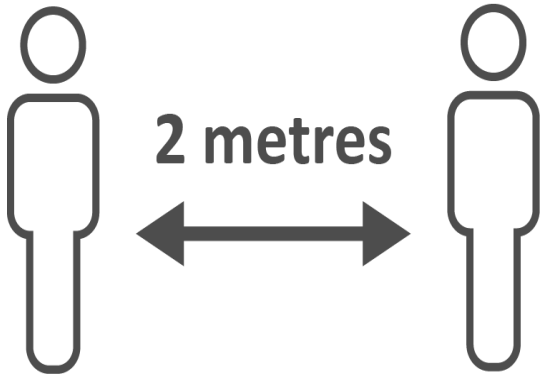


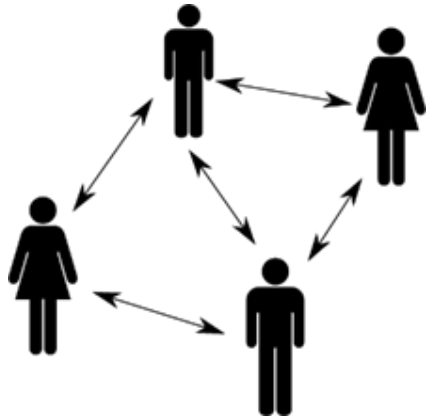
*Until April 23rd, 2021**,** COVID-19 outbreak definition differed for hospitals (2 or more confirmed cases) compared to LTC/RH (1 or more confirmed case(s))

Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Ontario COVID-19 Data Tool: cumulative reported COVID-19 outbreaks in Ontario [Internet]. Toronto, ON: Queen's Printer for Ontario; 2021 [cited 2021 Jul 06]. Available from: https://www.publichealthontario.ca/en/data-and-analysis/infectious-disease/covid-19-data-surveillance/covid-19-data-tool?tab=summary

Impact of COVID-19 Control Measures on Other Pathogens

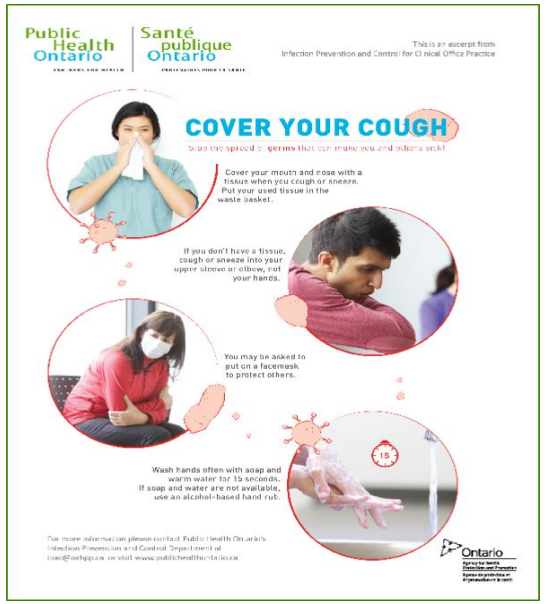
- COVID-19 and other viral respiratory pathogens associated with outbreaks in healthcare settings are primarily spread via respiratory droplets and aerosols
- Implementation of control measures for COVID-19 likely prevented the introduction and transmission of other viral respiratory pathogens





Usual Outbreak Control Measures

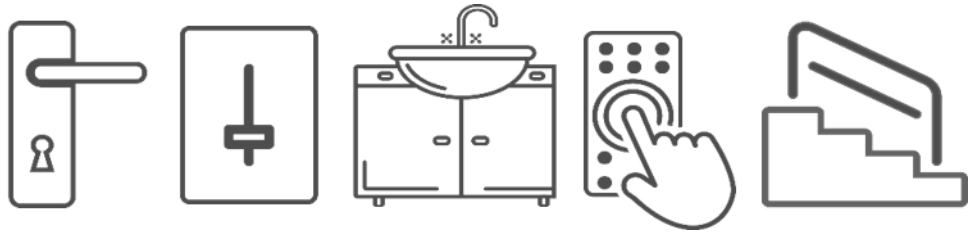
- Isolation of ill residents/patients
- Use of Droplet and Contact Precautions by staff providing care to ill residents/patients
- Cleaning and disinfection using a product with appropriate efficacy
- Hand hygiene
- Visitor restrictions
- Cough and sneeze etiquette



Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Cover your cough [Internet]. Toronto, ON: Queen's Printer for Ontario; 2013 [cited 2021 Aug 08]. Available from: https://www.publichealthontario.ca/-/media/documents/C/2013/clincial-office-cough-signage.pdf

COVID-19 Specific Outbreak Control Measures

- Physical distancing
- Universal masking
- Cohorting of residents in LTC/RH and of patients in hospital
- Increased frequency of disinfection (high-touch surfaces)
- Designated isolation sites
- Screening of all staff, residents/patients and visitors
- Increased testing of residents/patients and staff
- Reduced use of ward rooms in LTC – increased physical separation



Finding the Balance

- Future considerations for outbreak management may incorporate lessons learned during the COVID-19 pandemic
- Key preventative measures shown to be effective in reducing the risk of non-COVID-19 viral respiratory pathogen transmission may merit consideration for use in future viral respiratory outbreak seasons.
- Early pathogen identification is key to informing outbreak control measures and limiting viral transmission in healthcare settings
- Outbreak control measures could potentially be more permissive in some outbreaks
- Where a causative pathogen is unknown, consideration could be given to managing the outbreak as per the most restrictive guidance

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CCDR Publication

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