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ENHANCED EPIDEMIOLOGICAL SUMMARY

Fatalities Among COVID-19 Cases in Long-Term Care Home Residents in Ontario

Purpose

This report describes the case-fatality ratio (CFR) among residents of long-term care homes (LTCH) with confirmed coronavirus disease 2019 (COVID-19), with a focus on cases recorded during the Delta (June 13, 2021 – December 12, 2021) and Omicron BA.1/BA.2 periods (December 13, 2021– June 26, 2022) of the pandemic.

For additional information on COVID-19 among long-term care residents, please see the Ontario COVID-19 Data Tool. For information on COVID-19 vaccine uptake in the province and impact of the vaccination program on COVID-19 cases please refer to the COVID-19 Vaccine Uptake in Ontario report.

Highlights

- Case fatality (defined as death within 30 days of infection) among LTCH residents has varied over time and as new variants have emerged. CFR has declined since the beginning of the pandemic, and although it noticeably increased with emergence of the Delta variant, CFR during the Omicron BA.1/BA.2 period is at its lowest point of the pandemic (Figure 1). The decline in CFR has been driven in part by the uptake of vaccines and booster doses, and changes in the variant severity (Figure 2).

- Vaccine uptake, especially of booster doses, differed between the Delta and Omicron BA.1/BA.2 periods. Among residents infected during the Delta period, most had received two doses of vaccines more than 120 days prior to their infection, with fewer residents having received either a recent second dose or third dose (Table 2A). Booster dose uptake was much higher among those infected during Omicron BA.1/BA.2 period, with the majority of the vaccinated residents having received a third or fourth dose between 14 and 120 days of their infection (Table 2B).

- There is a considerable decrease in CFR when comparing the Delta period to the Omicron BA.1/BA.2 period. Among the unvaccinated residents, risk of death within 30 days of disease onset during the Omicron period was 0.17 times the risk of death during the Delta period (a decrease of 83%) (Table 3B).

- There is a considerable decrease in CFR when comparing vaccinated residents with unvaccinated residents. During the current Omicron BA.1/BA.2 period, risk of death among those who have received at least two doses between 14 and 120 days before infection was 0.66 times the risk of an unvaccinated individual (a 33% decrease in the risk of death) (Table 3C).

- Combining the impacts of variant type and vaccination status, LTCH residents with the most vaccine protection have a risk of death that is 89% lower during the Omicron BA.1/BA.2 period compared to an unvaccinated resident infected during the Delta period (CFR relative risk (RR) = 0.11) (Table 3D).

Definitions: Vaccine Status

Vaccine protection status in this report is based on the combination of number of COVID-19 vaccine doses received, and days since last dose before infection:

- **Most protected:** Received two or more doses, between 14 and 120 days prior to infection
- **Partially protected:** Either received one dose, or received two or more doses more than 120 days prior to infection
- **Unvaccinated:** has not received any vaccine doses

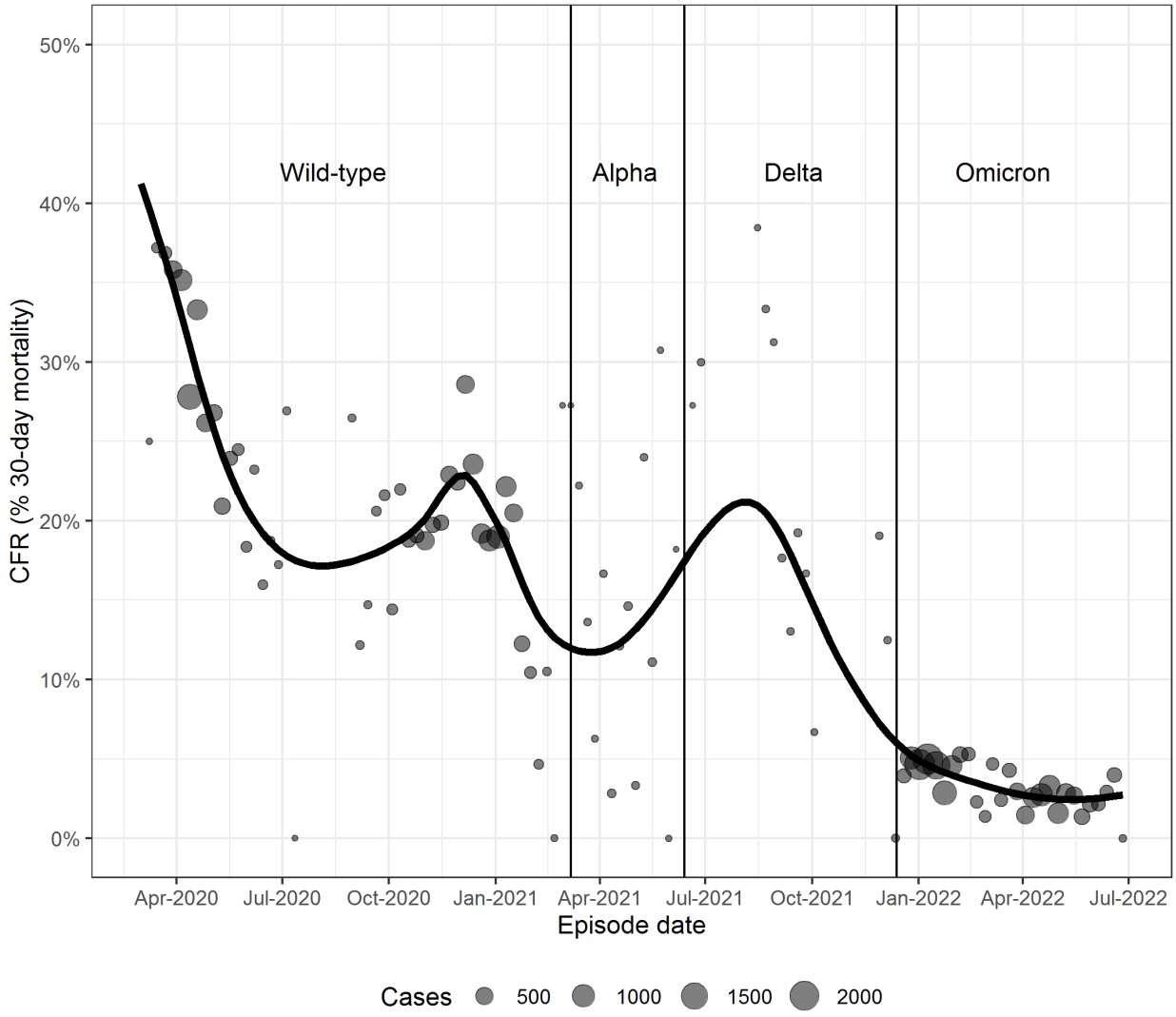
Results

Table 1. Summary of cases and deaths in long-term care home residents during the Delta (June 13, 2021 – December 12, 2021) and Omicron BA.1/BA.2 (December 13, 2021 – June 26, 2022) periods, Ontario

Cases and Deaths	Delta period (June 13, 2021 – December 12, 2021)	Omicron period (December 13, 2021 – June 26, 2022)
Number of cases	316	17,947
Number of deaths	58	657
Case Fatality Ratio (# of deaths/ # of cases)	18.4%	3.7%
Median age (IQR) of cases not resulting in death (years)	86 (78 - 92)	85 (78 - 91)
Median age (IQR) of deaths (years)	88.5 (83 - 94)	88 (82 - 93)
% male* (among cases not resulting in death)	30.6%	35.5%
% male* (among deaths)	48.38%	48.0%

Notes: IQR refers to interquartile range, with the first quartile (Q_1) and third quartile (Q_3) being listed in parenthesis.
*Not all cases have a gender reported. The denominator for calculating male case percentages includes all cases.
Data Source: CCM

Figure 1. Case-fatality ratio among long-term care home residents by case episode week, March 1, 2020 to June 26, 2022



Notes: Line is a smoothed CFR estimate produced using generalized additive model based on the weekly number of cases and deaths. The size of the dots corresponds to the weekly number of cases. Points have been suppressed for weeks with less than 10 cases. Variant periods are defined as the time period for which the estimated prevalence of the given lineage is at least 50% of cases.
Data Source: CCM/COVax

Table 2A. Number of confirmed COVID-19 cases (and % of column total) by vaccine protection status categories during the Delta period (June 13, 2021 – December 12, 2021)

Number of doses and days since last dose before infection	Unvaccinated	Partially protected	Most protected
Unvaccinated	33 (100%)	n/a	n/a
1st dose was 14 to 120 days before infection	n/a	4 (2%)	n/a
1st dose was more than 120 days before infection	n/a	3 (1%)	n/a
2nd dose was 14 to 120 days before infection	n/a	n/a	32 (43%)
2nd dose was more than 120 days before infection	n/a	202 (97%)	n/a
3rd dose was 14 to 120 days before infection	n/a	n/a	42 (57%)
3rd dose was more than 120 days before infection	n/a	n/a	n/a
4th dose was 14 to 120 days before infection	n/a	n/a	n/a
4th dose was more than 120 days before infection	n/a	n/a	n/a
Total	**33**	**209**	**74**

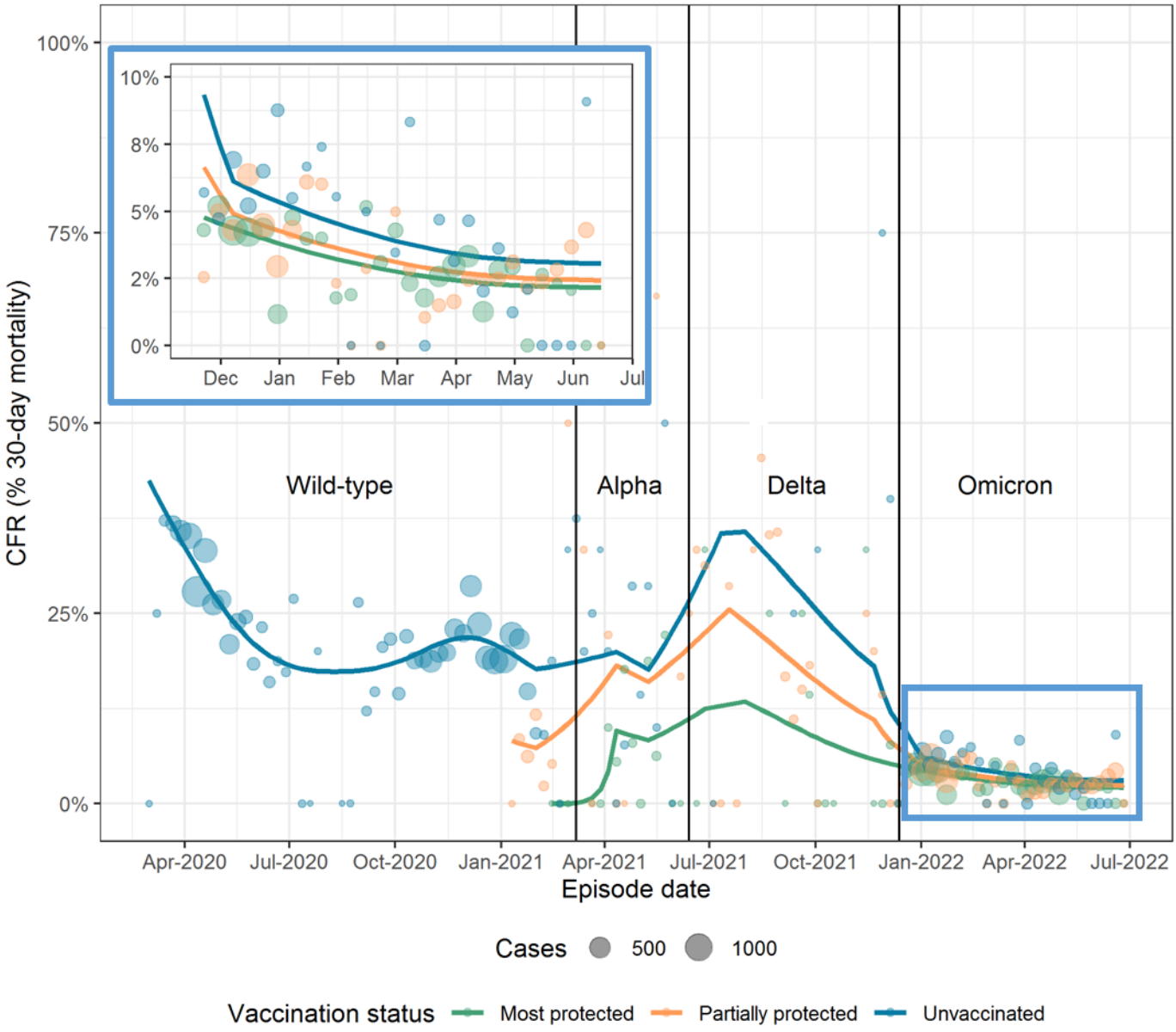
Note: LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection. Individuals are not considered to have received a valid dose until 14 days after dose administration to account for the time required to establish an immune response.
Data Source: CCM/COVax

Table 2B. Number of confirmed COVID-19 cases (and % of column total) by vaccine protection status categories during the Omicron BA.1/BA.2 period (December 13, 2021 – June 26, 2022)

Number of doses and days since last dose before infection	Unvaccinated	Partially protected	Most protected
Unvaccinated	2,018 (100%)	n/a	n/a
1st dose was 14 to 120 days before infection	n/a	60 (1%)	n/a
1st dose was more than 120 days before infection	n/a	65 (1%)	n/a
2nd dose was 14 to 120 days before infection	n/a	n/a	215 (2%)
2nd dose was more than 120 days before infection	n/a	1,559 (26%)	n/a
3rd dose was 14 to 120 days before infection	n/a	n/a	5,631 (57%)
3rd dose was more than 120 days before infection	n/a	3,567 (59%)	n/a
4th dose was 14 to 120 days before infection	n/a	n/a	4,079 (41%)
4th dose was more than 120 days before infection	n/a	753 (13%)	n/a
Total	**2,018**	**6,004**	**9,925**

Note: LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection. Individuals are not considered to have received a valid dose until 14 days after dose administration to account for the time required to establish an immune response.
Data Source: CCM/COVax

Figure 2. Case-fatality ratio (CFR) among long-term care home residents by vaccination status, March 1, 2020 to June 26th, 2022



Notes: Lines are smoothed CFR estimates produced using a generalized additive model based on the weekly number of cases and deaths, adjusted with an interaction term for variant period and vaccine status. The size of the dots corresponds to the weekly number of cases. Points have been suppressed for weeks with less than two cases to improve legibility. Vaccine protection status is defined based on number of doses and days since last dose before infection. LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection.
Data Source: CCM/COVax

Table 3A. Summary of case-fatality ratios (CFR) among long-term care home residents by vaccine protection status* during the Delta (June 13, 2021 – December 12, 2021) and Omicron BA.1/BA.2 (December 13, 2021 – June 26, 2022) periods

Case-fatality Ratio	Unvaccinated CFR (# deaths/# cases)	Partially protected CFR (# deaths/# cases)	Most protected CFR (# deaths/# cases)
Delta period (June 13, 2021 – December 12, 2021)	30.3% (10/33)	20.1% (42/209)	8.1% (6/74)
Omicron period (December 13, 2021 – June 26, 2022)	4.8% (96/2018)	3.8% (230/6004)	3.3% (331/9925)

Notes: *Vaccine protection status is defined based on number of doses and days since last dose before infection. LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection.
Data Source: CCM/COVax

Table 3B. Estimates of CFR risk reduction and 95% confidence intervals (95% CI) due to variant severity by vaccine protection status* during the Omicron BA.1/BA.2 (December 13, 2021 – June 26, 2022) period

Risk reduction due to variant severity	Reference group	Crude RR	Adjusted† RR (95% CI)
Unvaccinated	Delta unvaccinated	0.16	0.17 (0.10 - 0.30)
Partially protected	Delta partially protected	0.19	0.20 (0.14 - 0.25)
Most protected	Delta most protected	0.41	0.42 (0.18 - 0.78)

Notes: *Vaccine protection status is defined based on number of doses and days since last dose before infection. LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection.
† Adjusted risk reduction estimates are based on generalized additive models adjusted for age, sex, and an interaction term for variant period and vaccine status. Confidence intervals are estimated using parametric bootstrapping.
Data Source: CCM/COVax

Table 3C. Estimates of CFR risk reduction and 95% confidence intervals (95% CI) due to vaccine protection status* during the Omicron BA.1/BA.2 (December 13, 2021 – June 26, 2022) period

Risk reduction due vaccination status	Reference group	Crude RR	Adjusted† RR (95% CI)
Unvaccinated	Omicron unvaccinated	Reference	Reference
Partially protected	Omicron unvaccinated	0.81	0.77 (0.62 - 0.99)
Most protected	Omicron unvaccinated	0.70	0.66 (0.54 - 0.89)

Notes: *Vaccine protection status is defined based on number of doses and days since last dose before infection. LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection.
† Adjusted risk reduction estimates are based on generalized additive models adjusted for age, sex, and an interaction term for variant period and vaccine status. Confidence intervals are estimated using parametric bootstrapping.
Data Source: CCM/COVax

Table 3D. Estimates of total CFR risk reduction and 95% confidence intervals (95% CI) due to variant severity and vaccine protection status* during the Omicron BA.1/BA.2 (December 13, 2021 – June 26, 2022) period

Total risk reduction due to variant severity and vaccination status	Reference group	Crude RR	Adjusted† RR (95% CI)
Unvaccinated	Delta unvaccinated	0.16	0.17 (0.10 - 0.30)
Partially protected	Delta unvaccinated	0.13	0.13 (0.08 - 0.25)
Most protected	Delta unvaccinated	0.11	0.11 (0.07 - 0.19)

Notes: *Vaccine protection status is defined based on number of doses and days since last dose before infection. LTCH residents are considered partially protected if they have received only one dose, or two or more doses more than 120 days prior to infection. LTCH residents are considered most protected if they have received two or more doses with the last dose between 14 and 120 days of infection.
† Adjusted risk reduction estimates are based on generalized additive models adjusted for age, sex, and an interaction term for variant period and vaccine status. Confidence intervals are estimated using parametric bootstrapping.
Data Source: CCM/COVax

Technical Notes

Data Sources

- SARS-CoV-2 infection and mortality data were based on information successfully extracted from CCM for all public health units (PHU) by PHO as of: August 2, 2022 at 1 p.m. for cases reported from January 1, 2022 onwards; August 2, 2022 at 9 a.m. for cases reported from January 1, 2021 to December 31, 2021; and June 24, 2022 at 9 a.m. for cases reported up to December 31, 2020.
    - To account for 7 days of data entry lag and 30 days for case follow-up, the data included are for cases reported in Ontario with case episode dates before June 26, 2022 and deaths linked to those cases up until the date of extraction (August 2, 2022).
- COVID-19 vaccination data were based on information successfully extracted from the Ontario Ministry of Health's COVaxON application as of August 2, 2022 at approximately 7:00 a.m.

Methods

POPULATION

- In order to identify cases post-vaccination, clients in CCM and COVaxON were linked using health care number as well as other personal identifiers, including name, date of birth, gender, and postal code.
- Methods for processing COVaxON vaccine uptake data are described in the Technical Notes of the COVID-19 Vaccine Uptake Report[1] and methods for processing the CCM case data are described in the Technical Notes of the Ontario COVID-19 data tool.[2]
- 'Long-term care home residents' includes cases that reported 'Yes' to the risk factor 'Resident of a long-term care home'; or 'Yes' to the risk factor 'Resident of nursing home or other chronic care facility' and reported to be part of an outbreak assigned as a long-term care home (via the Outbreak number or case comments field); or were reported to be part of an outbreak assigned as a long-term care home (via the outbreak number or case comments field) with an age over 70 years and did not report 'No' to the risk factors 'Resident of long-term care home' or 'Resident of nursing home or other chronic care facility'. 'Long-term care home residents' excludes cases that reported 'Yes' to any of the health care worker occupational risk factors.

MEASURES

- For surveillance purposes, a COVID-19 death is defined as a death resulting from a clinically compatible illness unless there is a clear alternative cause of death that cannot be related to COVID-19 (e.g., trauma, medically assisted death). There should be no period of complete recovery from COVID-19 between illness and reported death.
    - Deaths are determined by using the Outcome and Type of Death fields in CCM. COVID-19 deaths are counted where the Outcome value is 'Fatal' and the Type of Death value is not 'DOPHS (Disease of Public Health Significance) was unrelated to cause of death'. COVID-19 deaths are placed in time using the 'Date of Death' field in CCM.

- Variant periods for Delta and Omicron are defined as the time period for which the estimated prevalence of a given lineage is at least 50% of cases. The variant periods do not necessarily correspond with dates used for COVID-19 waves. The date range for the Omicron period used in this report (December 13, 2021 – June 26, 2022) approximately corresponds to when BA.1 and BA.2 lineages were most prevalent, and so these findings may not apply to other Omicron subvariants. Further details on COVID-19 variants may be found in the SARS-CoV-2 Genomic Surveillance in Ontario report.[3]

- Case Episode Date is based on the best estimate of the date of disease onset. This date is calculated based on either the date of symptom onset, specimen collection/test date for the COVID-19 test, or the date the COVID-19 case was reported to public health (not the specimen collection/test date).

- Only cases meeting the confirmed case classification as listed in the MOH COVID-19 Case Definition are included.[4]

- Demographic information (sex, age, public health unit of residence) in this report are sourced from demographic fields in CCM. Further details on CCM case data are described in the Technical Notes of the Ontario COVID-19 data tool.[2]

VACCINE STATUS

- Vaccine protection status is based on the number of doses received and the days since dose received. Residents are defined as "partially protected" if they have only received one dose, and/or received their last dose more than 120 days prior. Residents are considered "most protected" if they have received two or more doses, with the last dose received between 14 and 120 days before infection. Residents who were infected within 14 days of dose administration are considered "partially protected" as long as they had received at least one dose that was administered at least 120 days prior, or "unvaccinated" if they have not been vaccinated or were infected within 14 days of receiving their first dose.

- Individuals are not counted as having received a valid vaccine dose until 14 or more days after dose administration, to account for the time required to establish an immune response.

- Dose administration date was used to determine the dose number (e.g., the first chronological dose was considered dose 1) as well as the dose interval (e.g., number of days from first to second dose).

ANALYSIS

- The case fatality ratio is the proportion of identified cases that succumb to the infection within 30 days. For more information regarding CFR, refer to COVID-19 Case Fatality, Case Identification, and Attack Rates in Ontario.[5]

- Vaccine uptake varied between Delta and Omicron BA.1/BA.2 periods, as third and fourth booster doses were more available during the Omicron BA.1/BA.2 period (see Table 2). A sensitivity analysis conducted to assess for residual impacts of receiving a booster dose during the Omicron BA.1/BA.2 period found no additional effects of having received third and fourth doses compared to second doses received within 120 days prior to infection. For this reason, this report does not distinguish between vaccine protections provided by second, third and fourth doses, but does account for time since dose before infection.

- Fatal Delta and Omicron cases whose death date preceded their reported case episode date (N=4), or fatal cases who were missing a death date (N=2) were included. A total of 33 cases had a death date that was more than 30 days after case episode date and were excluded. An additional 146 deaths were classified as having a cause of death unrelated to COVID-19, and were excluded.

- Generalized additive models used to calculate estimates of adjusted risk reductions were adjusted for age, sex, and an interaction term for variant period and number of doses received. Variant period includes 10 week transitions between the wild-type, Alpha, and Delta periods, and a five week transition between Delta and Omicron periods. Model-adjusted CFR and confidence intervals are estimated using marginal standardization.[6]

- Cases are reported using age at the time of illness.

Data Caveats

- COVaxON and CCM are dynamic reporting systems, which allow ongoing updates to data previously entered. As a result, data extracted from COVaxON and CCM represent a snapshot at the time of extraction and may differ from previous or subsequent reports.

- The data represent vaccinations and case information reported and recorded in COVaxON or CCM, respectively. As a result, all counts may be subject to varying degrees of underreporting due to a variety of factors.

- The proportion of cases with a history of past infection is higher during the Omicron BA.1/BA.2 period. During the Delta period, 1.6% of cases among LTCH residents were considered re-infections, compared to 7.1% of cases among LTCH residents during the Omicron BA.1/BA.2 period. Natural immunity provided by past infection may contribute to the risk reductions observed between Delta and Omicron BA.1/BA.2 periods.

- Linking COVaxON and CCM data is dependent on availability of personal identifiers reported in both databases. For example, if a client was reported in both COVaxON and CCM, but personal identifiers (e.g., health card number, date of birth) were not available, then sufficient information would not have been available to identify the client and the client would not have been included in the linkage.

- Only cases that are unvaccinated or have received Health Canada authorized vaccines are included. Vaccinated cases included in this study were reported to have received the Pfizer-BioNTech Comirnaty, Moderna Spikevax, AstraZeneca Vaxzevria/COVISHIELD, and Janssen COVID-19 vaccines. Cases that received one or more doses of a non-Health Canada authorized vaccine are excluded.

- The time interval between doses was not assessed to determine if subsequent doses were administered as per the product-specific recommended minimum interval.

References

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