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Methods

Estimating the proportion of days with mild restrictions

When an elimination approach to COVID-19 is applied, severe restrictions are implemented to bring the number of cases back to zero whenever a community outbreak occurs, and restrictions are released afterwards. We are interested in broadly estimating the expected percentage of days when mild restrictions are implemented for different viral variants.

We know that the Alpha variant is 1.5 more transmissible than the original variant [1], that the Delta variant is 1.6 more than Alpha [2] and that the Omicron variant is 3.3 more times transmissible than Delta [3]. The Alpha variant arrived in Canada at the end of December 2020 [4]. Newfoundland and Labrador experienced a community outbreak of Alpha variant in February 2021, and no successive outbreak till the end of April 2021 [4]. Therefore, we use 120 days as an estimate for the expected time between community outbreaks (T_d) due to the Alpha variant. Respective estimates for other variants are provided in Table 1.

Additionally, we assume that an elimination strategy is enacted when 50 cases are already present in the community, and we calculate the time needed to reduce the number of cases from 50 to 1 (T_l) by assuming exponential decay in the number of cases. We find that

$$50\ e^{(R_0\gamma-\gamma)T_l} \longleftrightarrow T_l = \frac{\ln(1/50)}{R_0\gamma-\gamma}\,.$$

We assume that the net reproduction number with severe restrictions implemented is $R_0 = 0.1$ for the original strain, and calculate the corresponding reproductive number for different variants of concern taking into account their increased transmissibility [1,2,3]. We assume a recovery rate of 1/7 $days^{-1}$.
Finally, we calculate the expected percentage of days for when mild restrictions can be implemented, given an elimination strategy, as

$$\%\ \text{of days with mild lockdown} = \frac{T_d - T_l}{T_d} \times 100\,.$$

Estimates are provided in Table 1 and Fig. 2.

Estimating disease severity

Using the estimates of hospitalization rates for different viral variants in vaccinated and unvaccinated individuals [5], and Newfoundland and Labrador vaccination rates [6], we estimate the average number of hospitalizations per 1000 infections in Newfoundland and Labrador when variants were established in the province [7]. Estimates are provided in Table 1.

	Original	Alpha	Delta	Omicron
Date of establishment in NL [6]	March 14, 2020	Feb 12, 2021	Apr 28, 2021	Dec 15, 2021
Percent of NL population vaccinated with one dose when the variant was established [5]	—	0.93%	26.46%	6.41%
Percent of NL population vaccinated with two doses when the variant was established [5]	—	0.78%	1.86%	85.33%
Average probability of hospitalization for unvaccinated individuals [4]	2.3%	3.84%	5.50%	1.82%
Average probability of hospitalization for individuals vaccinated with one dose [4]	—	1.79%	2.14%	1.27%
Average probability of hospitalization for individuals vaccinated with two doses [4]	—	—	1.73%	1.01%
Average hospitalizations per 1000 cases, given NL vaccination rates when the variant was established	23	38	45	11
Estimated time between community outbreaks (T_d)	180 days	120 days	75 days	23 days
Estimated duration of a severe lockdown to bring the number of cases from 50 to 1 (T_l).	30 days	32 days	36 days	132 days
If elimination is implemented, estimated % of days of severe lockdown.	83.1%	73.2%	52.0%	0%

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