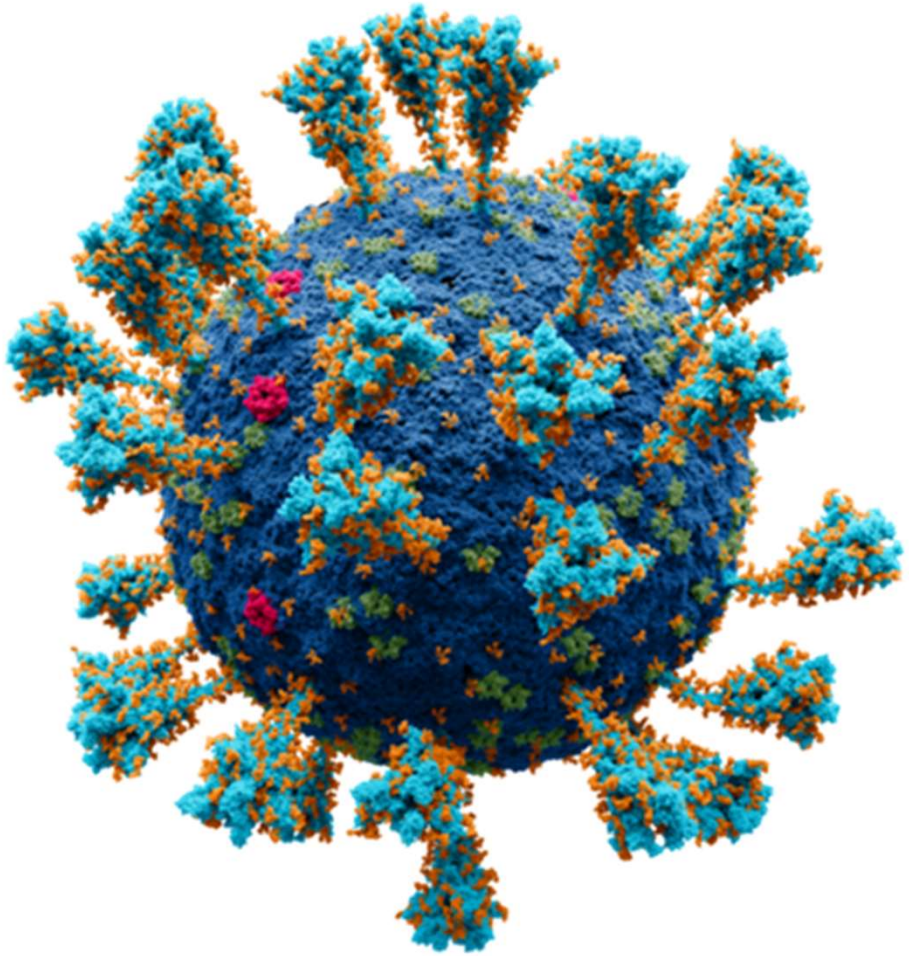
COVID-19: Fall 2021

September 27, 2021



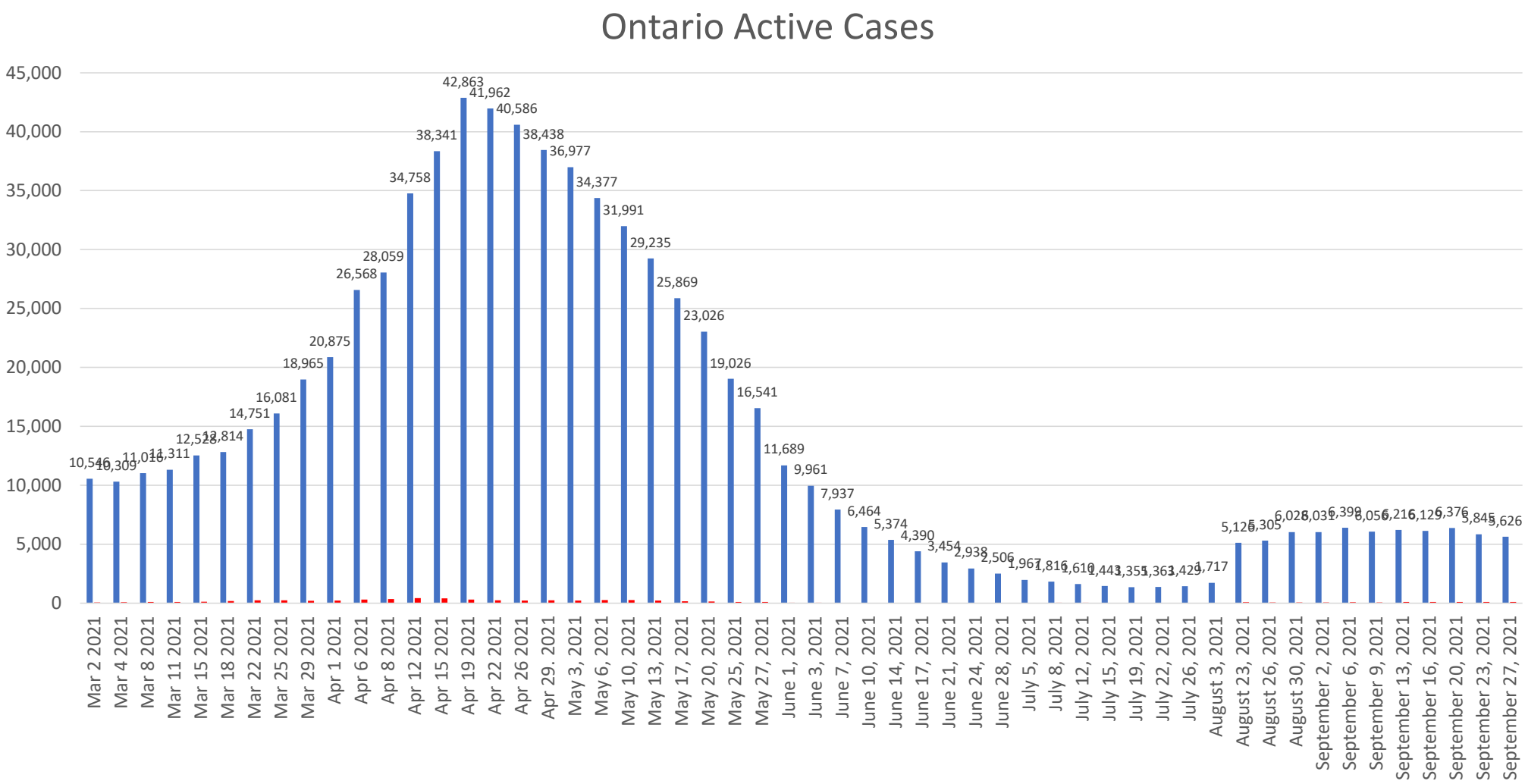
Outline

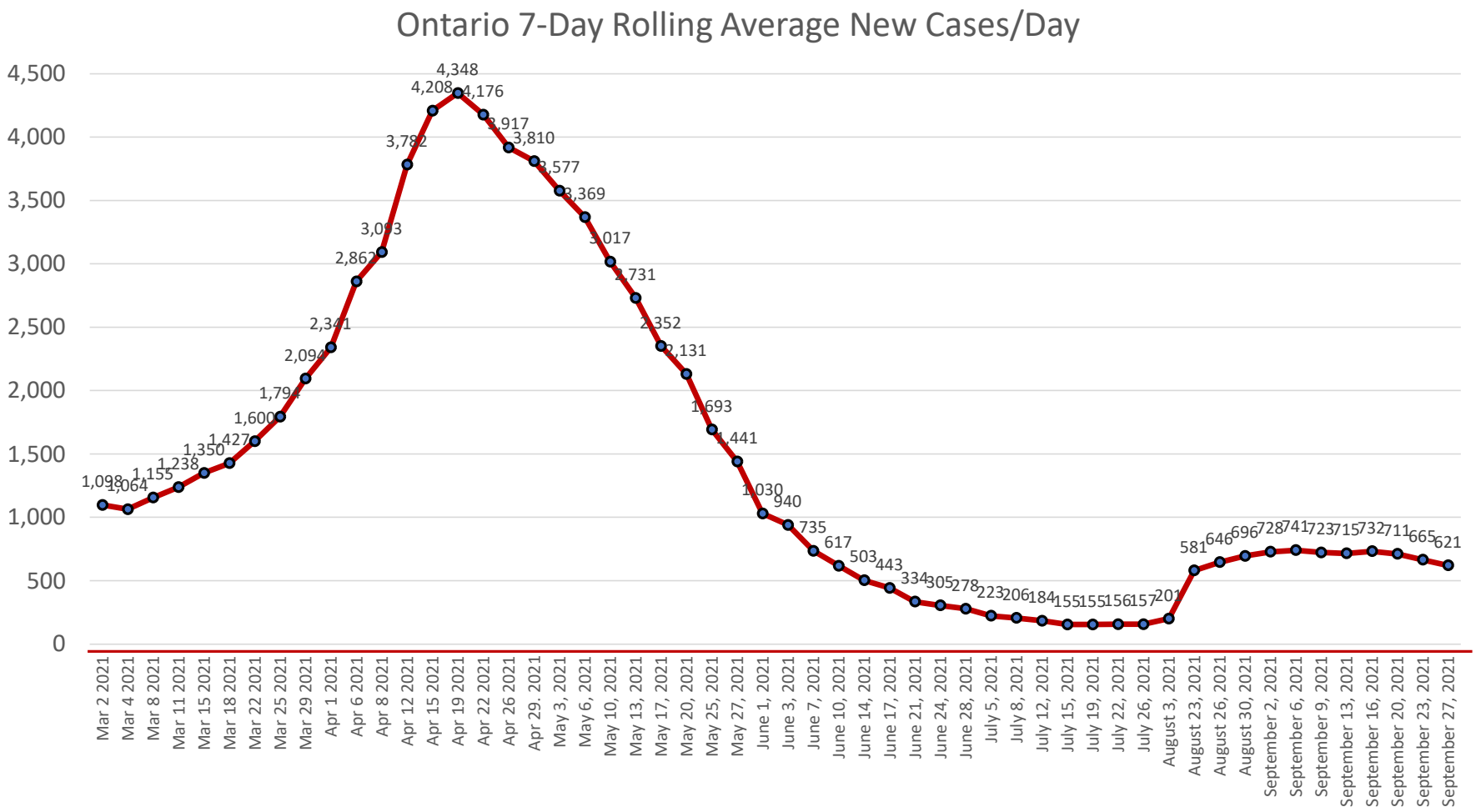
- Where we are today
- Delta Variant Update
- Vaccine Science Update
- The Coming Fall

Ontario COVID-19 Science Advisory Table – Current Status in Ontario

Key Indicators	
Effective Reproduction Number R(t), on 23-Sep-2021	0.87
Estimated Number of COVID-19 Cases per Day, on 26-Sep-2021	602
Change per week	-89
Estimated Percentage Caused by Delta	99.8%
COVID-19 Hospital Occupancy, on 26-Sep-2021	224
Change per week	-42
COVID-19 ICU Occupancy, on 26-Sep-2021	177
Change per week	-5
COVID-19 Deaths per Day, on 23-Sep-2021	7
Change per week	+1
COVID-19 Cases per 1 Million per Day, on 26-Sep-2021	40.9
Among Unvaccinated	136.5
Among Fully Vaccinated	18.0
Reduction Associated with Full Vaccination	-86.8%
COVID-19 Hospital Occupancy per 1 Million, on 26-Sep-2021	15.2
Among Unvaccinated	80.3
Among Fully Vaccinated	3.5
Reduction Associated with Full Vaccination	-95.7%
COVID-19 ICU Occupancy per 1 Million, on 26-Sep-2021	12.0
Among Unvaccinated	76.2
Among Fully Vaccinated	1.0
Reduction Associated with Full Vaccination	-98.7%
COVID-19 Vaccination, on 25-Sep-2021	
Number of People With at Least 1 Dose	11'190'066
Change per week	+101'861
Percent of Population Aged 12+ Vaccinated With at Least 1 Dose	85.8%
Change per week	+0.8%
Number of Fully Vaccinated People	10'461'784
Change per week	+162'339
Percent of Population Aged 12+ Fully Vaccinated	80.3%
Change per week	+1.2%

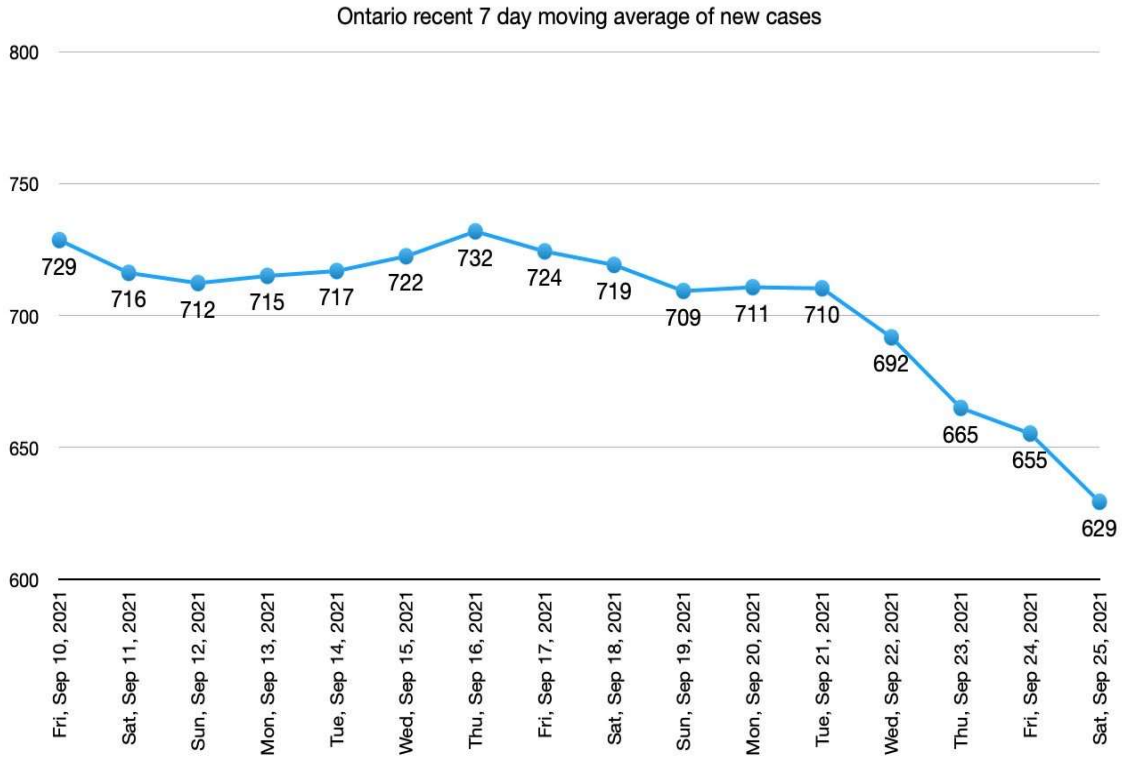
Source: https://covid19-sciencetable.ca/ontario-dashboard/

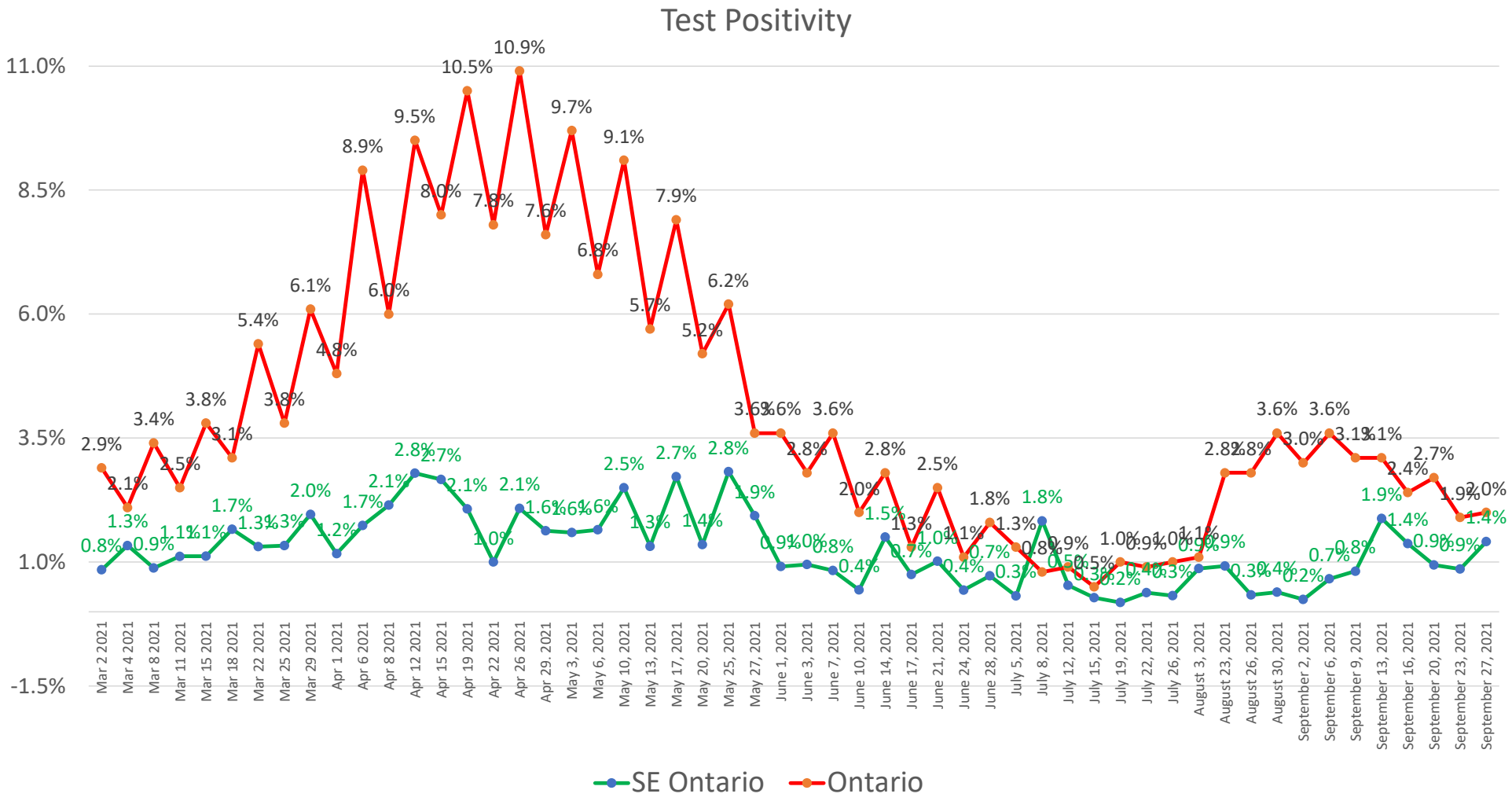

Ontario Active Cases
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10,546
10,309
11,016
11,311
12,528
12,814
14,751
16,081
18,965
20,875
26,568
28,059
34,758
38,341
42,863
41,962
40,586
38,438
36,977
34,377
31,991
29,235
25,869
23,026
19,026
16,541
11,689
9,961
7,937
6,464
5,374
4,390
3,454
2,938
2,506
1,967
1,816
1,610
1,443
1,355
1,363
1,429
1,717
5,126
5,305
6,028
6,398
6,056
6,216
6,129
6,376
5,845
5,626
Mar 2 2021
Mar 4 2021
Mar 8 2021
Mar 11 2021
Mar 15 2021
Mar 18 2021
Mar 22 2021
Mar 25 2021
Mar 29 2021
Apr 1 2021
Apr 6 2021
Apr 8 2021
Apr 12 2021
Apr 15 2021
Apr 19 2021
Apr 22 2021
Apr 26 2021
Apr 29. 2021
May 3, 2021
May 6, 2021
May 10, 2021
May 13, 2021
May 17, 2021
May 20, 2021
May 25, 2021
May 27, 2021
June 1, 2021
June 3, 2021
June 7, 2021
June 10, 2021
June 14, 2021
June 17, 2021
June 21, 2021
June 24, 2021
June 28, 2021
July 5, 2021
July 8, 2021
July 12, 2021
July 15, 2021
July 19, 2021
July 22, 2021
July 26, 2021
August 3, 2021
August 23, 2021
August 26, 2021
August 30, 2021
September 2, 2021
September 6, 2021
September 9, 2021
September 13, 2021
September 16, 2021
September 20, 2021
September 23, 2021
September 27, 2021


Ontario 7-Day Rolling Average New Cases/Day
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1,098
1,064
1,155
1,238
1,350
1,427
1,600
1,794
2,094
2,341
2,862
3,093
3,782
4,208
4,348
4,176
3,917
3,810
3,577
3,369
3,017
2,731
2,352
2,131
1,693
1,441
1,030
940
735
617
503
443
334
305
278
223
206
184
155
155
156
157
201
581
646
696
728
741
723
715
732
711
665
621
Mar 2 2021
Mar 4 2021
Mar 8 2021
Mar 11 2021
Mar 15 2021
Mar 18 2021
Mar 22 2021
Mar 25 2021
Mar 29 2021
Apr 1 2021
Apr 6 2021
Apr 8 2021
Apr 12 2021
Apr 15 2021
Apr 19 2021
Apr 22 2021
Apr 26 2021
Apr 29. 2021
May 3, 2021
May 6, 2021
May 10, 2021
May 13, 2021
May 17, 2021
May 20, 2021
May 25, 2021
May 27, 2021
June 1, 2021
June 3, 2021
June 7, 2021
June 10, 2021
June 14, 2021
June 17, 2021
June 21, 2021
June 24, 2021
June 28, 2021
July 5, 2021
July 8, 2021
July 12, 2021
July 15, 2021
July 19, 2021
July 22, 2021
July 26, 2021
August 3, 2021
August 23, 2021
August 26, 2021
August 30, 2021
September 2, 2021
September 6, 2021
September 9, 2021
September 13, 2021
September 16, 2021
September 20, 2021
September 23, 2021
September 27, 2021

Ontario Daily New Cases (current day is preliminary)

Date	New Cases	Last week	7 day avg	% chg vs last wk
Fri, Sep 10, 2021	848	807	729	
Sat, Sep 11, 2021	857	944	716	
Sun, Sep 12, 2021	784	811	712	
Mon, Sep 13, 2021	600	581	715	
Tue, Sep 14, 2021	577	564	717	
Wed, Sep 15, 2021	593	554	722	
Thu, Sep 16, 2021	864	798	732	1.3%
Fri, Sep 17, 2021	795	848	724	-0.6%
Sat, Sep 18, 2021	821	857	719	0.4%
Sun, Sep 19, 2021	715	784	709	-0.4%
Mon, Sep 20, 2021	610	600	711	-0.6%
Tue, Sep 21, 2021	574	577	710	-0.9%
Wed, Sep 22, 2021	463	593	692	-4.3%
Thu, Sep 23, 2021	677	864	665	-9.1%
Fri, Sep 24, 2021	727	795	655	-9.5%
Sat, Sep 25, 2021	640	821	629	-12.5%




Test Positivity
11.0%
8.5%
6.0%
3.5%
1.0%
-1.5%
Mar 2 2021
Mar 4 2021
Mar 8 2021
Mar 11 2021
Mar 15 2021
Mar 18 2021
Mar 22 2021
Mar 25 2021
Mar 29 2021
Apr 1 2021
Apr 6 2021
Apr 8 2021
Apr 12 2021
Apr 15 2021
Apr 19 2021
Apr 22 2021
Apr 26 2021
Apr 29, 2021
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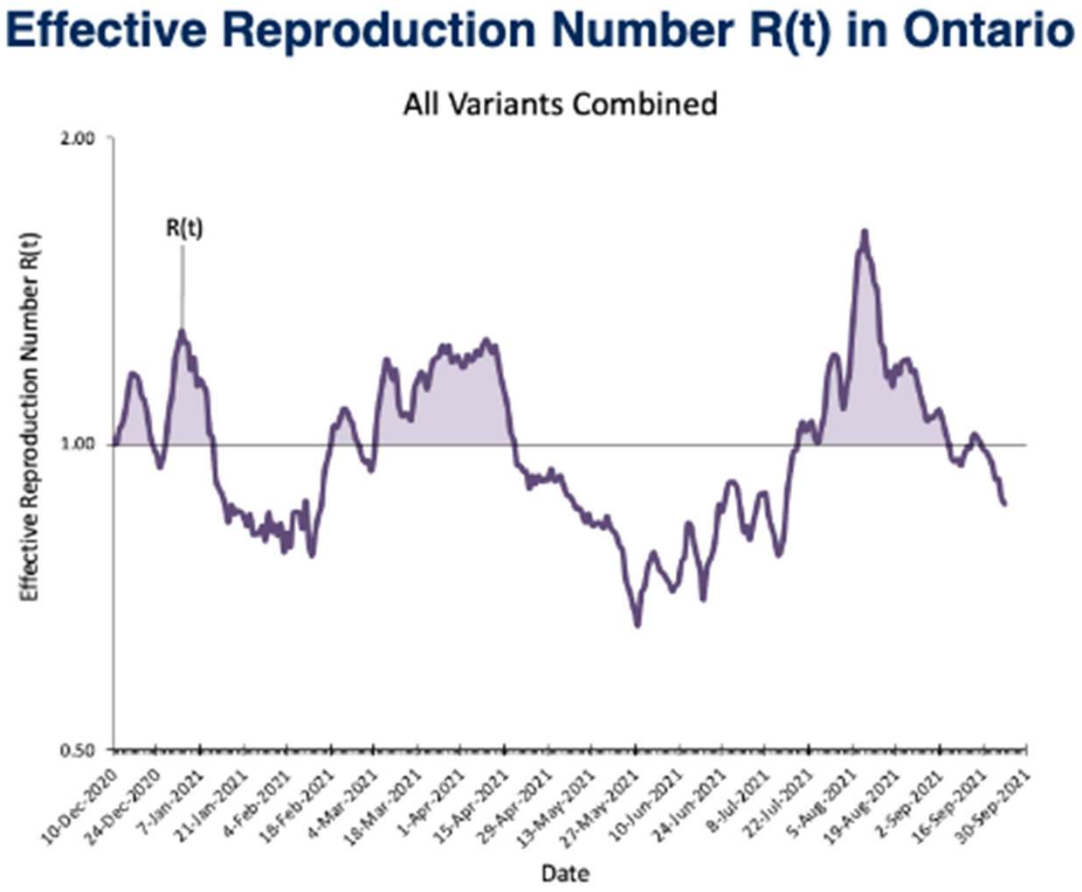
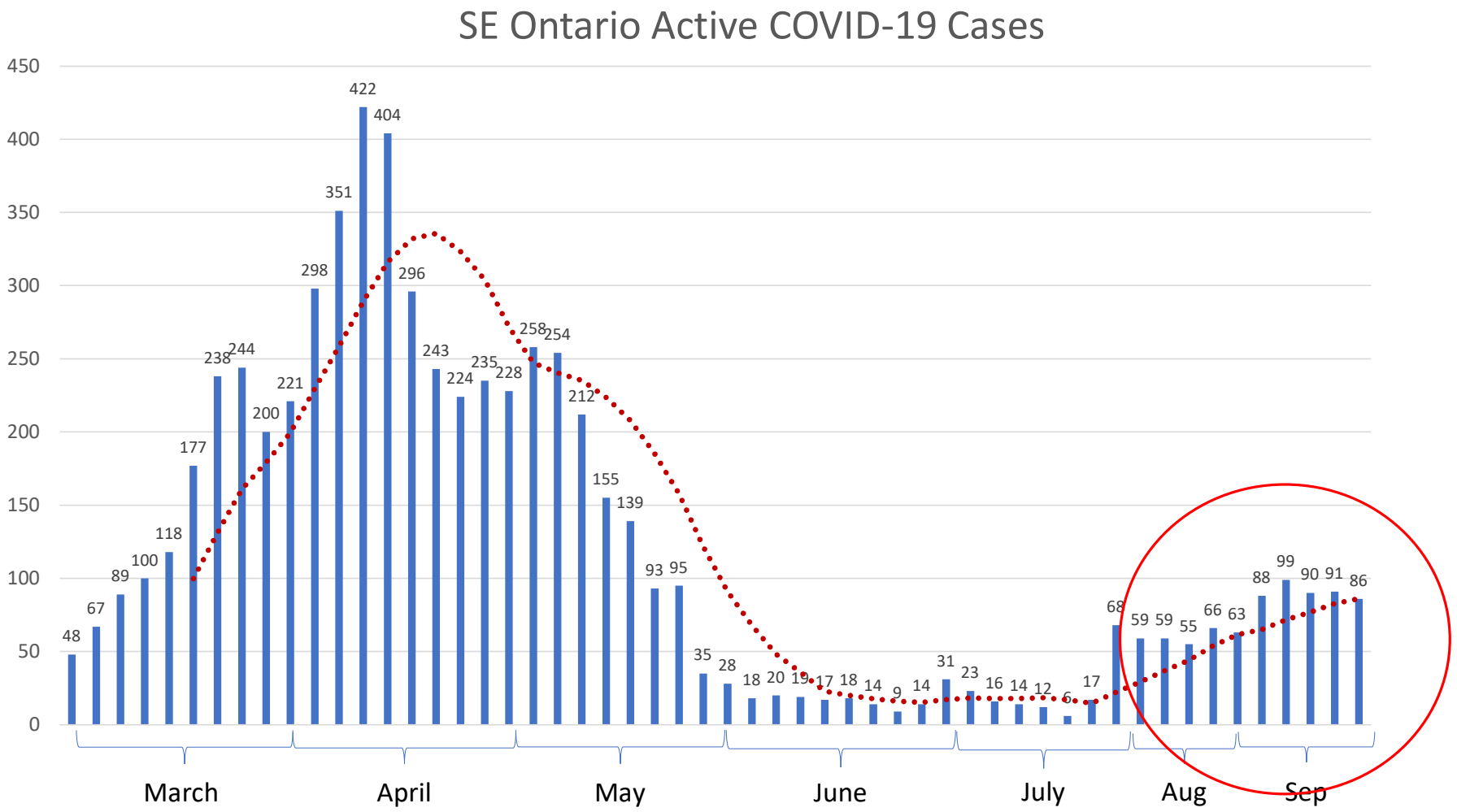
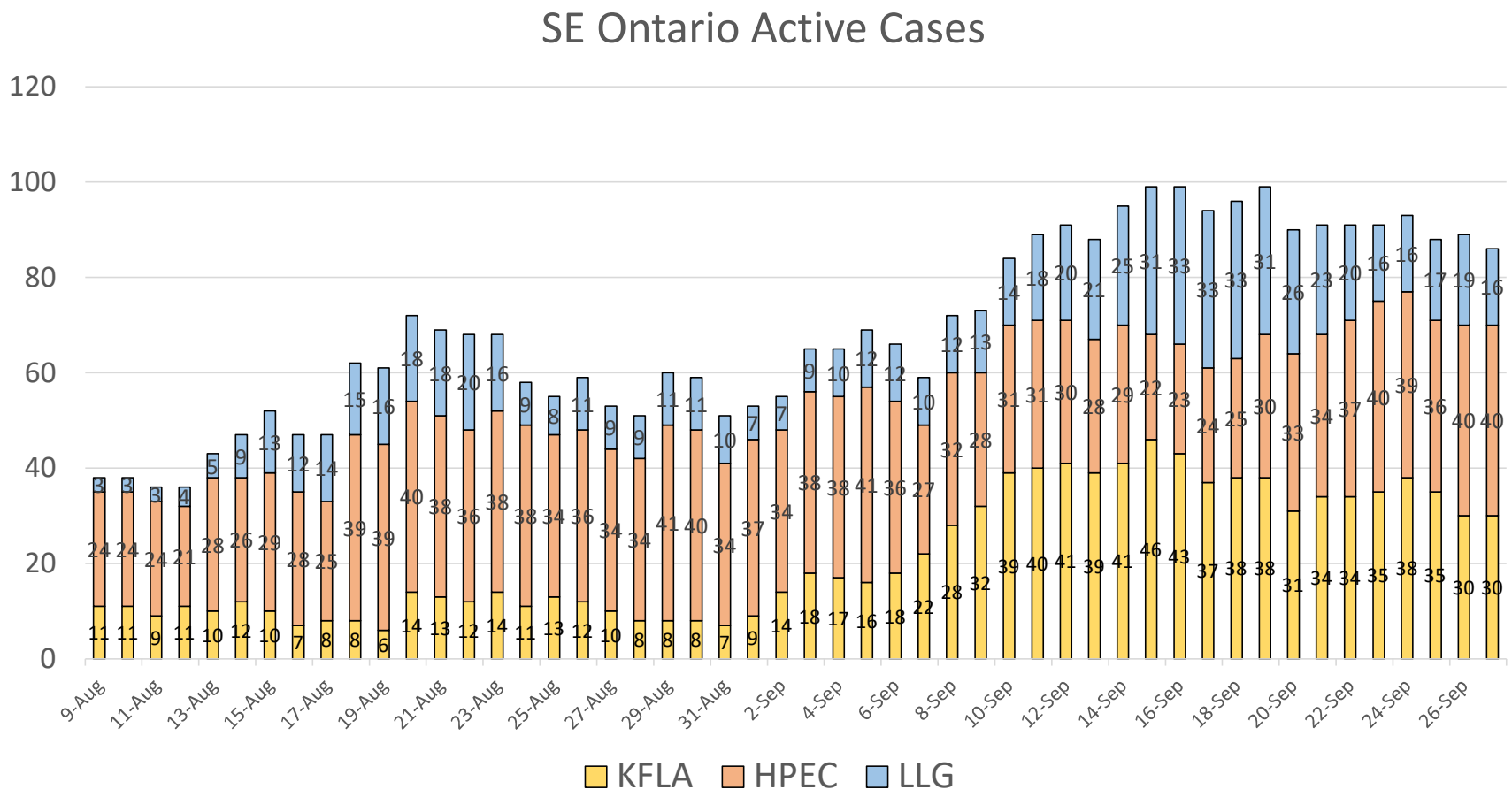
July 5, 2021
July 8, 2021
July 12, 2021
July 15, 2021
July 19, 2021
July 22, 2021
July 26, 2021
August 3, 2021
August 23, 2021
August 26, 2021
August 30, 2021
September 2, 2021
September 6, 2021
September 9, 2021
September 13, 2021
September 16, 2021
September 20, 2021
September 23, 2021
September 27, 2021
SE Ontario
Ontario

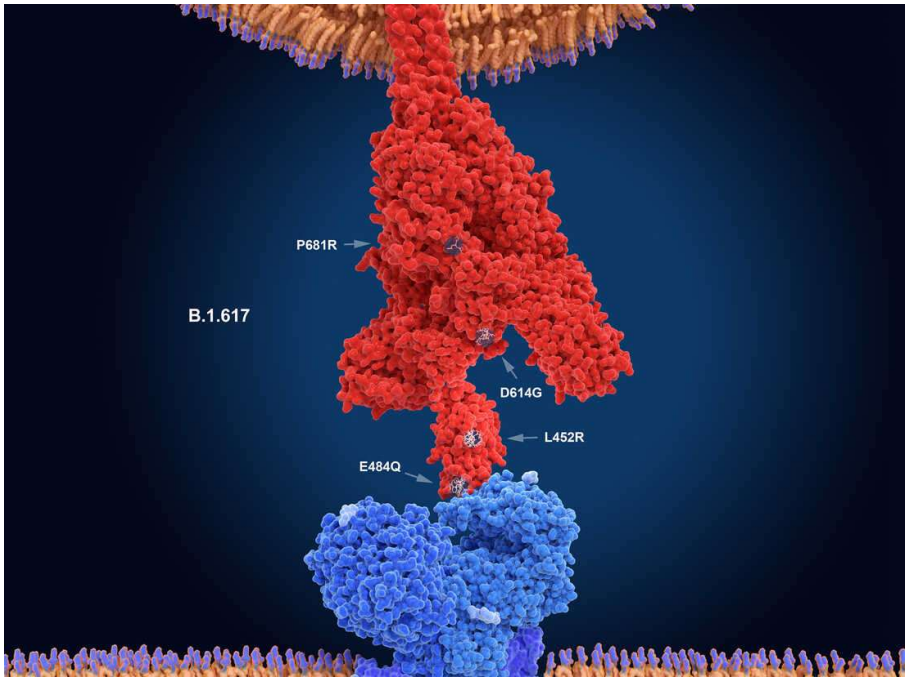


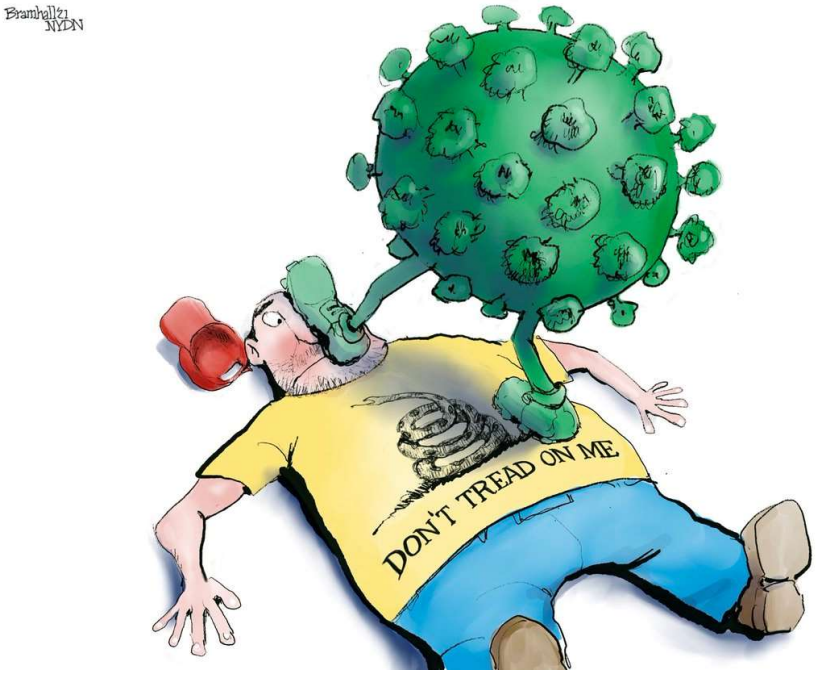
Source: https://covid19-sciencetable.ca/ontario-dashboard/


SE Ontario Active COVID-19 Cases
450
400
350
300
250
200
150
100
50
0
48 67 89 100 118 177 238 244 200 221 298 351 422 404 296 243 224 235 228 258 254 212 155 139 93 95 35 28 18 20 19 17 18 14 9 14 31 23 16 14 12 6 17 68 59 59 55 66 63 88 99 90 91 86
March
April
May
June
July
Aug
Sep


SE Ontario Active Cases
120
100
80
60
40
20
0
9-Aug
11-Aug
13-Aug
15-Aug
17-Aug
19-Aug
21-Aug
23-Aug
25-Aug
27-Aug
29-Aug
31-Aug
2-Sep
4-Sep
6-Sep
8-Sep
10-Sep
12-Sep
14-Sep
16-Sep
18-Sep
20-Sep
22-Sep
24-Sep
26-Sep
KFLA
HPEC
LLG

The Delta Variant





Symptoms of Delta Variant Infection are Not Different from Previous Variants

- Fever (temperature of 37.8˚C/100.0˚F or greater) and/or chills
- Cough (new or worsening)
- Shortness of breath
- Decrease or loss of taste or smell

- For children (<18 years old): nausea, vomiting and/or diarrhea
- For adults (>18 years old): fatigue, lethargy, malaise and/or myalgias

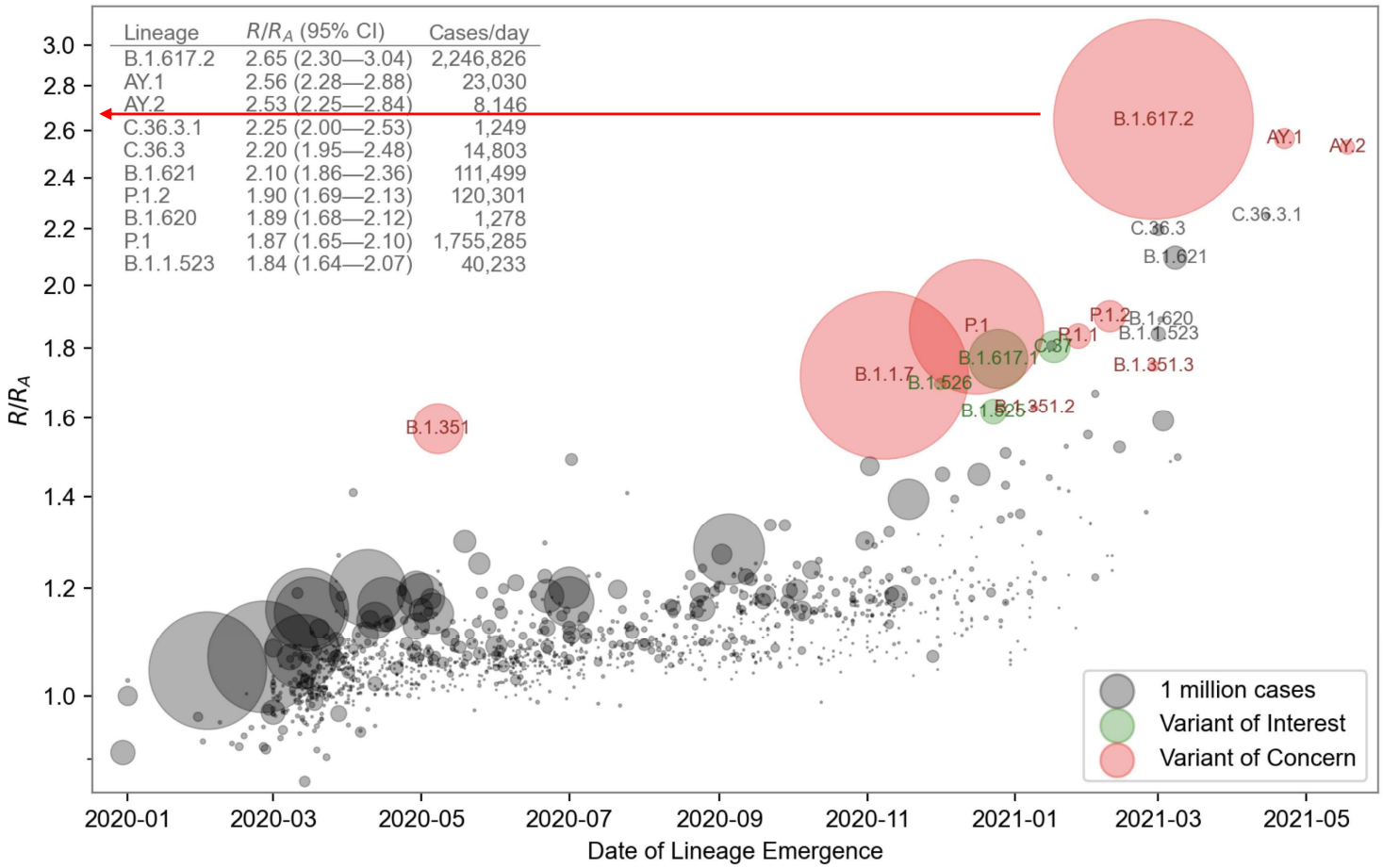
Characteristics of Delta Variant

23 July 2021 Risk assessment for SARS-CoV-2 variant: Delta Public Health England

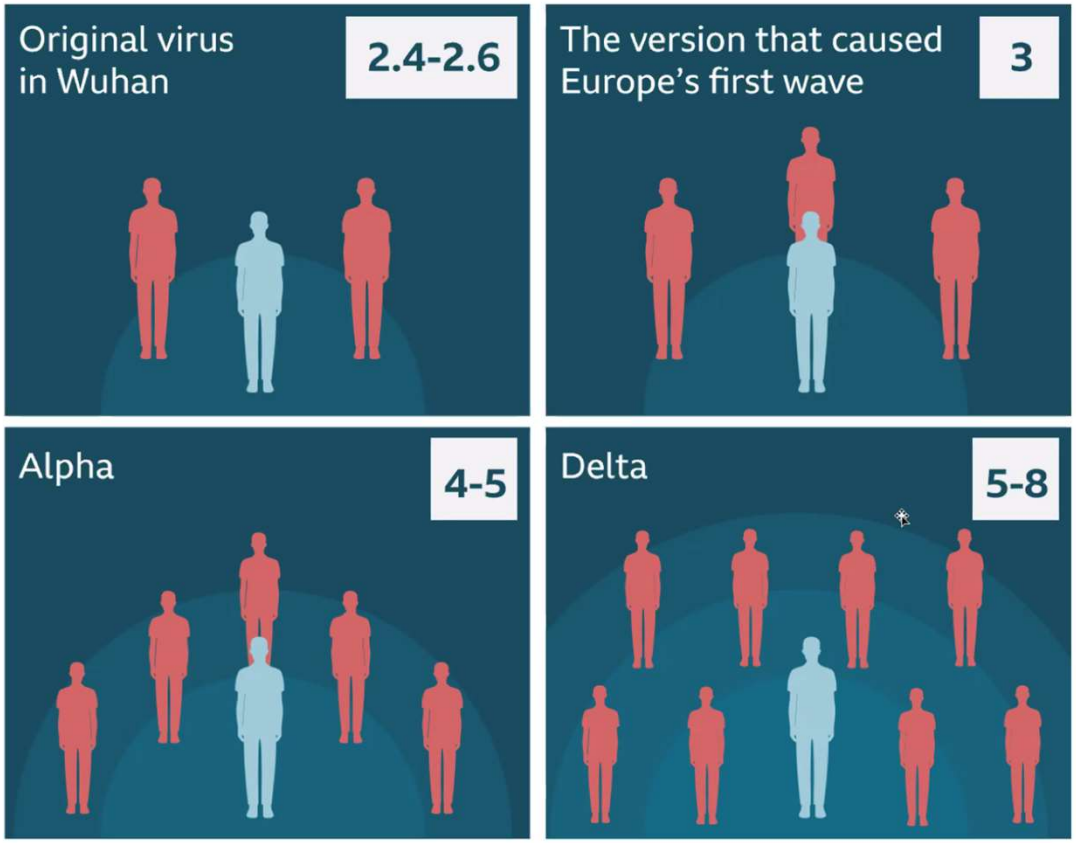
Indicator	RAG*	Confidence	Assessment and rationale
Transmissibility between humans		**HIGH**	**Transmissibility appears greater than wild type (first wave) virus.** All analyses support increased transmissibility for Delta compared to both wild type virus and Alpha. There is in vitro evidence suggestive of increased replication in biological systems that model human airway, and evidence of optimised furin cleavage. There is epidemiological evidence from secondary attack rates, household transmission studies, and growth rate modelling. The finding of lower CT values in routine testing data, compared to Alpha, may be relevant to the mechanism of increased transmissibility, however there may be multiple contributors.
Infection severity		**LOW**	**Increased severity (hospitalisation risk) when compared to Alpha.** There is an apparent increased risk of hospitalisation compared to contemporaneous Alpha cases. Analysis of deaths in England is limited by low numbers but suggests that Delta has at least an equivalent case fatality rate to Alpha (LOW confidence). Further analysis is required of both national surveillance and CO-CIN data to understand the severity and characteristics of disease in hospital.
Immunity after natural infection		**LOW**	**Evidence of increased reinfections** Pseudovirus and live virus neutralisation using convalescent sera from first wave and Alpha infections shows a reduction in neutralisation. National surveillance analysis, adjusted for different variables including age and vaccination, shows a preliminary signal of increased risk of reinfection with Delta compared to Alpha. Further investigations are being undertaken
Vaccines		**HIGH**	**Epidemiological and laboratory evidence of reduced vaccine effectiveness** There are analyses from England and Scotland supporting a reduction in vaccine effectiveness for Delta compared to Alpha against symptomatic infection. This is more pronounced after 1 dose. Iterated analysis continues to show vaccine effectiveness against Delta is high after 2 doses. Current evidence suggests that VE against hospitalisation is maintained. Although this is observational data subject to some biases, it holds true across several analytic approaches and the same effect is seen in both English and Scottish data. It is strongly supported by pseudovirus and live virus neutralisation data from multiple laboratories. There are no data on whether vaccine effectiveness against transmission is affected.
Overall assessment			Delta remains predominant in the UK and the rapid global spread continues. Distinct clades within Delta are beginning to be identified, predominantly distinguished by changes outside spike of uncertain biological significance. Laboratory investigations have been triggered. The changes in this update concern severity and reinfection risk. Both hospitalisation and deaths analyses now point towards severity that is at least as great as that of Alpha, although there is a high level of uncertainty in these findings. Whilst laboratory data and anecdotal reports have long raised the possibility of an increased risk of reinfection, there is now a signal in the national surveillance data. The priority investigations are to improve understanding of asymptomatic transmission in the vaccinated, to further investigate the developing diversity within Delta, and continued investigation of the clinical course of disease.

The therapeutics risk assessment is under review for all variants and is not included.

*refer to scale and confidence grading slide

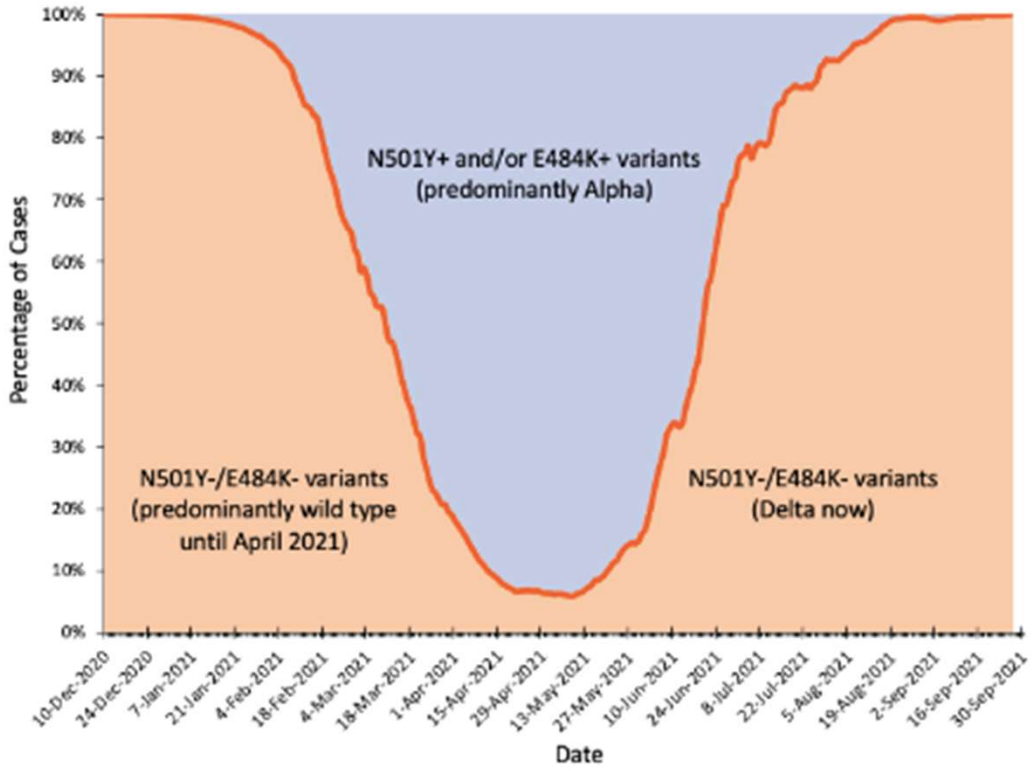

Lineage | R/R_A (95% CI) | Cases/day
B.1.617.2 | 2.65 (2.30—3.04) | 2,246,826
AY.1 | 2.56 (2.28—2.88) | 23,030
AY.2 | 2.53 (2.25—2.84) | 8,146
C.36.3.1 | 2.25 (2.00—2.53) | 1,249
C.36.3 | 2.20 (1.95—2.48) | 14,803
B.1.621 | 2.10 (1.86—2.36) | 111,499
P.1.2 | 1.90 (1.69—2.13) | 120,301
B.1.620 | 1.89 (1.68—2.12) | 1,278
P.1 | 1.87 (1.65—2.10) | 1,755,285
B.1.1.523 | 1.84 (1.64—2.07) | 40,233
R/R_A
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
2020-01
2020-03
2020-05
2020-07
2020-09
2020-11
2021-01
2021-03
2021-05
Date of Lineage Emergence
B.1.617.2
AY.1
AY.2
C.36.3.1
C.36.3
B.1.621
P.1.2
B.1.620
P.1
P.1.1
B.1.1.523
C.37
B.1.617.1
B.1.1.7
B.1.351.3
B.1.526
B.1.525
B.1.351.2
B.1.351
1 million cases
Variant of Interest
Variant of Concern

Effective Reproductive Number of Variants of Concern



https://www.bbc.com/news/health-57431420

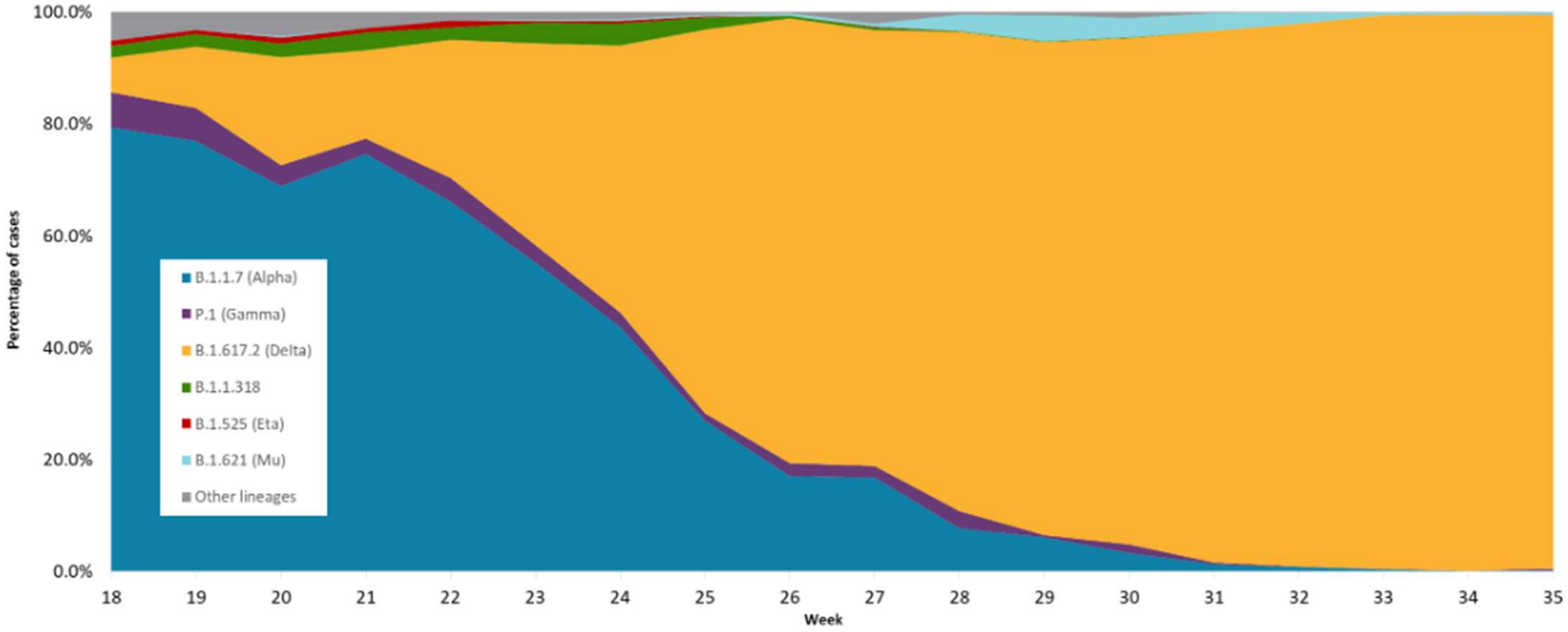
Percentage of Cases Caused by Different Variants in Ontario



Source: https://covid19-sciencetable.ca/ontario-dashboard/

Ontario WGS Data as of September 21, 2021

Figure 1. Percentage of COVID-19 cases by top 6 most prevalent VOC/VOI lineages and week, representative surveillance, Ontario, May 2 to September 4, 2021



Alpha vs Delta UK Hospitalizations

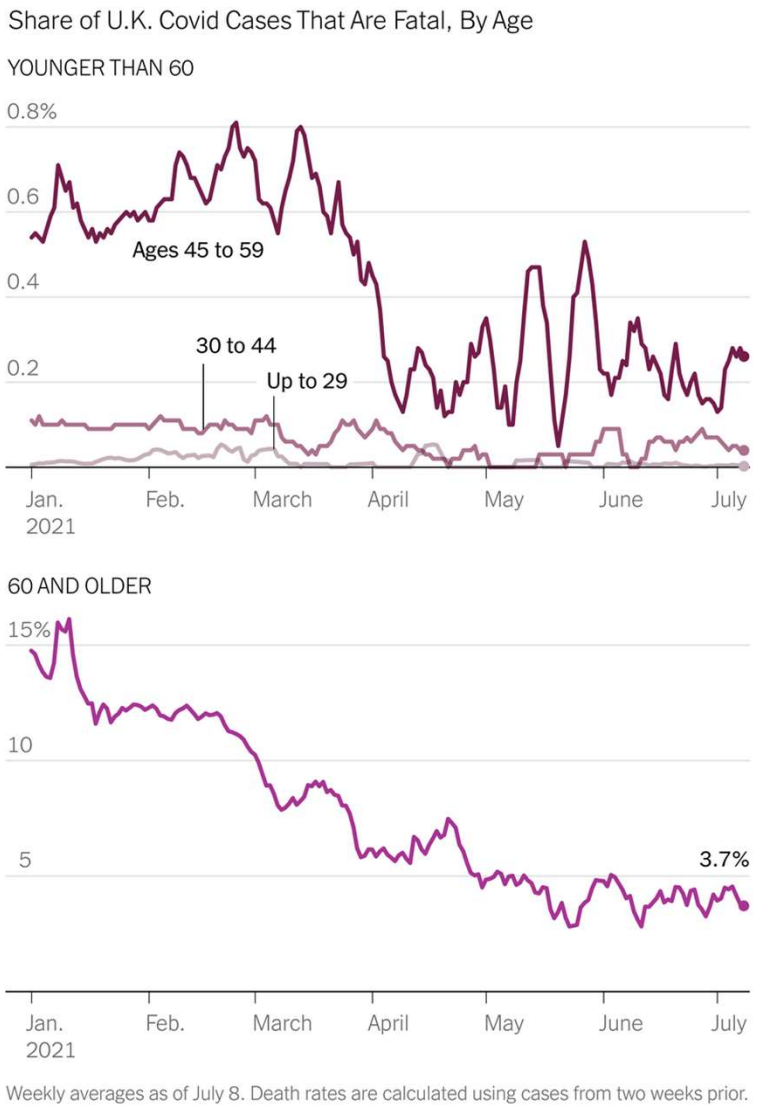
	Alpha variant (B.1.1.7)	Delta variant (B.1.617.2)	HR (95% CI), delta variant *vs* alpha variant	
			Unadjusted	Adjusted*
Hospital admission within 14 days after specimen	764/34 656 (2·2%)	196/8682 (2·3%)	1·03 (0·88–1·21)	2·26 (1·32–3·89)
Hospital admission or emergency care attendance within 14 days after specimen	1448/34 656 (4·2%)	498/8682 (5·7%)	1·39 (1·25–1·53)	1·45 (1·08–1·95)

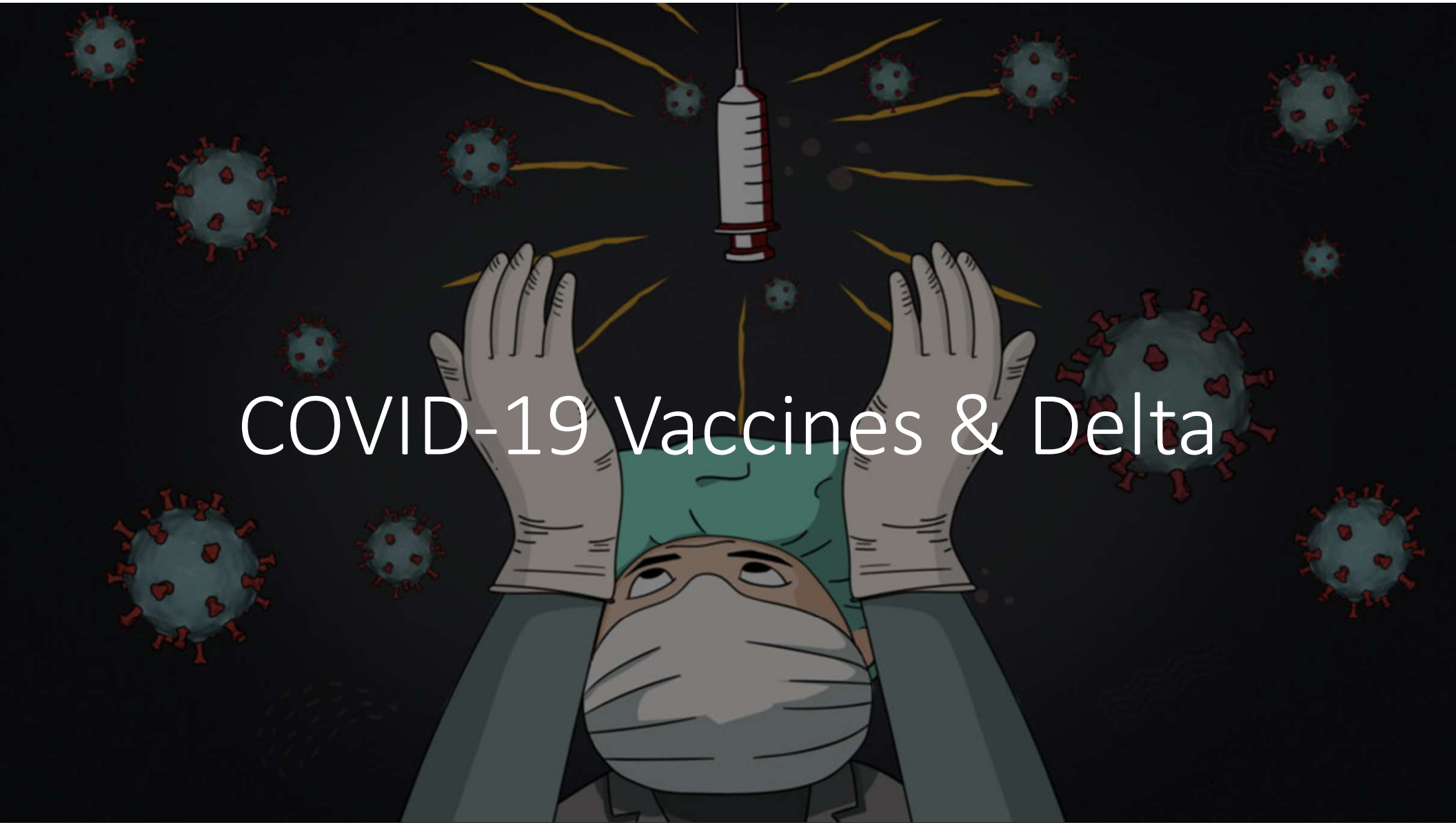
Data are n/N (%) except where otherwise stated. HR=hazard ratio. *Stratification for age group, ethnicity, lower-tier local authority, calendar week of specimen, vaccination status; regression adjustment for age (linear), date (linear), sex, index of multiple deprivation, and international traveller status.

***Table 2:* Hospitalisation outcomes for patients with the delta variant compared with patients with the alpha variant**

Source: KA Twohig et al *Lancet Infect Dis* 2021 August 27, 2021 https://doi.org/10.1016/ S1473-3099(21)00475-8

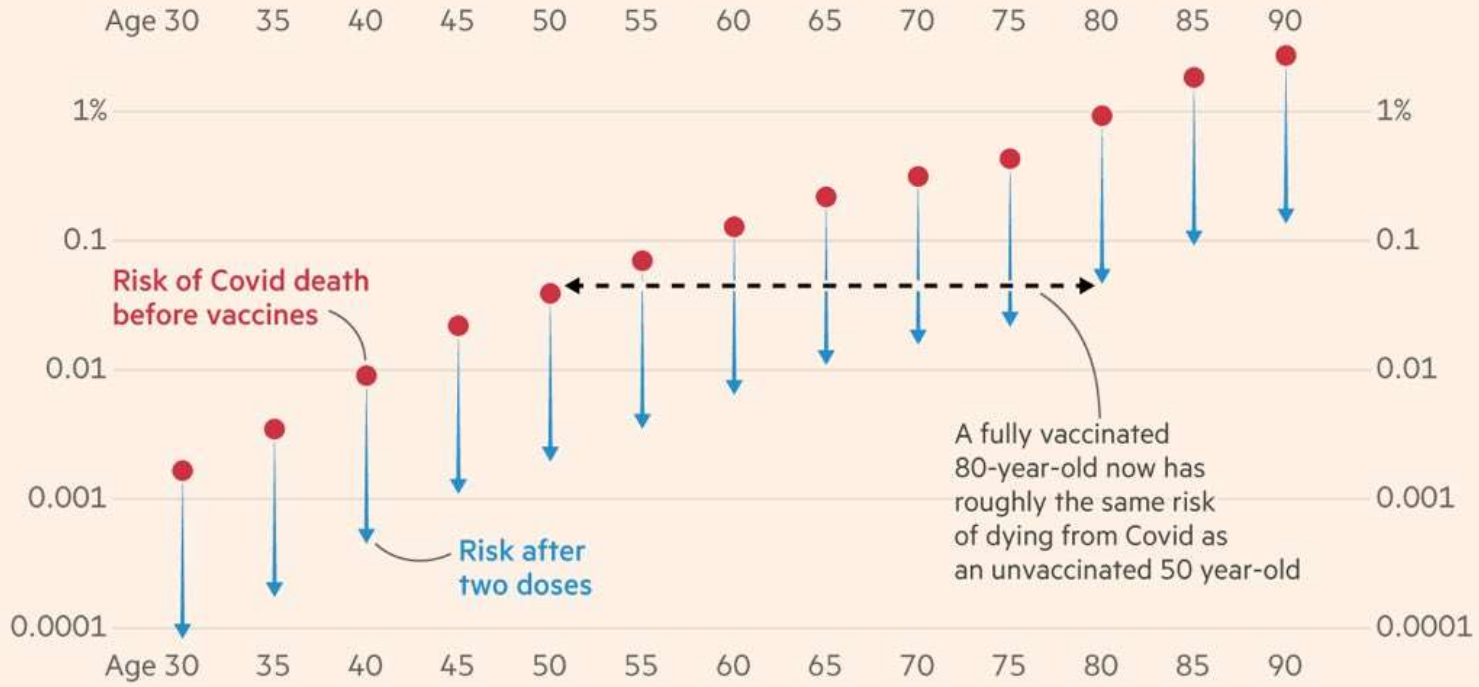
Delta and Fatalities – UK




COVID-19 Vaccines & Delta

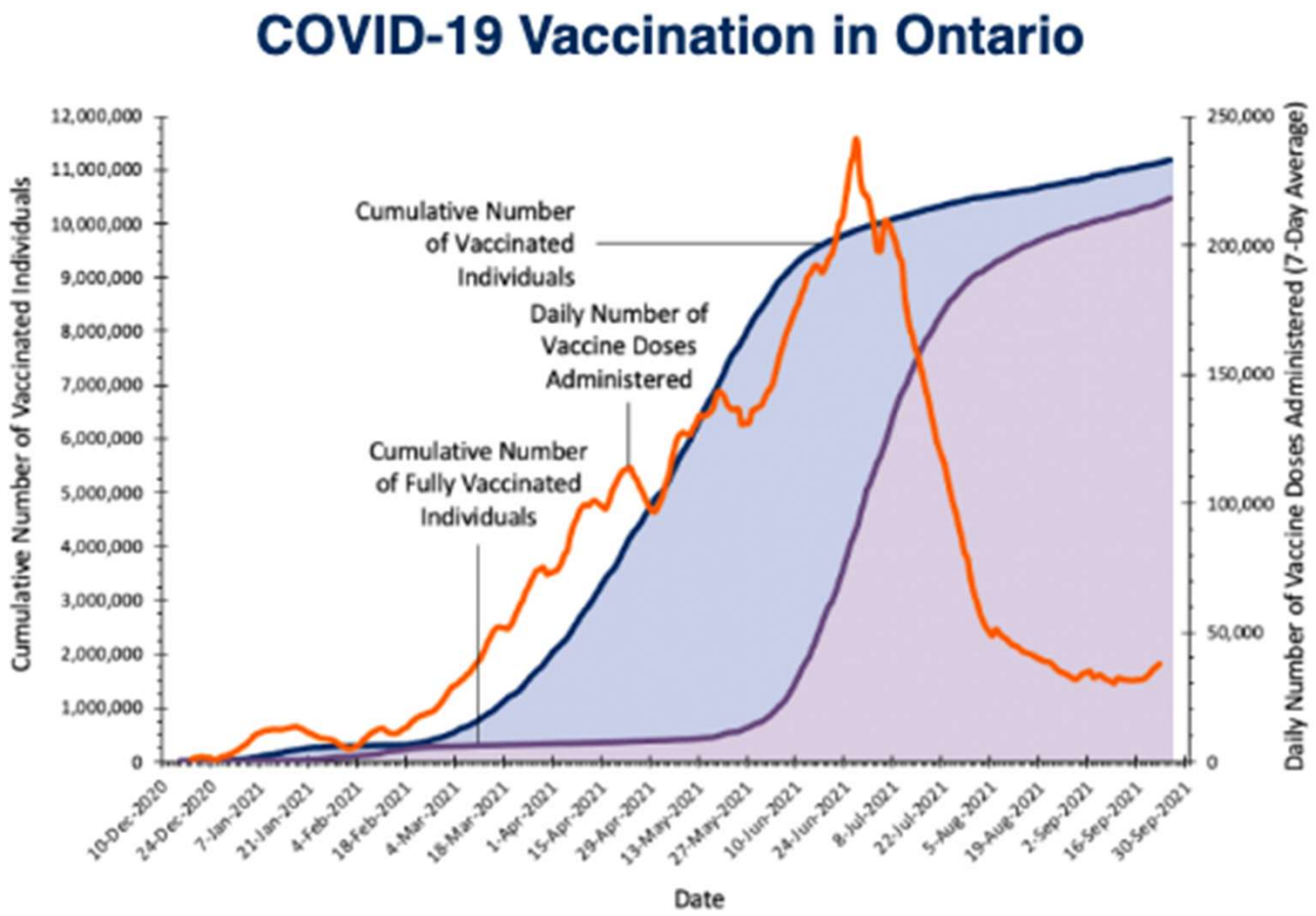
Vaccines have made Covid-19 far less lethal. A fully-vaccinated 80-year-old now has the same mortality risk as an unvaccinated 50-year-old

Risk of catching and dying from Covid* (log scale), by age group, before and after full vaccination



*Risk is the population fatality rate, e.g before vaccines roughly 1% of all 80-year-olds in England had died from Covid

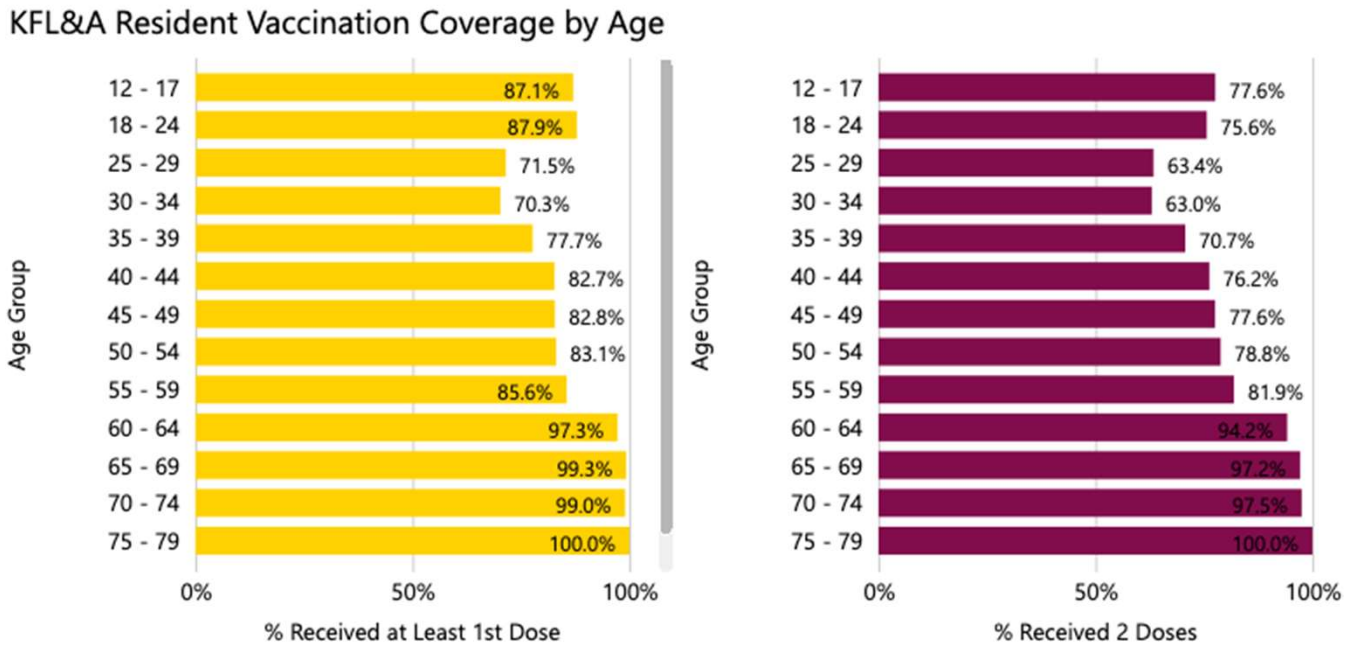
Source: FT analysis of data from Public Health England



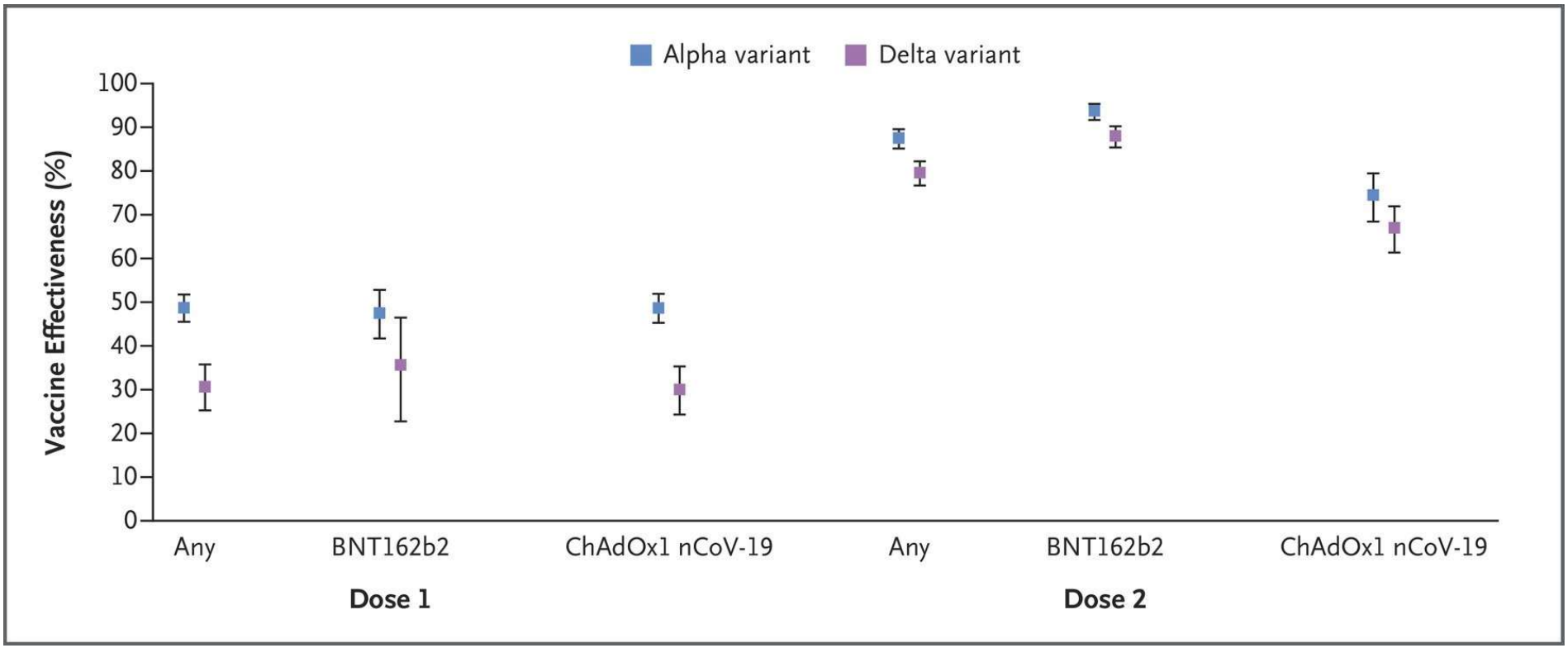
Source: https://covid19-sciencetable.ca/ontario-dashboard/

% KFLA Population
Age > 12 years
One Dose = 86.8%
Two Doses = 81.2%

September 24, 2021



Vaccine Effectiveness Alpha vs. Delta



Source: JL Bernal et al NEJM 2021 DOI: 10.1056/NEJMoa2108891

VE - Severe disease vs. Any infection

- Review of reports of VE (with a 95% in observational or randomised studies that gave results both for severe disease and for any infection

A. VE against any infection (50% to <80%, 80% to <90%, and ≥90%)

B. By viral variant

C. By type of vaccine (AdV, inactivated virus, adjuvanted protein subunit or mRNA)

D. Studies reporting vaccine efficacy early relative to vaccination) or later relative to vaccination during the follow-up of the same observational study

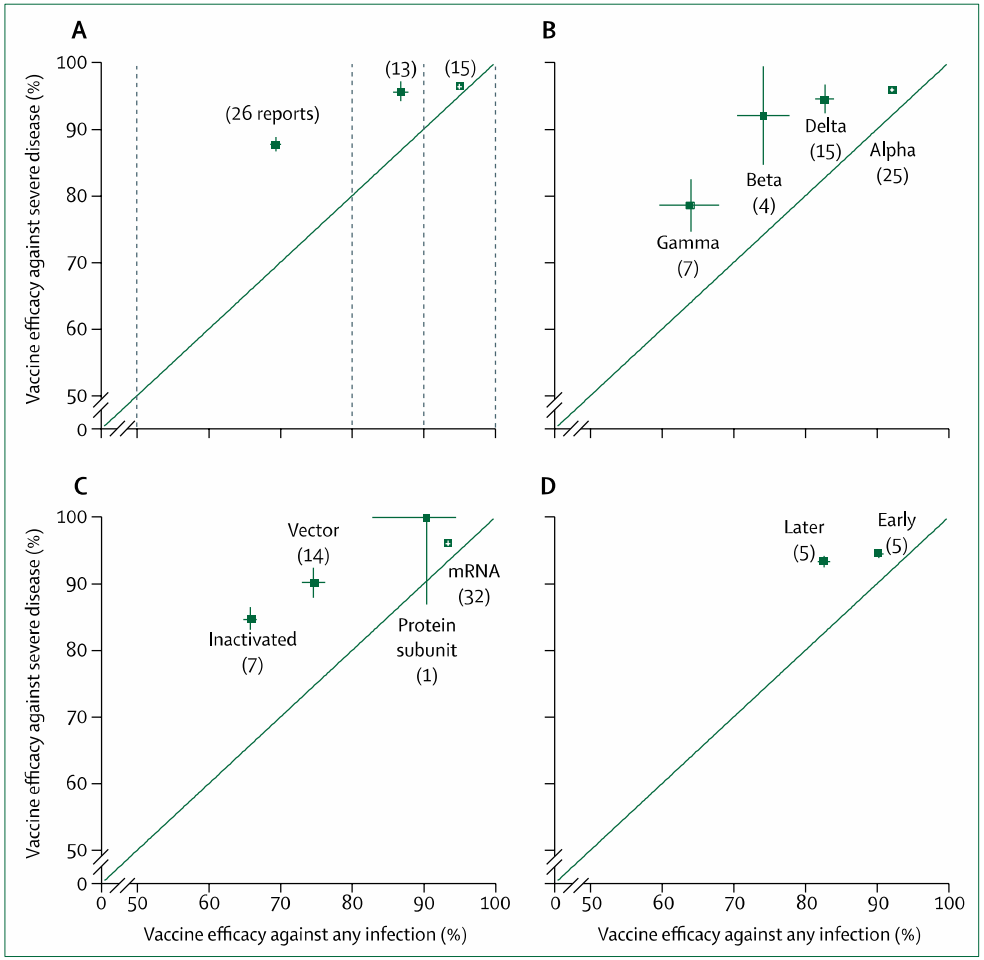
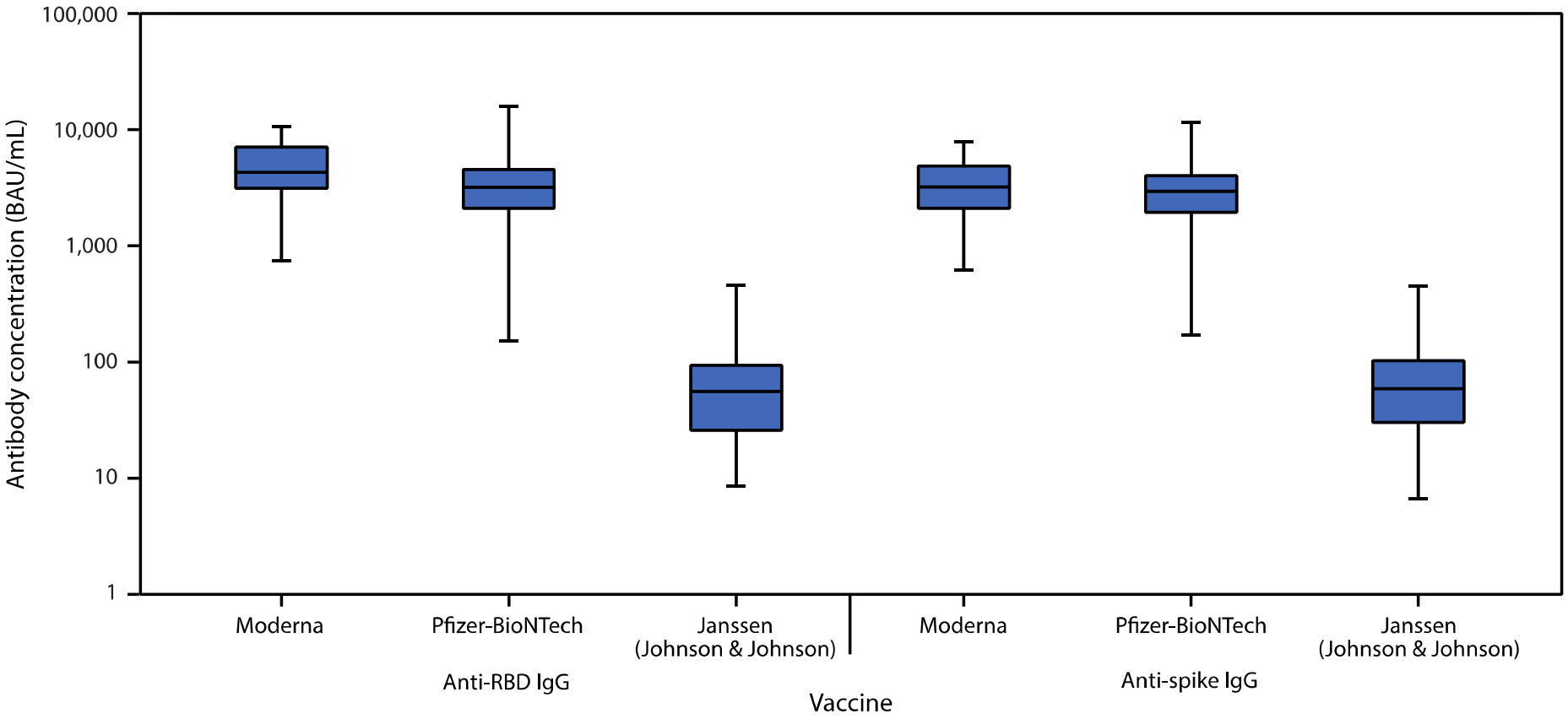


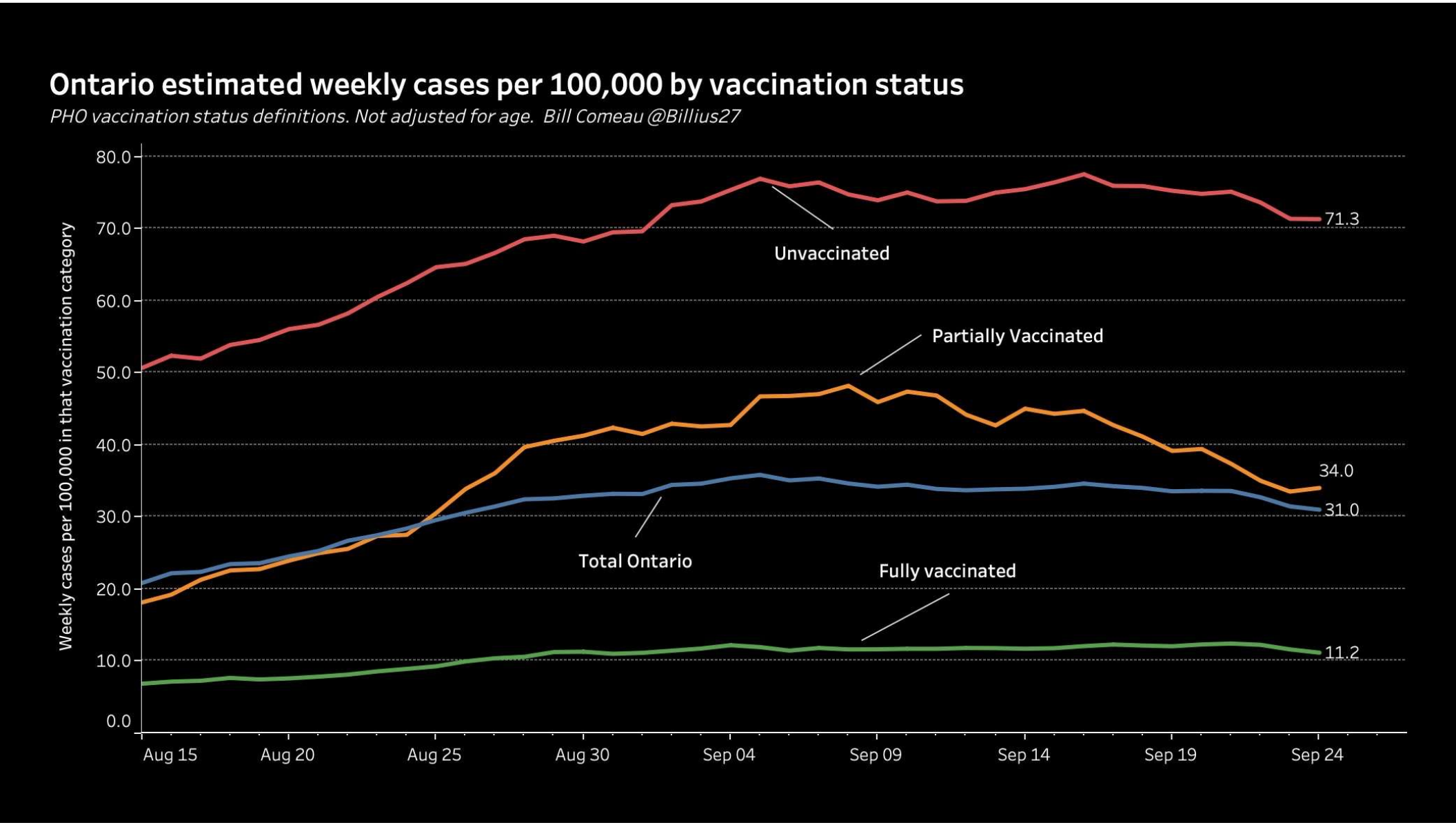
***Figure*: Vaccine efficacy against severe disease versus vaccine efficacy against any infection**

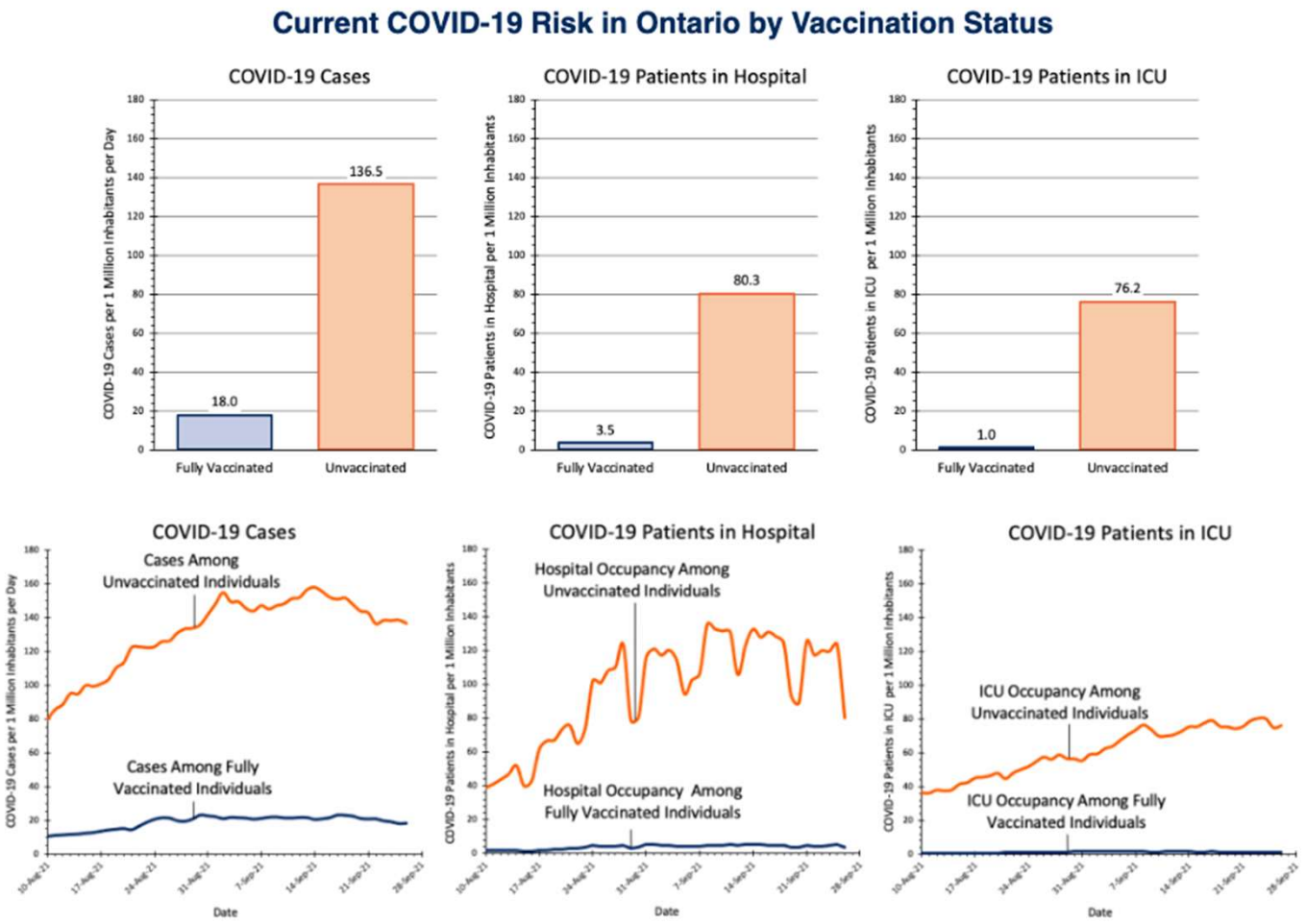
Source: PK Krause et al Lancet 2021 https://doi.org/10.1016/ S0140-6736(21)02046-8

FIGURE. Serum anti–receptor binding domain and anti-spike immunoglobulin G levels 2–6 weeks after full vaccination among healthy adult volunteers — three hospitals in three U.S. states,*,† April–June 2021



Source: WH Self et al MMWR 2021;70:1-7

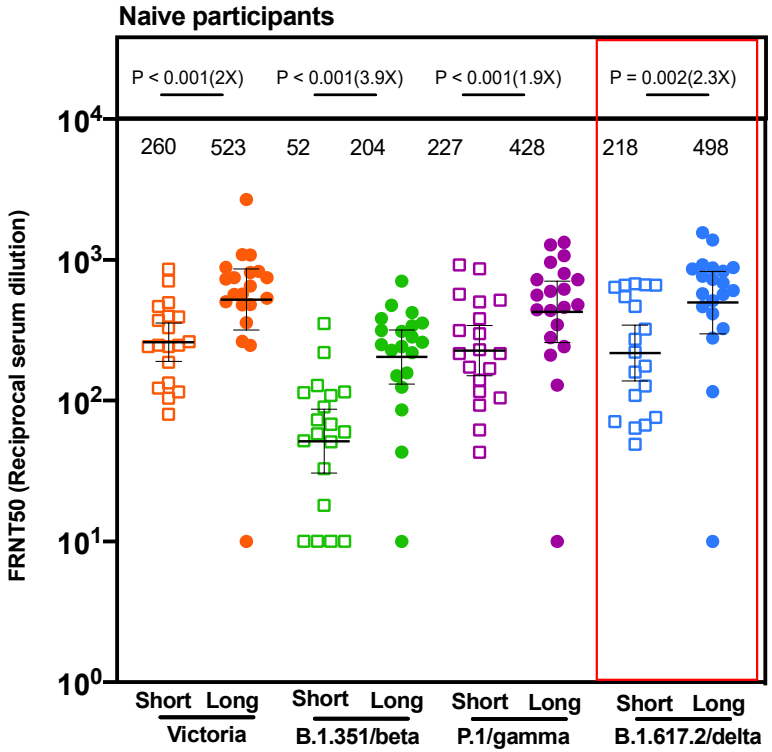

Ontario estimated weekly cases per 100,000 by vaccination status
PHO vaccination status definitions. Not adjusted for age. Bill Comeau @Billius27
Weekly cases per 100,000 in that vaccination category
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Aug 15
Aug 20
Aug 25
Aug 30
Sep 04
Sep 09
Sep 14
Sep 19
Sep 24
Unvaccinated
71.3
Partially Vaccinated
34.0
Total Ontario
31.0
Fully vaccinated
11.2



Source: https://covid19-sciencetable.ca/ontario-dashboard/

PITCH Study of Longer Interval for Pfizer-BioNTech Vaccine

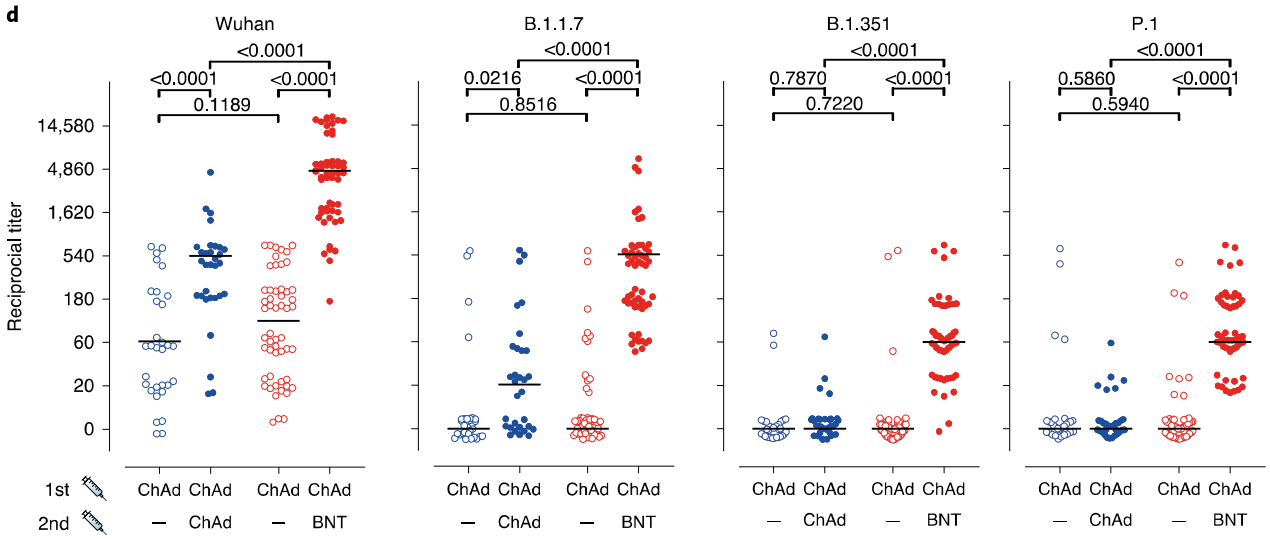
- Extension of the interval between vaccine doses for the BNT162b2 mRNA vaccine was examined in a study of 503 HCWs
- Neutralizing Ab levels were higher after the extended dosing interval (6-14 weeks) compared to the conventional 3-4 week regimen, accompanied by an enrichment of CD4+ T cells
-



Source: RR Payne et al Preprint 2021 Cell https://ssrn.com/abstract=3891065

Heterologous Vaccination – U.K.

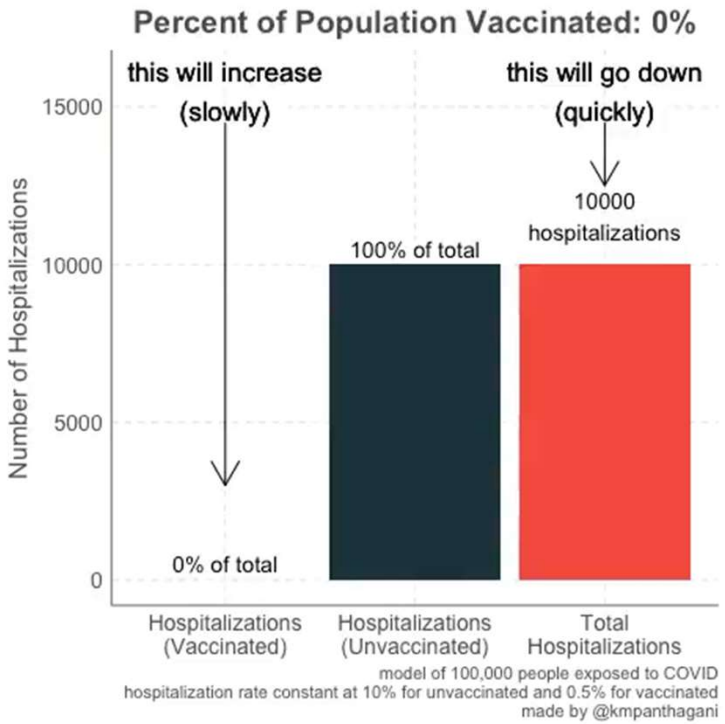
- Stronger antibody immune responses were seen against SARS-CoV-2 variants after heterologous ChAd/BNT versus homologous ChAd/ChAd vaccination



Source: J Barros-Martin et al Nature Medicine 2021 at https://doi.org/10.1038/ s41591-021-01449-9

“Breakthrough” Infections & Transmission Immunity

How Percentage of Fully Vaccinated Cases Changes based on % of Population Vaccinated



Shorter Period of Transmissibility in Vaccinees

- Vaccinated patients had a faster rate of viral load decline compared with unvaccinated and likely shorter duration of viral shedding and infectivity
- If this is a valid observation, then it is likely that vaccination reduces secondary transmission

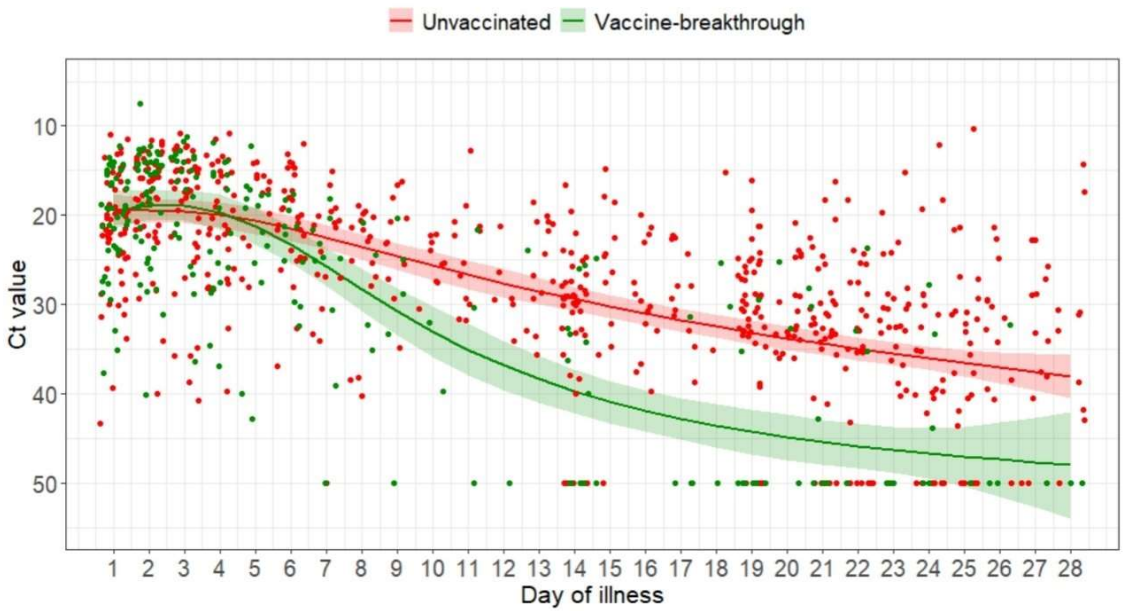


Figure 1: Scatterplot of Ct values and marginal effect of day of illness of COVID-19 B1.617.2 infected patients with 95% confidence intervals from generalized additive mixed model with interaction term between vaccination status and day of illness

Source: PY Chia et al Preprint 2021 https://doi.org/10.1101/2021.07.28.21261295

SARS-CoV-2 Virus is Less Infectious in Vaccine Recipients

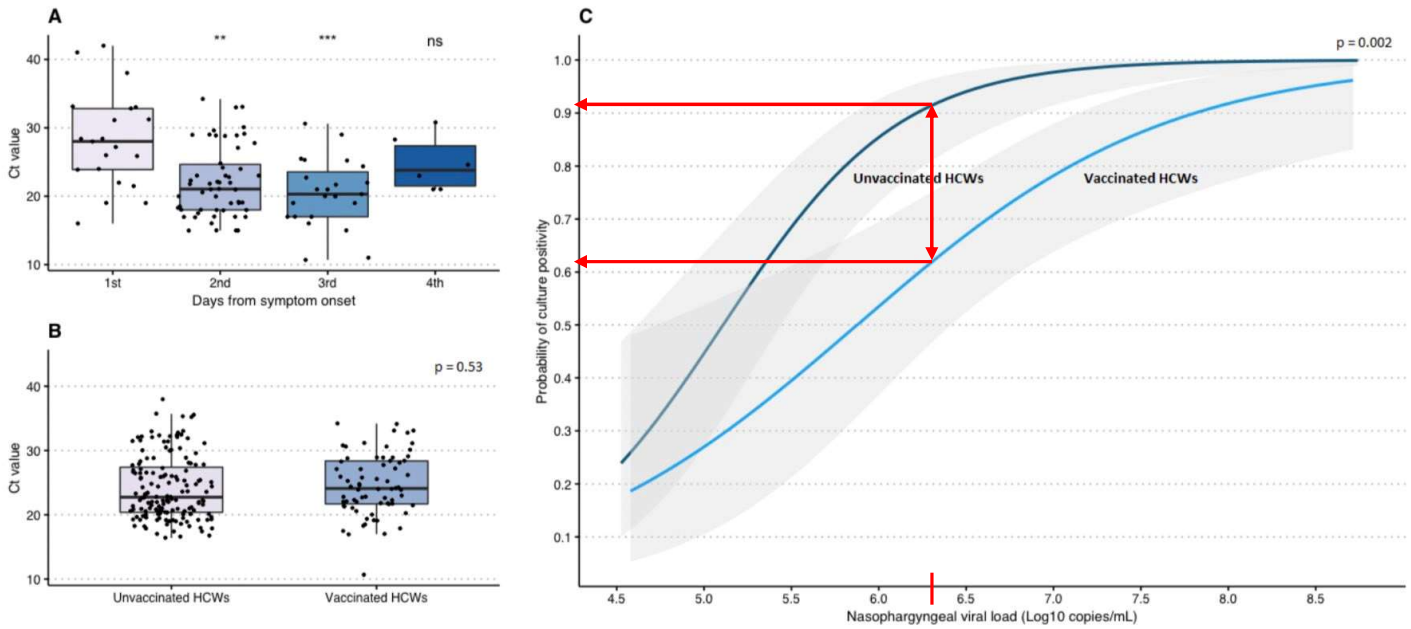
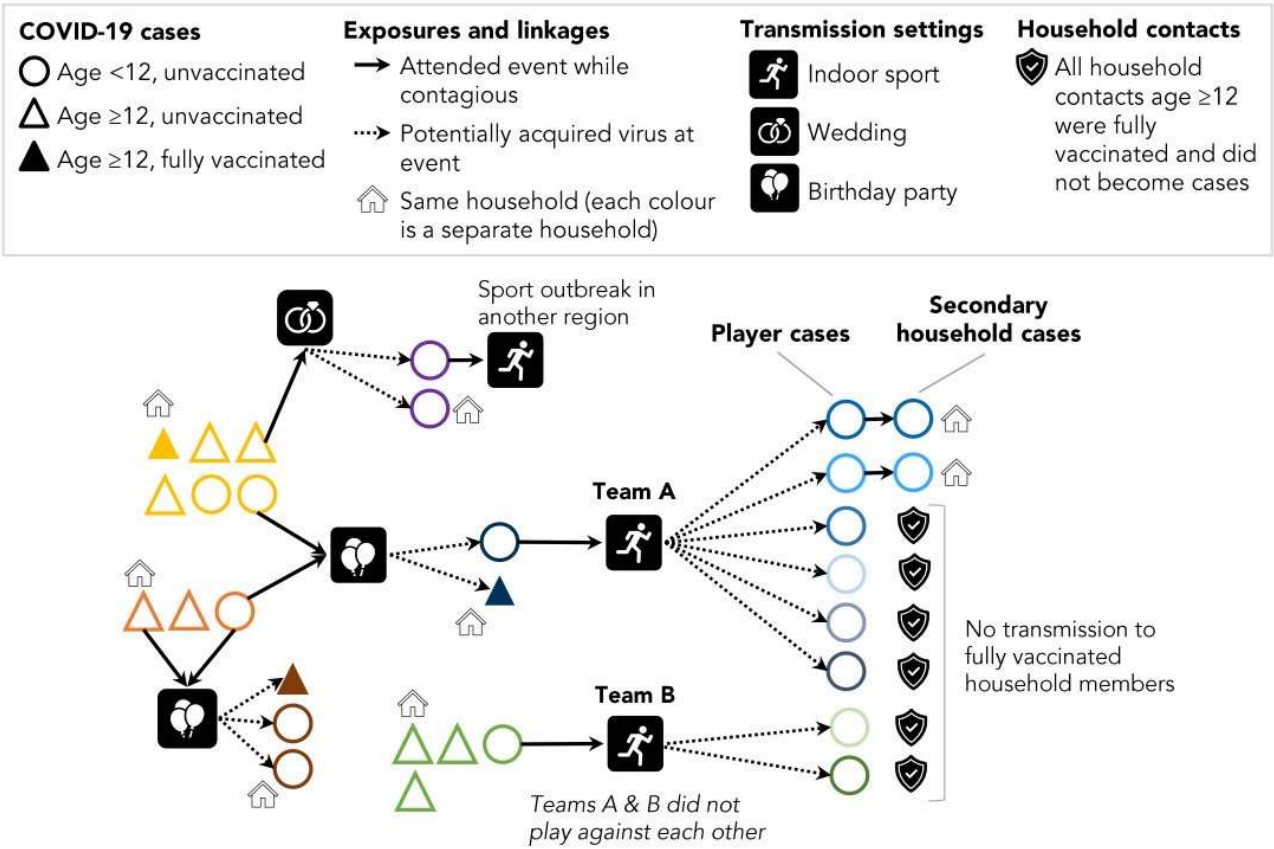


Figure 1. SARS-CoV-2 culture positivity and Ct-values in nasopharyngeal samples of health care workers with SARS-CoV-2 breakthrough infections. (A) Ct-values by day from symptom onset (B) Ct-values of HCWs with vaccine breakthrough infections (primarily Delta) compared to Ct-values of HCWs with primary infections (primarily D614G) (C) Probability of culture positivity by nasopharyngeal viral load (Probit Analysis), comparing HCWs with vaccine breakthrough infections (primarily Delta) to HCWs with primary infections (primarily D614G)

Figure 7. A children's indoor sport COVID-19 outbreak in Peel, August 2021



Source: Ontario Ministry of Health, Public Health Case and Contact Management Solution (CCM), extracted by Peel Public Health [13/Sep/2021]

What will the Fall of 2021 look like?

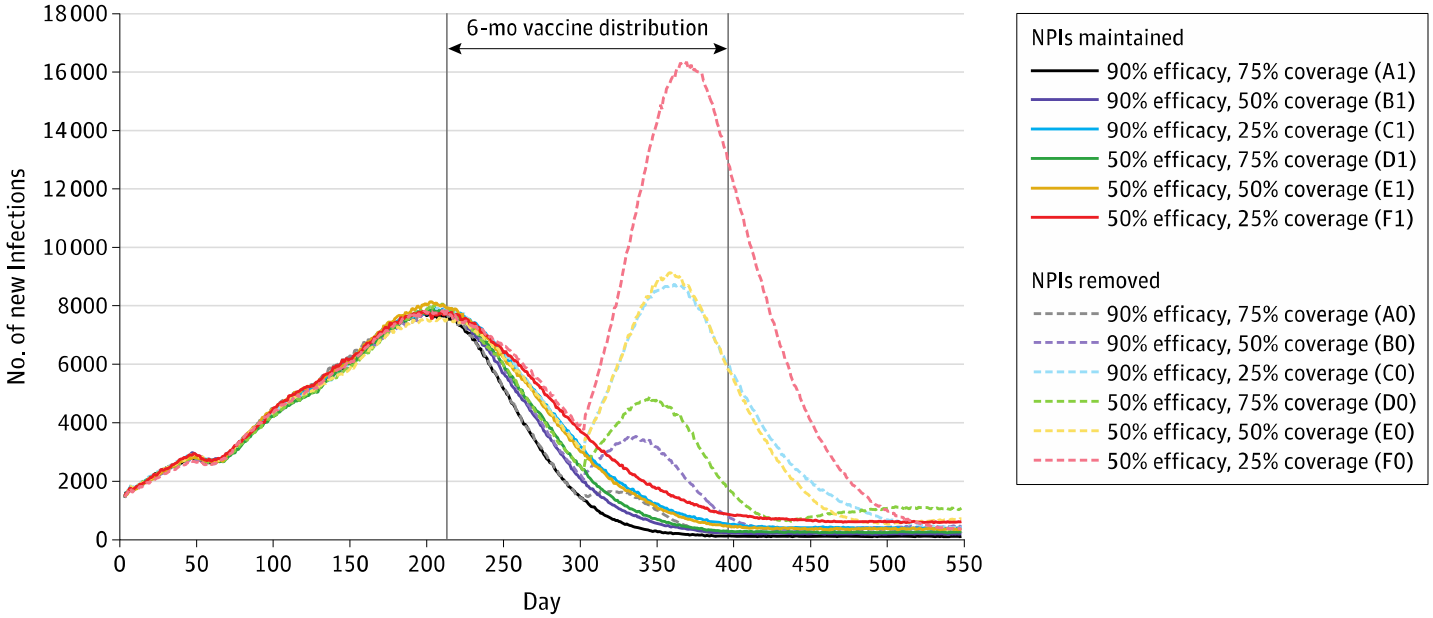
Tsunami or

Rogue Wave or

High Tide?

Modeling Vaccine Rollout & PH Restrictions

Figure 2. Daily New Infections by Vaccination and Nonpharmaceutical Intervention (NPI) Scenarios During the 18-Month Simulation

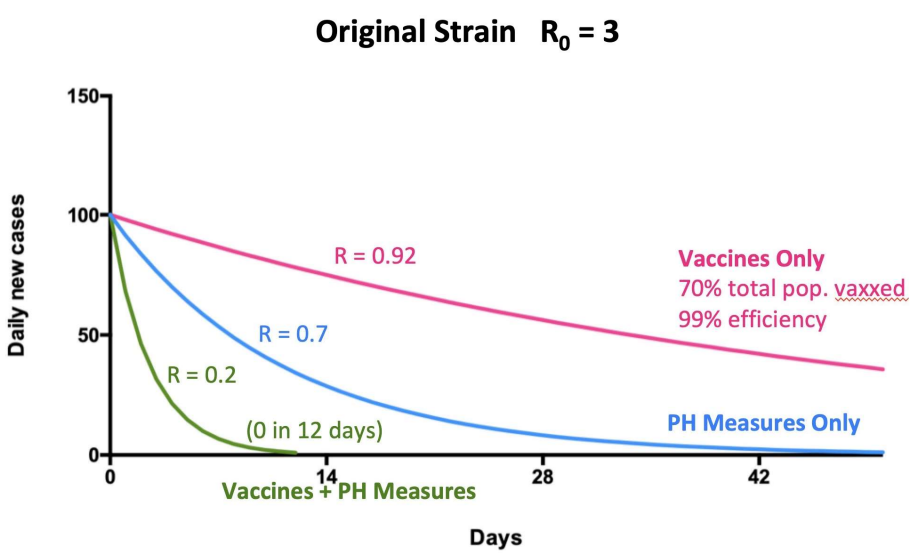


Modeled new infections by day are shown across varying vaccine efficacy and coverage with NPIs maintained and removed.

Source: MD Patel et al *JAMA Network Open.* 2021;4(6):e2110782. doi:10.1001/jamanetworkopen.2021.10782

Delta – Impact of Vaccination & PH Measures

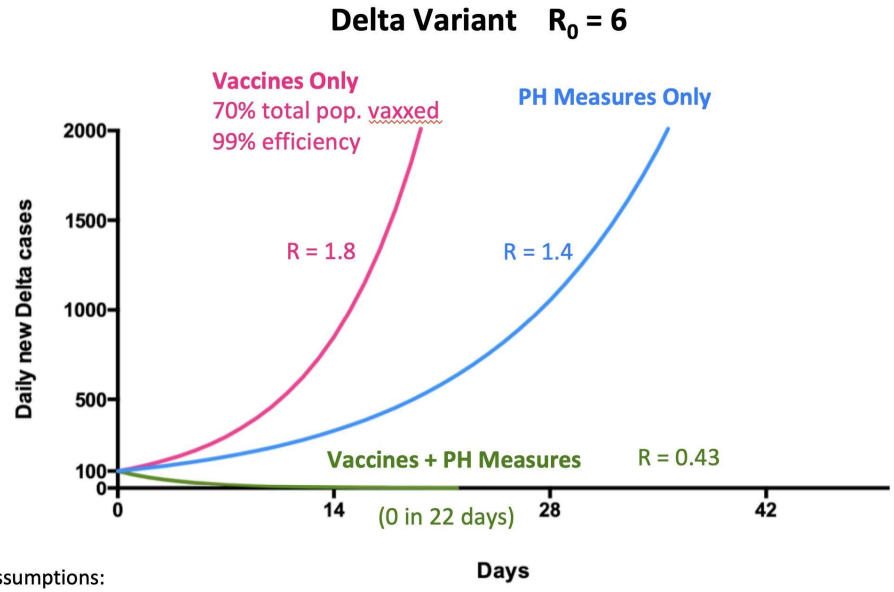
A) Effects of Vaccines and Public Health (PH) Measures on Virus Spread



Assumptions:
Vaccine efficiency against transmission: 99%
% population fully vaxxed: 70% total (82% eligible)
PH measures: Alberta Spring 2020 shut-down (which resulted in R=0.7)

Chart and analysis: @GosiaGasperoPhD

B) Effects of Vaccines and Public Health (PH) Measures on Virus Spread



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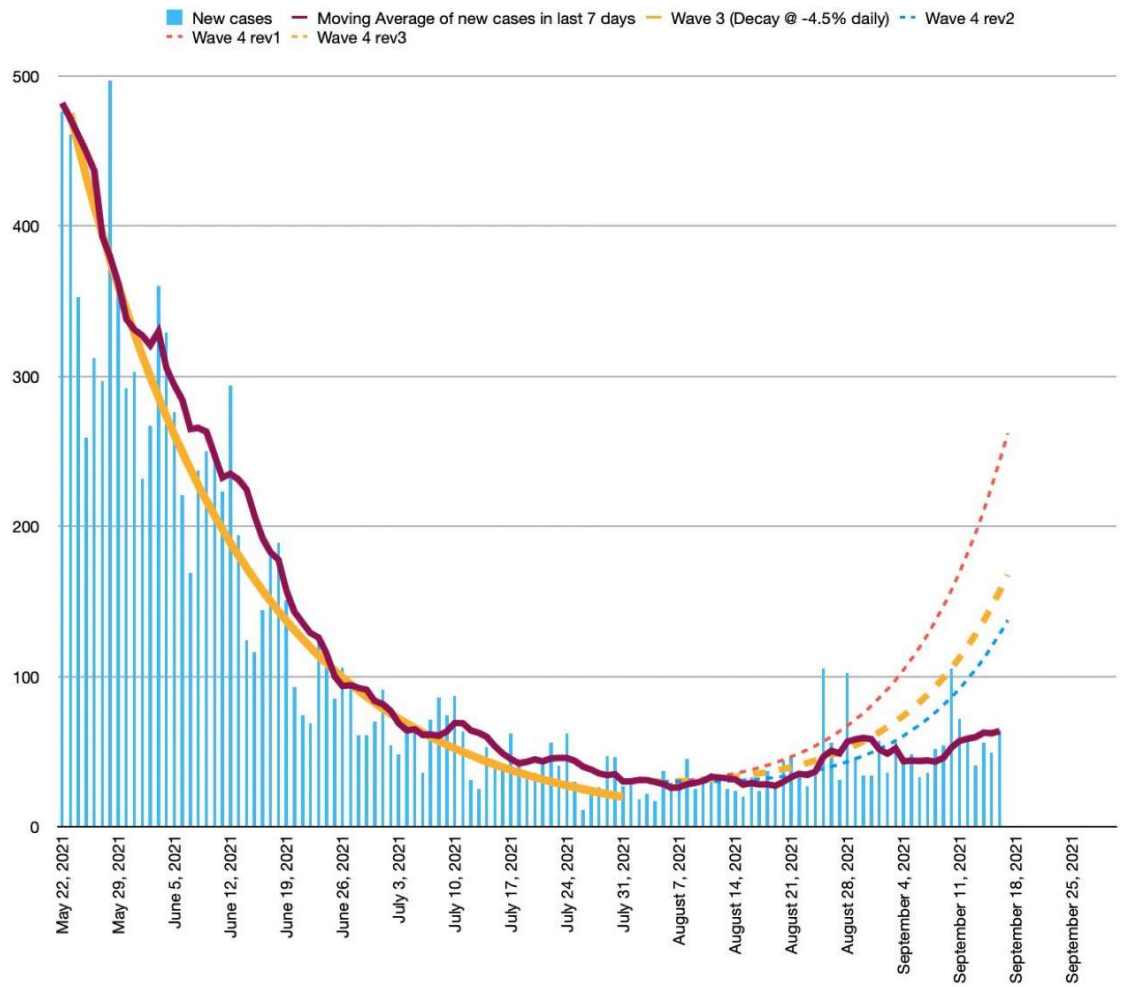
When a jurisdiction acts quickly to Delta – Manitoba

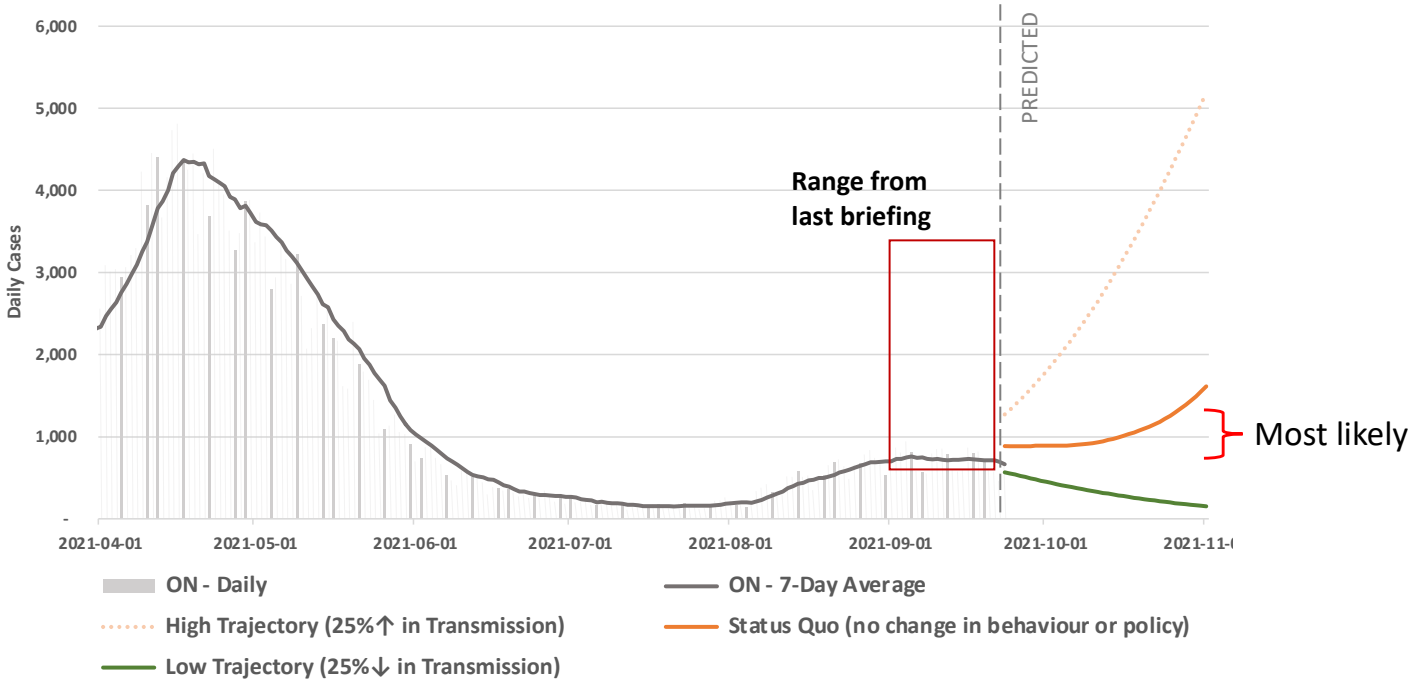


There is a wide range for case projections, reflecting the fragile situation and high degree of instability as colder weather approaches.

Figure shows predictions based on a consensus across models from 5 scientific teams.

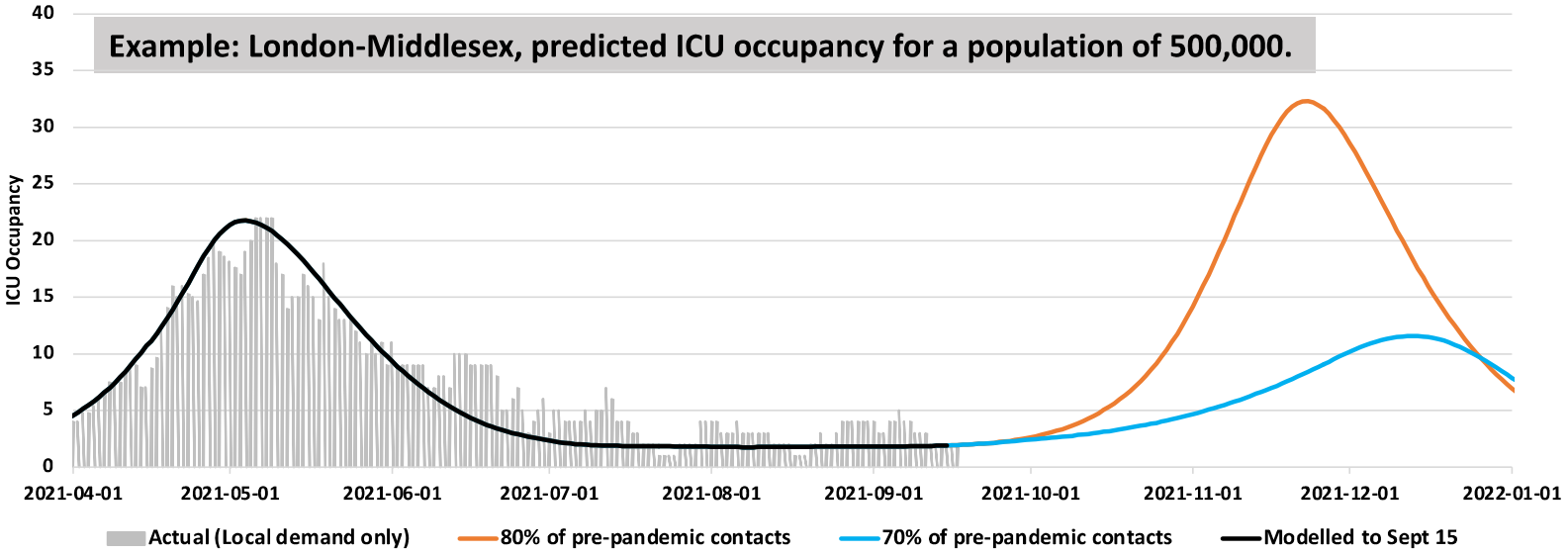
High uncertainty in estimates because:

- Uncertainty in vaccine effectiveness against infection
- Too early to see impact of increased contacts with return to school and workplaces
- Seasonality and time spent indoors vs. outdoors



Predictions informed by modeling from Fields Institute, McMasterU, PHO, WesternU, YorkU
Data (Observed Cases): covid-19.ontario.ca

Long-term predictions:
High risk of rapid increase in ICU occupancy can be reduced with a cautious approach and early contact reductions.



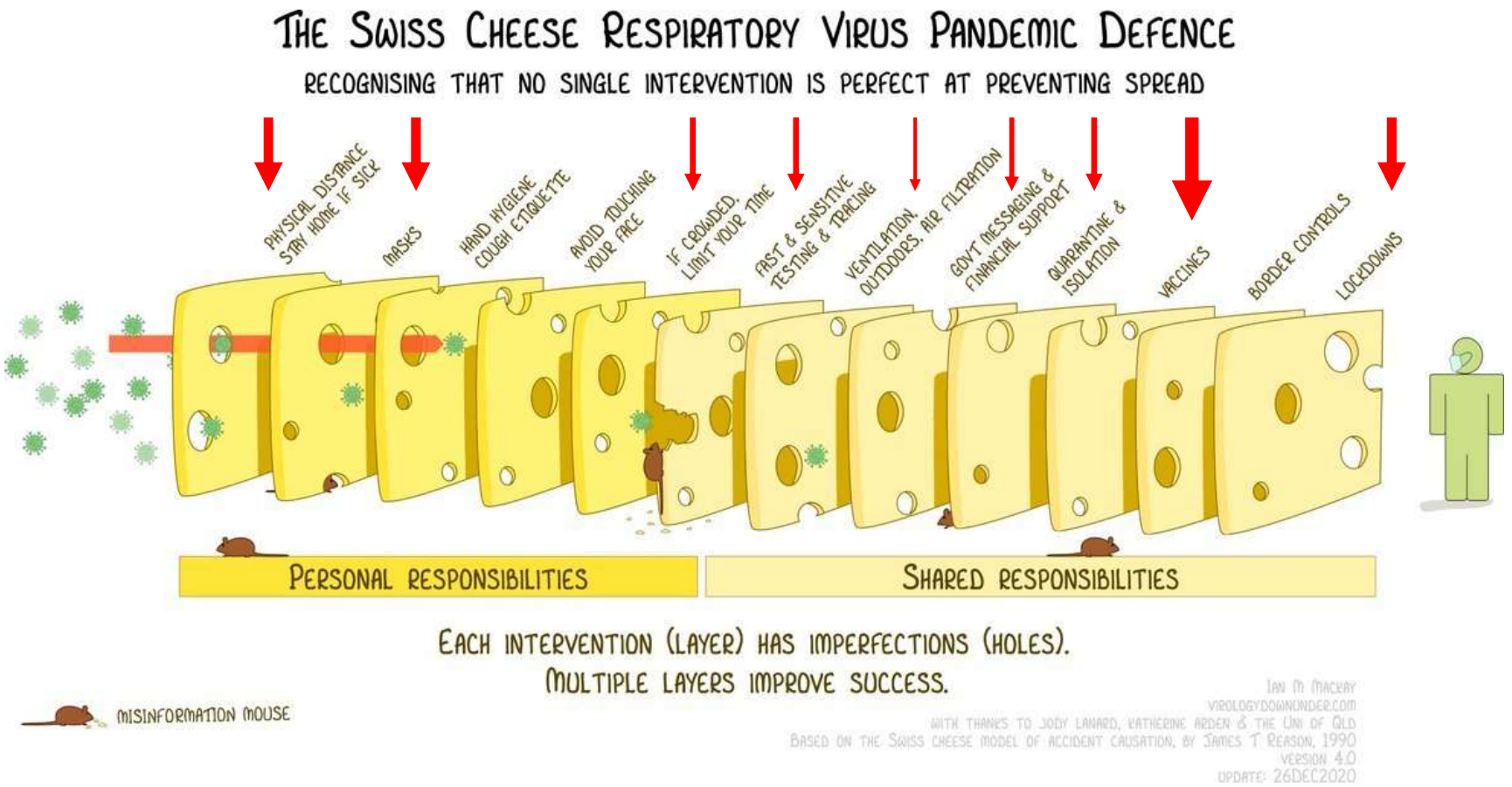
- Scenarios shown assume that as ICU occupancy and deaths increase, contacts will decrease due to behaviour change and implementation of public health measures
- Summer (Step 3) contacts approx. 82.5% compared to pre-pandemic contacts
- If scaling up to Ontario population, ICU occupancy predictions for Ontario would be expected to be higher and the peak to occur earlier, especially in large urban areas.

Predictions: WesternU

Why COVID-19 Waves from Other Countries are Less Applicable to Canada

Country	Vaccination Rate Compared to CA	Public Health Measures Compared to CA
United States	↓↓	↓↓↓
United Kingdom	↓	↓
Australia	↓↓↓	↑↑↑
Israel	**Same, but shorter interval between doses**	↓↓

COVID-19 Transmission Reduction Tools



Summing up

- **Where are we & where are we going?**
  - We're now in a muted 4th Wave due to:
    - Delta variant
    - Reduced PH measures
    - The 1 in 5 of us who are unvaccinated
- **Variants**
  - New variants of interest are NOT able to compete with Delta
- **Vaccines**
  - Are effective against all variants and our best chance to flatten the 4th wave along with maintenance of PH measures
  - Please get vaccinated!