

Covid-19 Update: Herd Immunity and Vaccines

Elizabeth O'Meara Aigerim Madiyeva

Math 747, Oct 29, 2020

Table of Contents

- 1 Covid-19 from Oct 22-28
- 2 Herd Immunity
- 3 Covid-19 Vaccine Progress

Canada Epi Curve Oct 27th

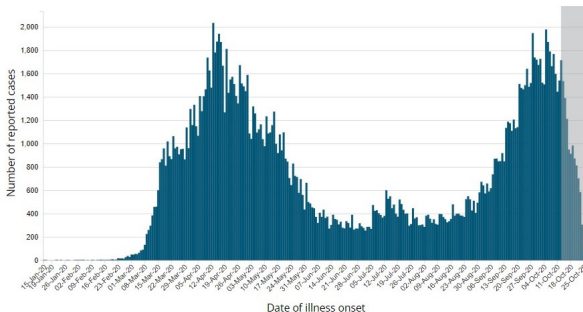


Figure: Epi curve for Canada as of October 27th. This figure shows the number of reported cases by date of illness onset. The grey area represents reporting delays.

Ontario Epi Curve Oct 27th

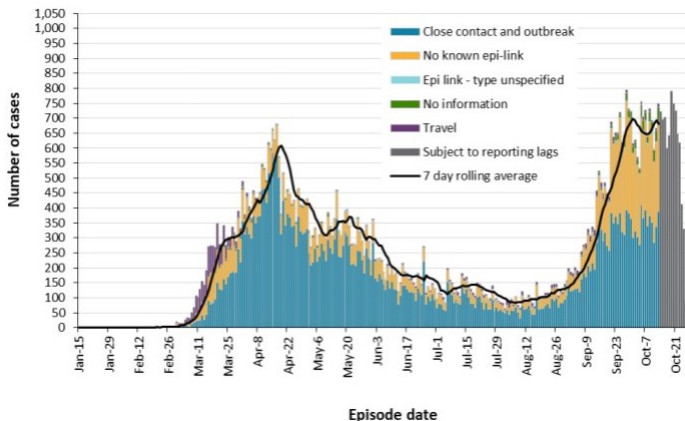


Figure: Epi curve for Ontario as of October 27th. This figure shows the number of cases by date of symptom onset. The data is separated by likely acquisition. The grey section represents reporting delays.

Notable Covid-19 Information Since Oct 22nd

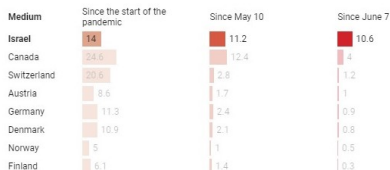
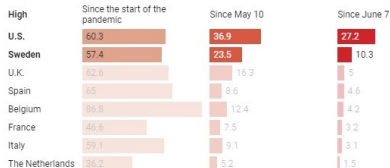
- Canada had its highest single day increase of 3004 new cases on Oct 25th
- Ontario saw its highest single day increase of 1042 new cases on Oct 24th
- British Columbia has seen a surge in cases over the weekend with 817 new cases and 3 deaths
 - 317 of the weekend cases occurring on Saturday

Herd Immunity in the News

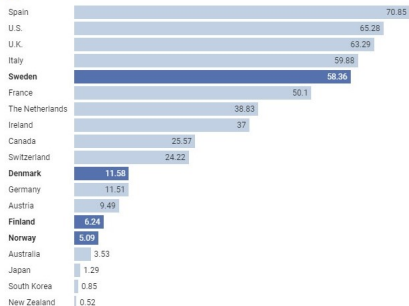
- Surge in covid-19 cases has spurred a discussion of achieving herd immunity
- Despite critique, herd immunity has sparked interests in Sweden, the UK and the US

Mortality Rates per 100k for Different Countries

Since the start of the pandemic Since May 10 Since June 7



Nordic countries



Consequences and Feasibility of Achieving Herd Immunity without a Vaccine

- How long immunity lasts
- Ethical issues of letting people get infected
- Uncertainty of the Case Fatality Ratio
- Hospital capacities
- Brett and Rohani 2020 suggest that achieving herd immunity is not plausible as it "...[requires] and unlikely balancing of multiple poorly defined forces."

The Vaccine Testing Process

1 PRECLINICAL TESTING

Scientists test a new vaccine on cells and then give it to animals.

2 PHASE 1 SAFETY TRIALS

Scientists give the vaccine to a small number of people

3 PHASE 2 EXPANDED TRIALS

Scientists give the vaccine to hundreds of people split into groups, such as children and the elderly

4 PHASE 3 EFFICACY TRIALS

Scientists give the vaccine to thousands of people and wait to see how many become infected, compared with volunteers who received a placebo.

The Vaccine Testing Process Continued

5 APPROVAL

Regulators in each country review the trial results and decide whether to approve the vaccine or not.

6 COMBINED PHASES

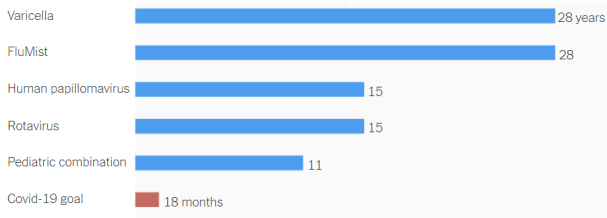
One way to accelerate vaccine development is to combine phases.

7 PAUSED

worrying symptoms

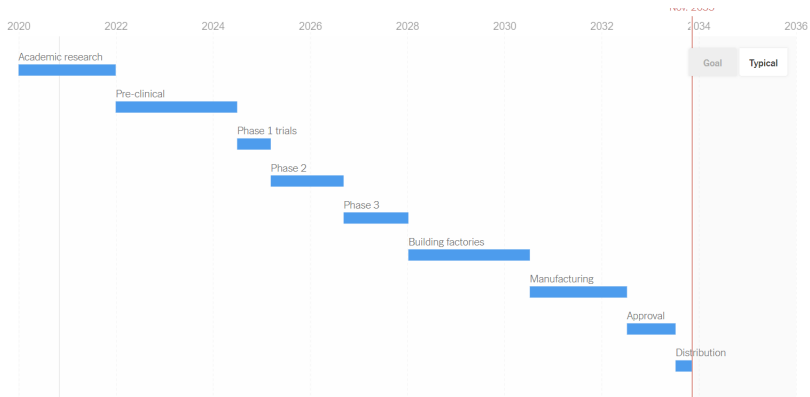
Years and years, at minimum

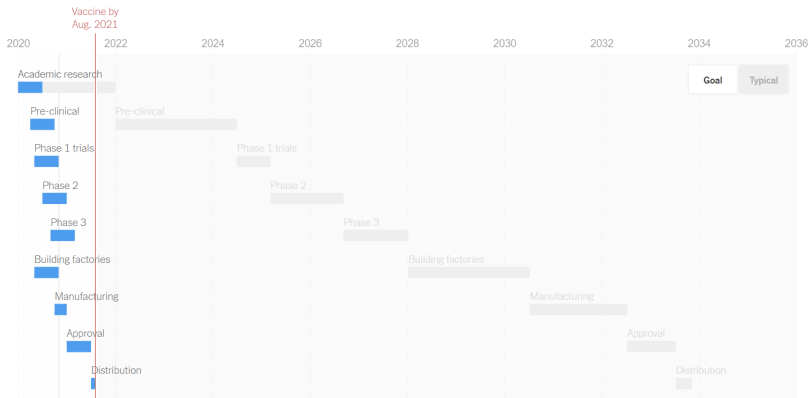
The vaccine development process has typically taken a decade or longer.



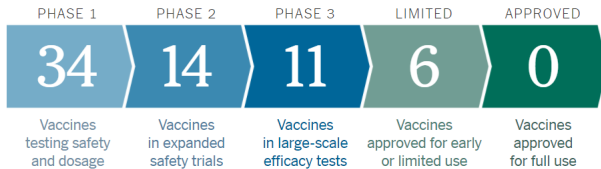
Note: Rotavirus and HPV vaccines include time from filing of the first investigational new drug to approval.

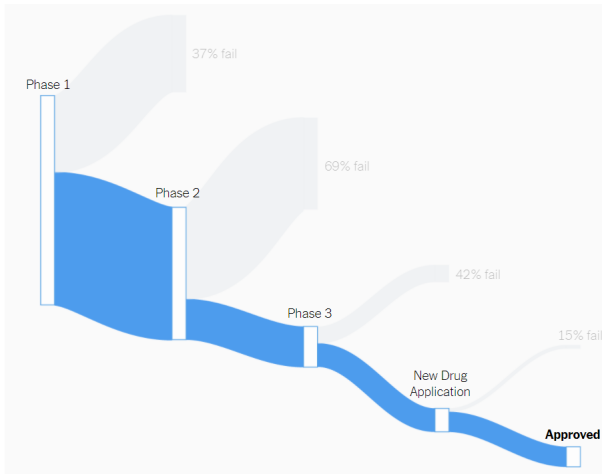
Source: "Plotkin's Vaccines" (7th edition)





Will you get vaccinated?





Phase 3

- 1 Moderna
- 2 BioNTech
- 3 CanSino Biologics
- 4 Gamaleya Research Institute
- 5 Johnson & Johnson company
- 6 AstraZeneca
- 7 Novavax
- 8 Wuhan Institute of Biological Products
- 9 Sinopharm
- 10 Sinovac Biotech
- 11 Bharat Biotech

Moderna and National Institutes of Health

- Vaccines based on messenger RNA (mRNA) to produce viral proteins in the body.
- Found that the vaccine protects monkeys from the coronavirus
- In March, the company put the first Covid-19 vaccine into human trials
- In October, the company announced that they had finished recruiting all 30,000 participants in the study, including 7,000 people 65 years or older.

- On Aug. 11, President Vladimir V. Putin announced that a Russian health care regulator had approved the vaccine
- On Sept. 4, three weeks after Putin's announcement, Gamaleya researchers published the results of their Phase 1/2 trial. In a small study, they found that Sputnik yielded antibodies to the coronavirus and mild side effects.
- Approval was a “conditional registration certificate, which would depend on positive results from Phase 3 trials.”

Johnson & Johnson and Beth Israel Deaconess Medical Center

- The vaccine has provided protection in experiments on monkeys.
- Began Phase 1/2 trials in July and launched a Phase 3 trial with up to 60,000 participants in September. Unlike other vaccines in Phase 3 trials, theirs only requires one dose instead of two.
- On Oct. 12, Johnson & Johnson announced it put its trial on pause to investigate an adverse reaction in a volunteer.

- The vaccine has provided protection in experiments on monkeys.
- In a Phase 1/2 trial, the vaccine developers did not detect any severe side effects.
- On Sept. 6, AstraZeneca halted global trials of the vaccine to investigate one volunteer, who developed a form of inflammation called transverse myelitis.
- Brazil reported on Oct. 21 that a volunteer in the trial there died of Covid-19
- On October 23, the F.D.A. authorized the restart of the trial.

References

- ① Chan, 2020
- ② CTV News, 2020
- ③ Boynton, 2020
- ④ Patel, 2020
- ⑤ Corum et al., 2020
- ⑥ PHO, 2020
- ⑦ PHAC, 2020
- ⑧ Randolph and Barreiro, 2020
- ⑨ Gajewski, 2020
- ⑩ Bjorklund and Ewing, 2020
- ⑪ Brett and Rohani, 2020
- ⑫ Duong, 2020
- ⑬ TIME, 2020