WEDNESDAY, MAY 26 | 1 P.M. EDT | ONLINE

Presenting the latest seroprevalence results from across Canada: what they mean for the future of our pandemic response

HOSTED BY

COVID-19 IMMUNITY TASK FORCE

GROUPE DE TRAVAIL SUR L'IMMUNITÉ FACE À LA COVID-19

IN COLLABORATION WITH

HÉMA-QUÉBEC

Canadian Blood Services

Speakers

- **Dr. Timothy Evans** - COVID-19 Immunity Task Force, Executive Director
- **Dr. Sheila O'Brien** - Canadian Blood Services, Associate Director of Epidemiology and Surveillance and primary investigator
- **Dr. Marc Germain** - Héma-Québec, Vice-President, Medical Affairs and Innovation and primary investigator
- **Dr. David Buckeridge** - COVID-19 Immunity Task Force, Scientific Lead, Data Management & Analysis

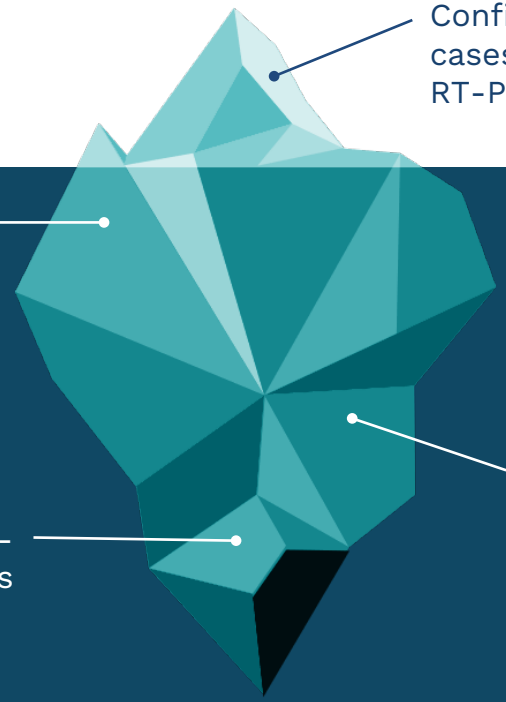
Dr. Timothy Evans

COVID-19 Immunity Task Force
Executive Director

COVID-19 Immunity Task Force mandate

- Established by the Government of Canada in April 2020
- Addresses the need to:
  - Assess the extent of SARS-CoV-2 infection across Canada
  - Understand the nature of immunity arising from infection
  - Develop improved antibody testing methods
  - Help monitor the effectiveness and safety of vaccines as they are rolled out across Canada
- Aims to catalyse, support, and harmonize the design and rapid implementation of population-based studies that will generate reliable first estimates of SARS-CoV-2 immunity, overall and in priority populations across Canada.

Serology data can help understand the full extent of the COVID-19 pandemic



JOHNS HOPKINS UNIVERSITY & MEDICINE | CORONAVIRUS RESOURCE CENTER

Cases found by diagnostic testing

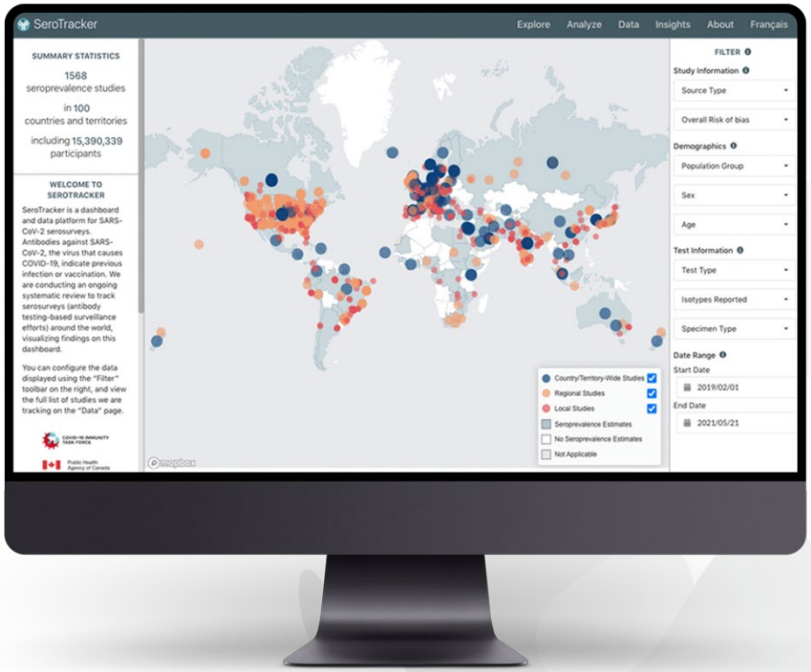
SeroTracker

Cases that serological testing can help reveal

SeroTracker is mapping global seroprevalence data

SeroTracker is a knowledge hub that **tracks and synthesizes** findings from SARS-CoV-2 serosurveillance efforts worldwide.

It was initiated in early April to serve the CITF's need for global serological testing data and is supported by the Task Force.



Seroprevalence is low in the general population

What have seroprevalence studies reported?

- **Studies:** 1568, across 100 countries
- **Total sample size:** 15.4 million
- **Seroprevalence estimates from national studies are low:** median 4.6% [IQR 1.9-7.7%]

How do seroprevalence and case numbers compare?

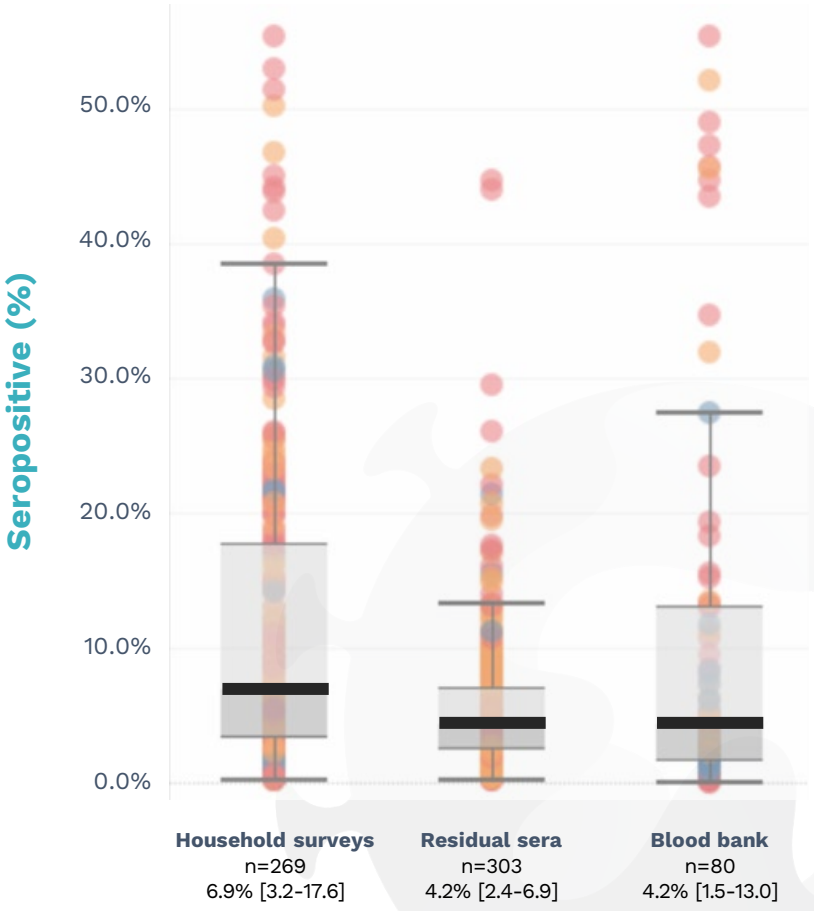
Varies widely by region:

- Central Europe, Eastern Europe, Central Asia: seroprevalence is median 4x cases [IQR 3-14]
- High-Income: 10x [4x-19x]
- Latin America and Carribean: 13.1x [10x-48x]
- South Asia: 107x [81x-134x]
- Limited data for other regions

Blood donor studies are representative of the general population

Do studies of blood donors produce comparable results?

- Meta-regression: **No difference** in seroprevalence from blood banks and household surveys
- Analysis corrects for risk of bias, study region, scope of study, and reported case burden



Low seroprevalence amongst blood donors across Canada after 1st wave

SARS-COV-2 SEROPREVALENCE BY PROVINCE (%)

British Columbia	0.50
Alberta	0.37
Saskatchewan	0.46
Manitoba	0.56
Ontario	0.96
Québec	1.06
New Brunswick	0.26
Nova Scotia	0.36
Prince Edward Island	0.00
Newfoundland and Labrador	0.29

SARS-COV-2 SEROPREVALENCE BY CITY (%)

Vancouver	0.60
Calgary	0.43
Edmonton	0.38
Ottawa	1.29
Toronto	1.07
Montréal	1.47

(May-June 2020, Canadian Blood Services and Héma-Quebec)

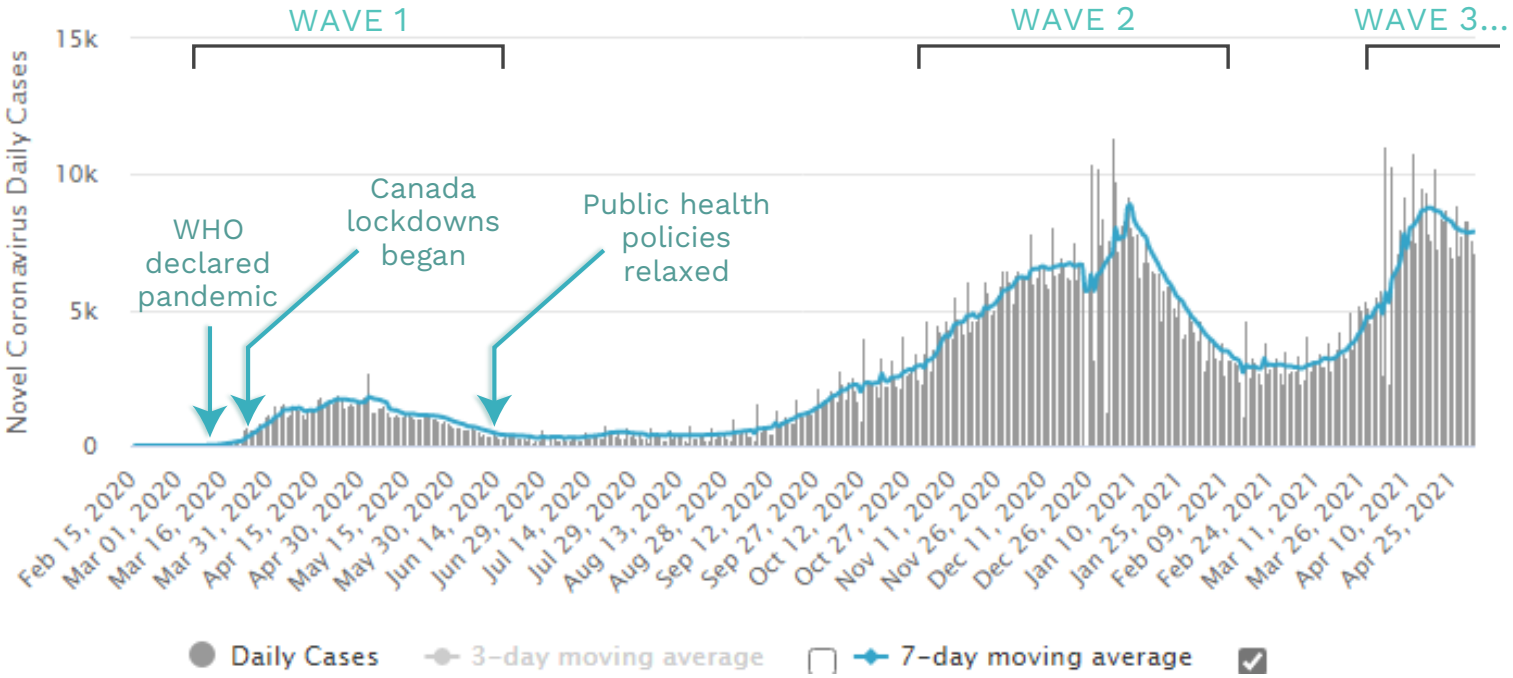
All seroprevalence figures based on Abbott anti-SARS-CoV-2 CMIA IgG Assay

Monitoring immunity in the vaccine era

Dr. Sheila O'Brien

Canadian Blood Services Associate
Director of Epidemiology and Surveillance
Primary Investigator

COVID-19 in Canada



AS OF MAY 2, 2021

31,756,698
Total tests performed

1,234,180
Total cases

83,744
Active cases

1,126,136
Recovered

24,300
Deaths

Canadian Blood Services
BLOOD PLASMA STEM CELLS ORGANS & TISSUES

Coronavirus disease (COVID-19) outbreak updates, symptoms, prevention, travel, preparation - Canada.ca

Sampling scheme

	2020										2021			
	March	April	May	June	July	August	September	October	November	December	January	February	March	April
National seroprevalence[1]			14,541	51,963	21,594	17,000	17,000	16,811	17,049	16,961	34,921	17,000	17,000	17,000
Orthogonal Testing[2]														

- [1] Samples tested against the **Abbott IgG Assay until January 2021** (residual blood from August and September are aliquoted but have not been tested)
- [2] Orthogonal Testing (PI: S. Drews (CIHR 2020) sampling 1500 samples per month until March 2021; this study is known as the "Correlates of Immunity Study"

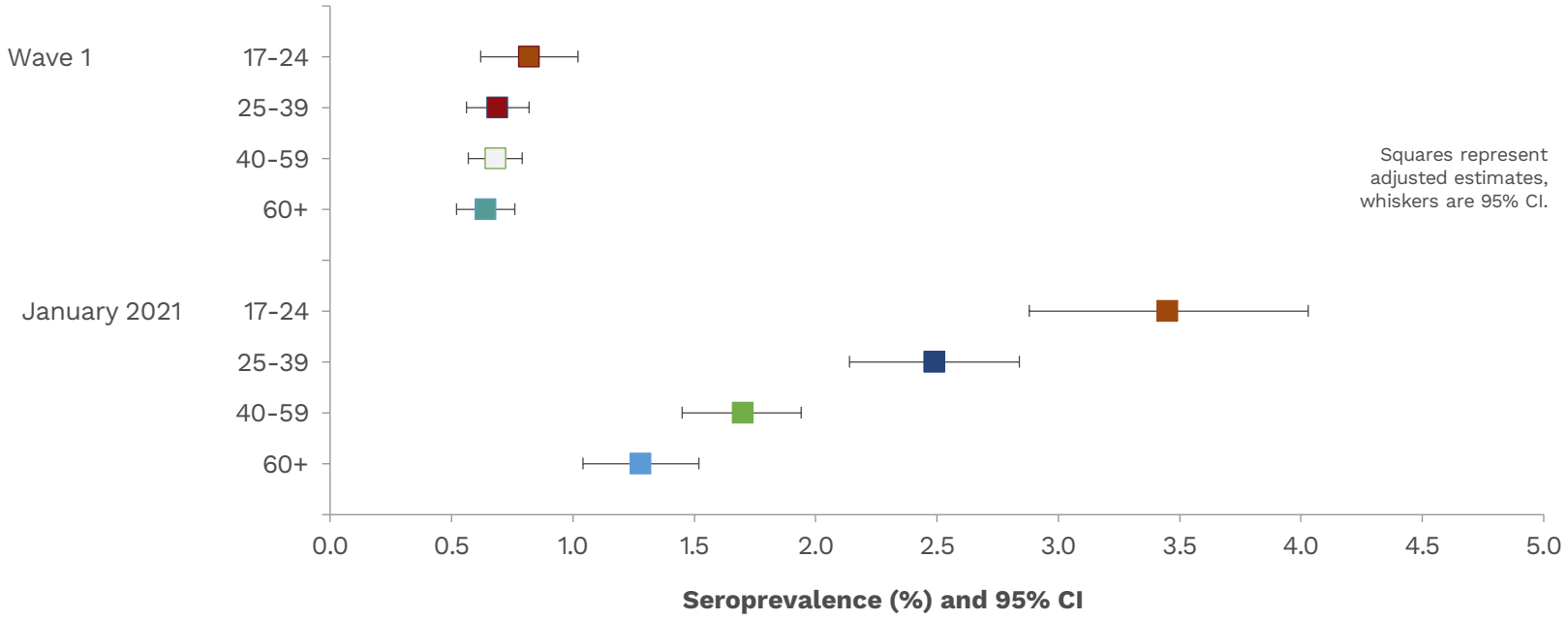
Methods

- Abbott Architect SARS-CoV-2 IgG assay (Nucleocapsid)
  - Sensitivity 92.7% and specificity 99.9%
- Roche Elecsys ® Anti-SARS-CoV-2 S immunoassay (total Ig, Spike)
  - Sensitivity 98.8% and specificity 99.6% (semi-quantitative)
- Roche Elecsys® Anti-SARS-CoV-2 immunoassay (total Ig, Nucleocapsid)
  - Sensitivity 99.5% and specificity 99.8%

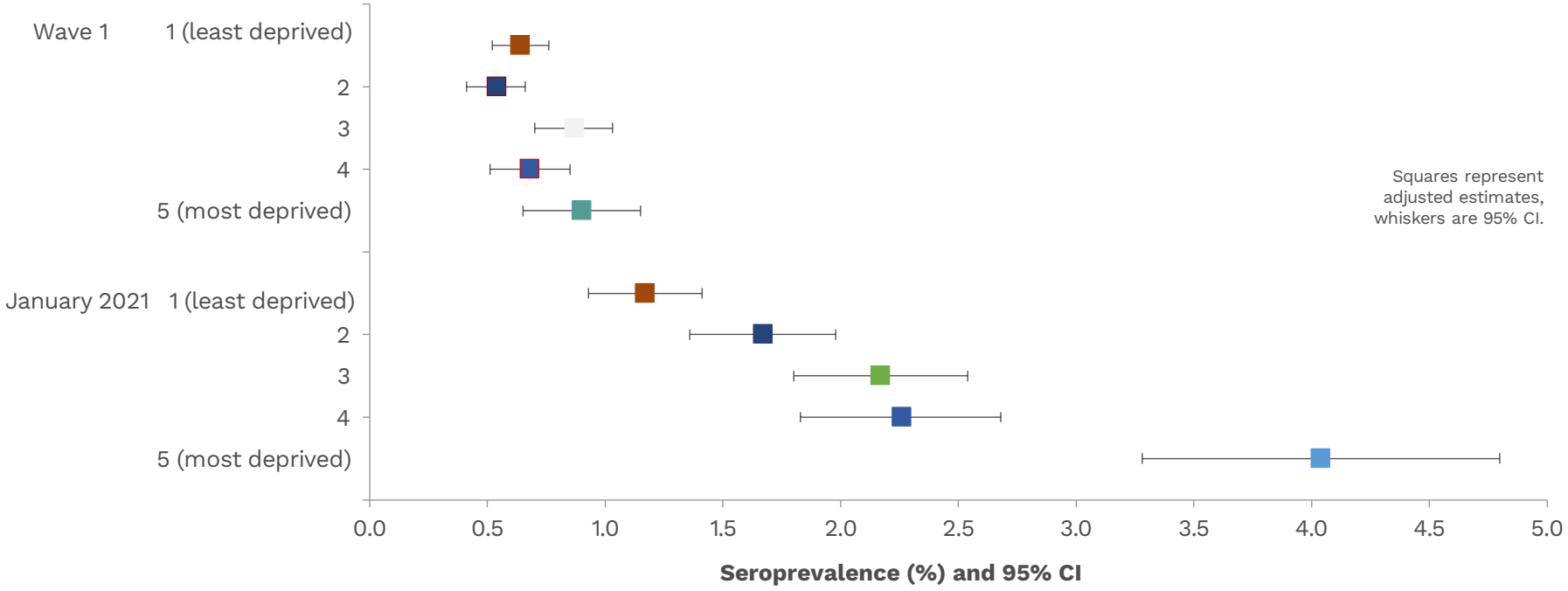
Methods (continued)

- Seroprevalence (% positive)
- Data were weighted to reflect the census data based on the donor's residential Forward Sortation Area (FSA), age group and sex
- Adjusted for sensitivity and specificity of the assay using the Rogan-Gladen equation

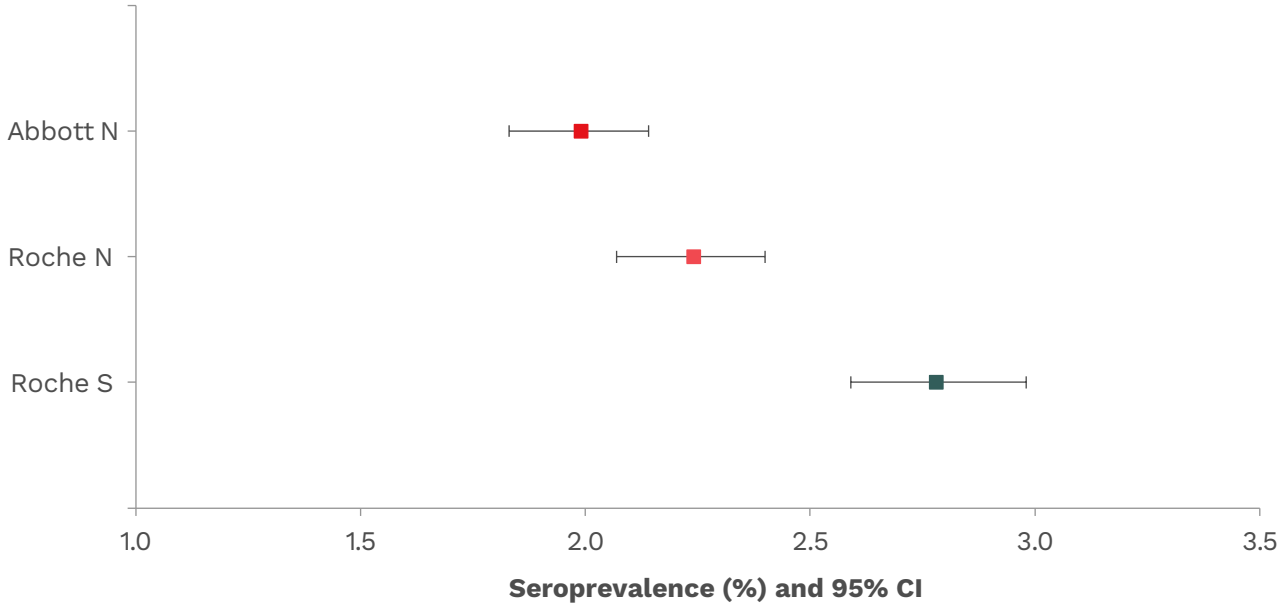
Comparison of seroprevalence estimates between Wave 1 and January 2021 by age group



Comparison of seroprevalence estimates between Wave 1 and January 2021 by material deprivation



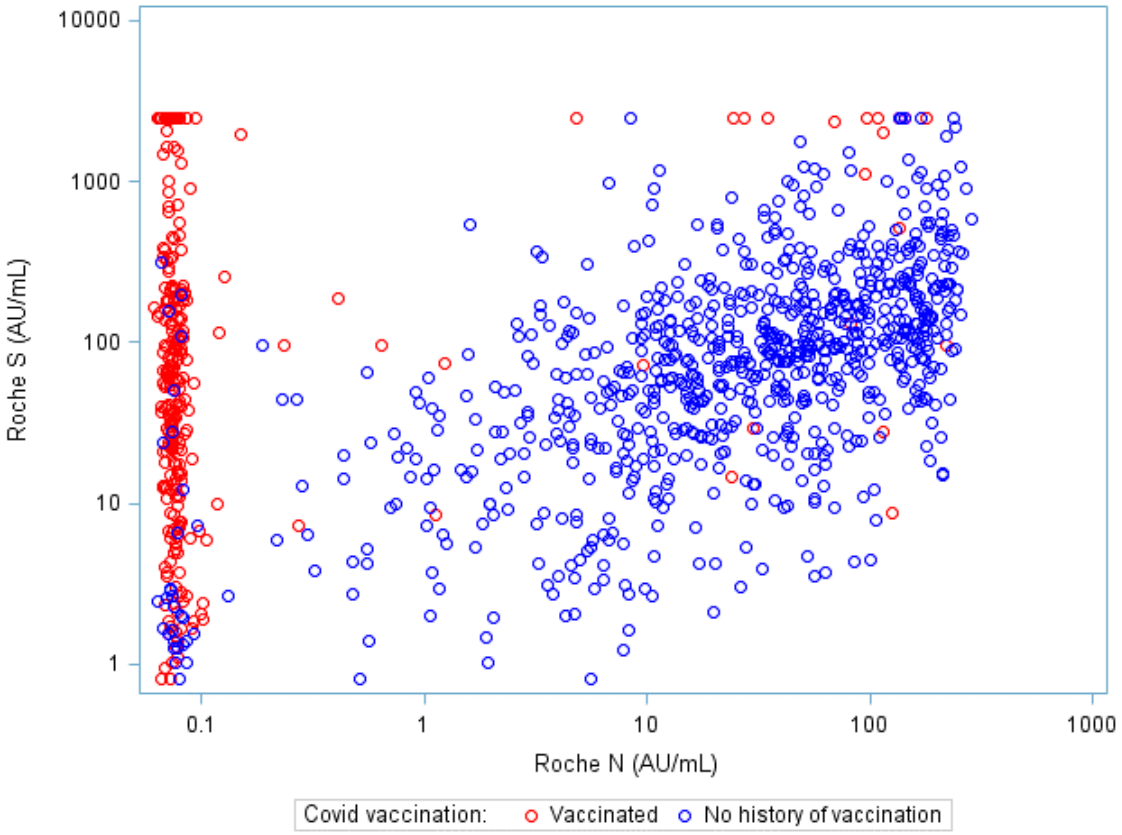
January seroprevalence and 95% confidence intervals for three assays



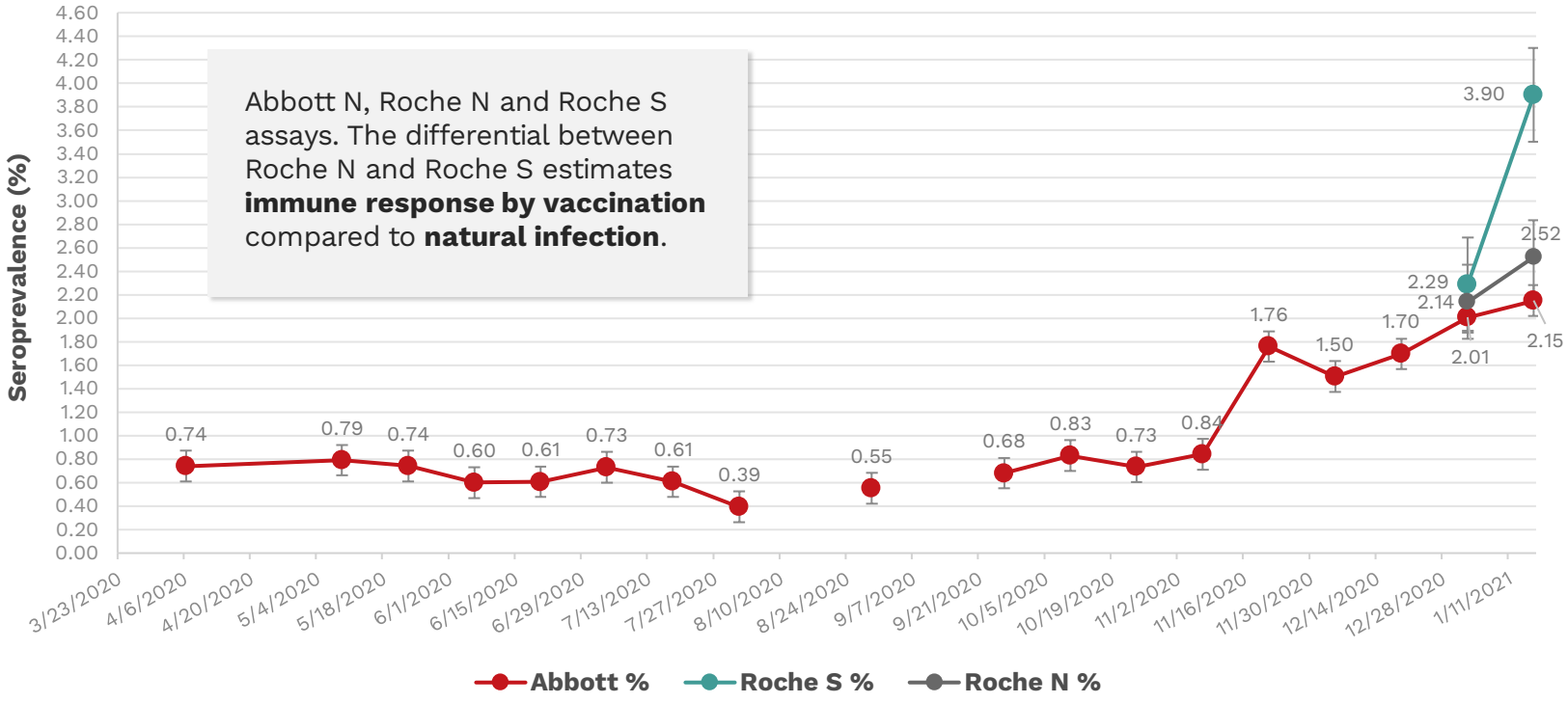
Self-reported vaccination

- 511 donors self-reported COVID-19 vaccination (1.5%); the majority were female (75%) and between 25-39 years old (52%).
  - 245 donors reported the date of their vaccination; the mean time since vaccination was 10 days.
  - Only 85 (35%) more than 2 weeks of whom 81 (95%) were reactive based on the S assay.
- Vaccination rates were similar by province, ethnicity, social or material deprivation index.

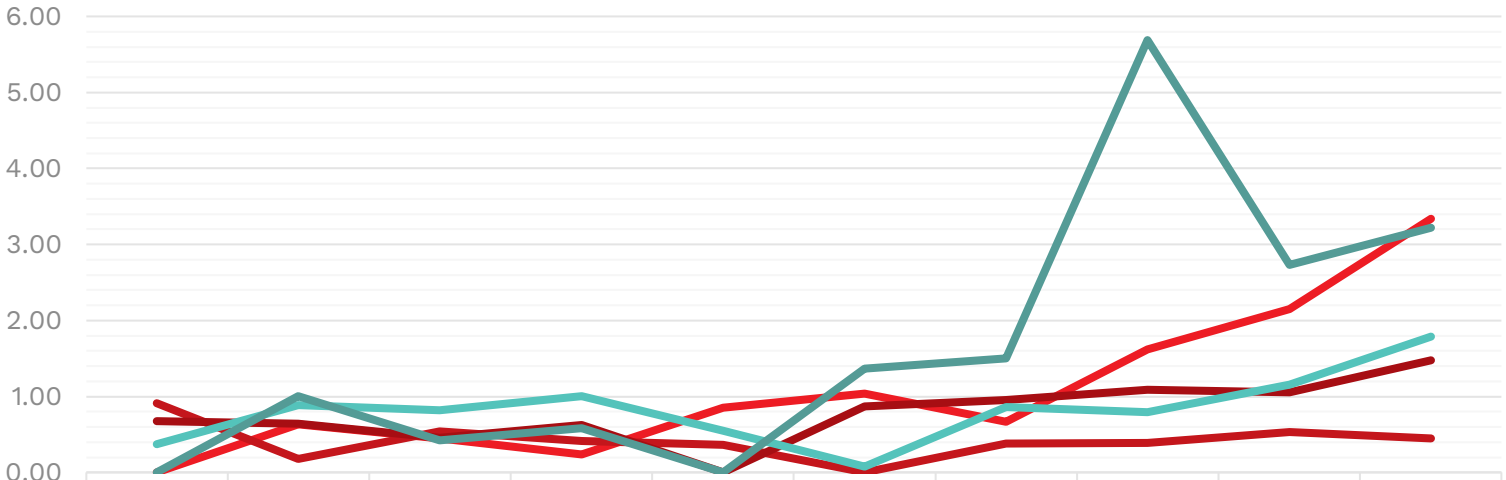
S-only assay identifies 82% of donors with history of vaccination



Overall temporal trends of SARS-CoV-2 seroprevalence by two-week intervals from April 2020-January 2021.



SARS-CoV-2 Seroprevalence | Regions



	April	May	June	July	August	September	October	November	December	January
Alberta	0.0	0.6	0.5	0.2	0.9	1.0	0.7	1.6	2.1	3.3
Atlantic	0.9	0.2	0.5	0.4	0.4	0.0	0.4	0.4	0.5	0.5
BC	0.7	0.6	0.5	0.6	0.0	0.9	1.0	1.1	1.1	1.5
ON	0.4	0.9	0.8	1.0	0.6	0.1	0.9	0.8	1.2	1.8
Prairies	0.0	1.0	0.4	0.6	0.0	1.4	1.5	5.7	2.7	3.2

Conclusion

- January 1-27, 2021 seroprevalence is low (<3%) regardless of the assay used.
- By January, 1.5% of donors reported receiving a COVID-19 vaccine.
- Among those with a date of vaccination, the majority (65%) had been vaccinated too recently to mount an immune response (less than 10 days)
- Moving forward distinguishing natural infections from vaccine induced immunity will be possible by comparing seroprevalence rates between Roche S and Roche N.

Seroprevalence studies of antibodies to SARS-CoV-2 in Héma-Québec blood donors – Phase 2

Dr. Marc Germain

Héma-Québec
Vice-President, Medical Affairs and Innovation
Primary Investigator

Reminder and objective of the study

- Collaboration with the INSPQ: monitoring antibody seroprevalence to the SARS-COV-2 virus in blood donors
- First study conducted in spring 2020 after the first COVID-19 wave
- Second study conducted while the second wave was in decline (mid-March 2021)
  - OBJECTIVE: To evaluate seroprevalence exiting the second wave

HÉMA-QUÉBEC

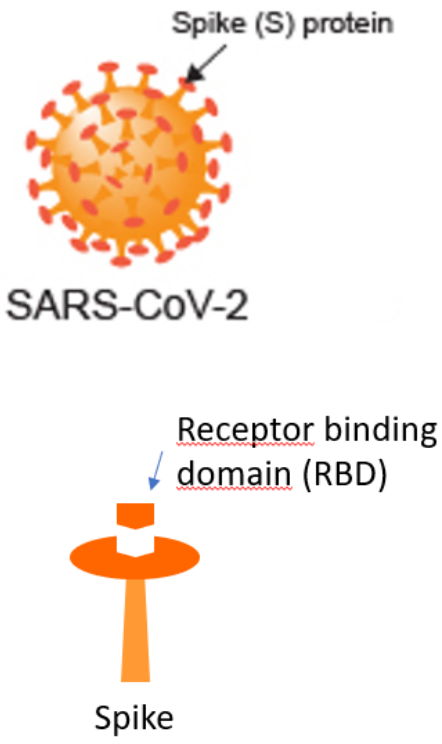
Method

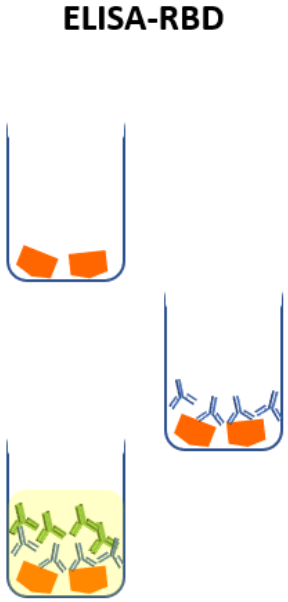
- 7,924 residual blood samples (single donors) collected by Héma-Québec as part of the regular blood donation process were included in this second phase of the study
- Blood drives were held between January 25 and March 11 in 14 of the 18 health regions
- Exclusions:
  - Individuals <18 years of age
  - Donors with active COVID-19 less than 14 days prior to donation

HÉMA-QUÉBEC

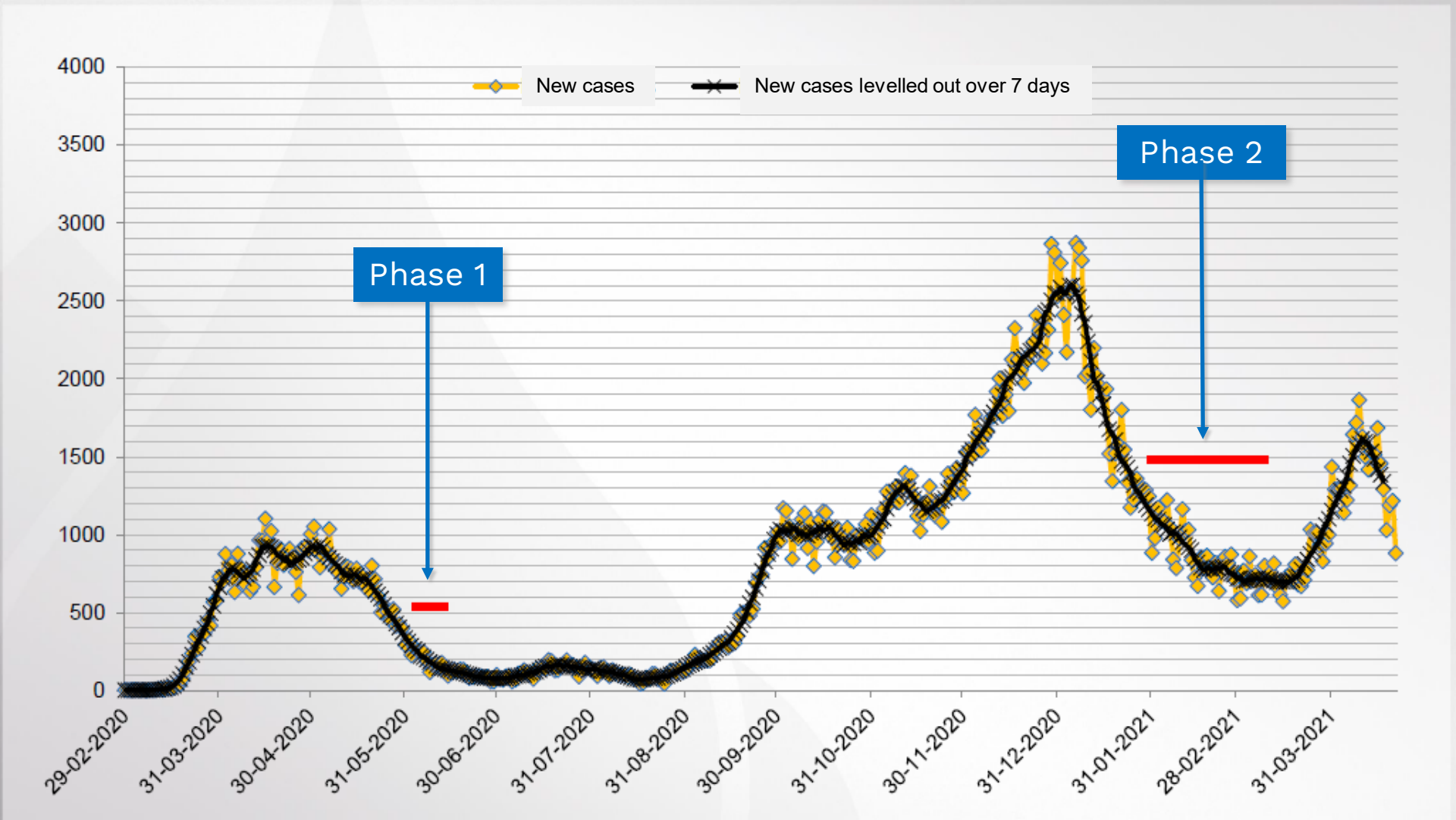
Method

- ‘In-house’ test (Bazin & Finzi)
- Same test used in Phase 1
- Detection of total Ig
- Validated: Se 95%; Sp 98%
- Evaluated using WHO standards





HÉMA-QUÉBEC


New cases
New cases levelled out over 7 days
Phase 1
Phase 2
4000
3500
3000
2500
2000
1500
1000
500
0
29-02-2020
31-03-2020
30-04-2020
31-05-2020
30-06-2020
31-07-2020
31-08-2020
30-09-2020
31-10-2020
30-11-2020
31-12-2020
31-01-2021
28-02-2021
31-03-2021

Results

Phase 1 (N = 7,691)	Phase 2 (N = 7,924)
7,518 negative • Median age 47 (IQR 31–59) • Ratio men/women (0.52)	6,733 negative • Median age 51 (IQR 34–62) • Ratio men/women (0.55)
173 positive • Median age 43 (IQR 28–57) • Ratio men/women (0.46)	1,191 positive • Median age 45 (IQR 29–60) • Ratio men/women (0.45)
Weighted rate: **2.23% (1.90–2.56)**	Weighted rate: **14.72% (13.81–15.63)**
Number of Quebecers 20–69 with antibodies: 124,880	Number of Quebecers 20–69 with antibodies: 824,320

HÉMA-QUÉBEC

Vaccination

Impact of vaccination on seroprevalence results

HQ TEST	Anti COVID-19 vaccination before donation			Total
	Yes	No	Don't know	
Seropositive	476 (39.97%)	685 (57.51%)	30 (0.38%)	1,191
Seronegative	144 (2.14%)	6361 (94.47%)	228 (3.39%)	6,733
Total	**620 (7.82%)**	7046 (88.92%)	258 (3.26%)	7,924

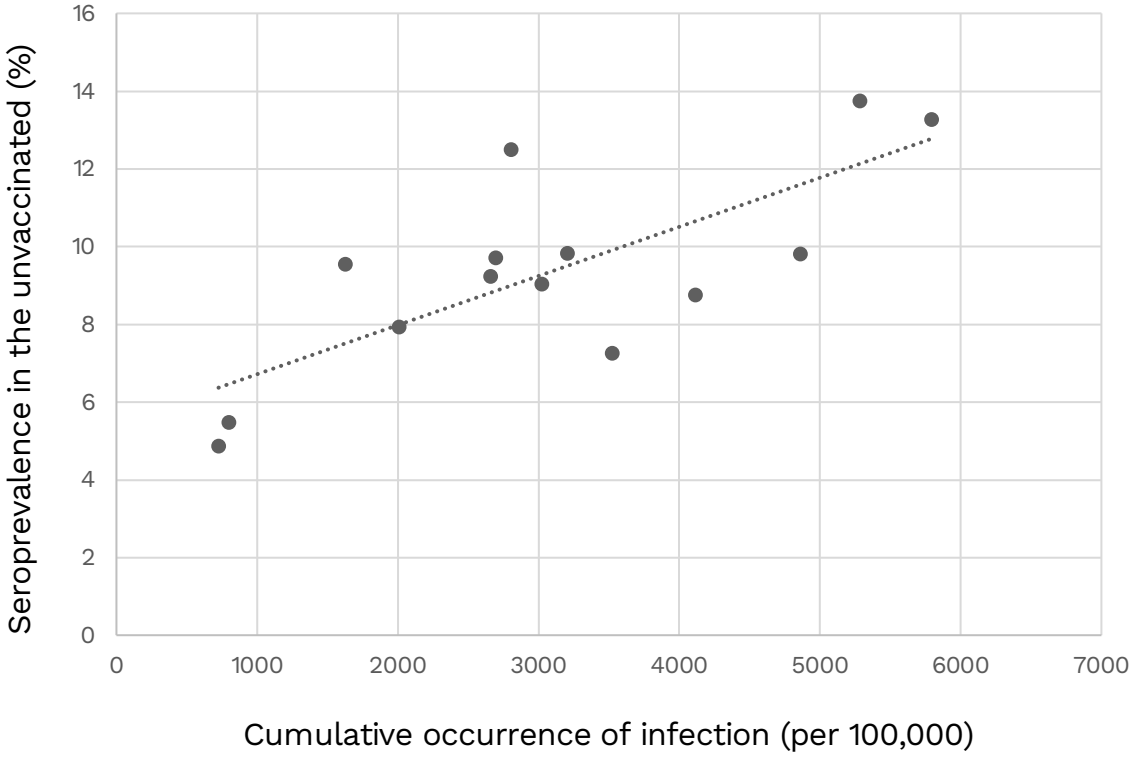
Impact of delay between vaccination and donation on seropositivity

Major regions	Q1: 1–9 days		Q2: 10–18 days		Q3: 19–28 days		Q4: 29–46 days		Q5: 47–117 days	
	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)	%
Mtl- Laval	5/13	38.46%	14/15	100%	24/25	96%	24/24	100%	5/5	100%
Montréal beltway	7/19	36.84%	15/15	100%	12/12	100%	22/22	100%	-	-
Other	8/85	8.60%	62/93	66.67%	87/88	98.86%	80/83	96.39%	114/116	98.28%
Total	20/125	16.00%	91/123	73.98%	**120/122**	**98.36%**	**126/129**	**97.67%**	**119/121**	**98.35%**

Seroprevalence by health region and major area

		Total seroprevalence		Seroprevalence among unvaccinated		Cumulative occurrence/ 100, 000
HR No.	Health Region	n/N	% weighted rates (CI 95%)	n/N	% weighted rates (CI 95%)	
01	Bas-Saint-Laurent	52/532	10.43 (5.62–15.25)	30/509	5.48 (1.79–9.16)	800.56
02	Saguenay–Lac-Saint-Jean	43/406	13.99 (9.33–18.64)	30/393	9.83 (5.73–13.92)	3,208.04
03	Capitale-Nationale	56/425	13.23 (10.39–16.07)	37/404	9.03 (6.56–11.49)	3,015.99
04	Mauricie et Centre-du-Québec	66/450	15.82 (10.81–20.84)	42/426	9.81 (5.58–14.04)	4,864.49
05	Estrie	53/524	9.60 (5.85–13.34)	40/511	7.25 (3.91–10.59)	3,524.68
06	Montréal	215/1,263	16.74 (14.81–18.66)	167/1,207	**13.75 (11.94–15.56)**	5,287.00
07	Outaouais	55/461	13.02 (9.13–16.92)	38/443	9.55 (6.08–13.02)	1,627.10
08	Abitibi-Témiscamingue	114/394	23.90 (15.99–31.82)	16/246	4.87 (0.29–9.44)	726.06
11	Gaspésie–Îles-de-la-Madeleine	119/398	27.76 (17.52–38.00)	19/218	7.93 (0.00–15.88)	2,010.83
12	Chaudière-Appalaches	68/464	15.60 (11.58–19.61)	54/450	12.49 (8.77–16.21)	2,808.26
13	Laval	69/394	18.54 (14.16–22.92)	48/371	**13.27 (9.32–17.23)**	5,797.38
14	Lanaudière	68/501	13.73 (10.20–17.26)	44/433	8.76 (5.78–11.74)	4,116.37
15	Laurentides	80/593	13.54 (10.32–16.76)	57/563	9.71 (6.84–12.58)	2697.94
16	Montérégie	133/1,117	12.79 (10.83–14.76)	93/1,068	9.23 (7.48–10.97)	2,659.69
	Montréal-Laval	284/1,657	17.05 (15.29–18.81)	215/1,578	13.67 (12.02–15.32)	-
	Montréal beltway	184/1,490	12.34 (10.49– 14.19)	128/1,422	8.67 (7.05–10.29)	-
	Other regions	723/4,777	14.31 (13.03–15.60)	372/4,304	9.35 (8.25–10.46)	-
Total		1,191/7,924	**14.72 (13.81–15.63)**	715/7,304	**10.52 (9.71–11.33)**	

Correlation between seroprevalence and rates of infection in health regions (r=0.76)



HÉMA-QUÉBEC

Seroprevalence and ethnic group

Ethnicity	n/N	% total weighted rates (CI 95%)	n/N	% weighted rates of unvaccinated (CI 95%)
Arab	30/146	22.43 (15.74–29.12)	27/143	21.11 (14.50–27.71)
Asian	16/89	15.36 (8.15–22.56)	11/84	10.81 (4.44–17.19)
Indigenous	1/15	1.81 (0.00–10.89)	0/14	-
Other	21/110	17.10 (9.48–24.72)	7/104	14.09 (6.92–21.27)
Caucasian	1,066/7,343	13.91 (12.97–14.85)	614/6,749	9.54 (8.72–10.36)
South Asian	2/16	11.40 (0.00–26.00)	1/15	7.79 (0.00–20.36)
Latino American	22/110	22.31 (14.87–29.74)	20/108	20.25 (12.98–27.52)
Black	32/91	36.59 (26.95–46.24)	26/84	32.95 (23.13 – 42.77)
Ethnic Group				
Caucasian	1,066/7,343	13.91 (12.97–14.85)	614/6,749	**9.54 (8.72–10.36)**
Other	124/577	22.07 (18.70–25.44)	101/552	**19.26 (15.99–22.52)**

Seroconversion rate

- Identification of the seroconversion rate in:
  1. Blood donors found to be seropositive in the first seroprevalence study conducted by HQ
  2. Convalescent plasma donors (SARS-CoV-2 infection confirmed by Public Health)
- A 20% seroconversion rate is a realistic estimate for people who were infected during the first wave.

After correction for seroconversion, the total prevalence rate rose from 14.72% to 15.16%.

Conclusions

- Coming out of the second wave: 15% of donors had developed antibodies to SARS-CoV-2 in Québec
- Extrapolating the seroprevalence (excluding those vaccinated) to 5.6 million Québec adults aged 20 to 69, there would have been in this age group:
  - 589,120 infections during the second wave: a 3x greater number of cases of COVID-19 than reported (194,255 at March 11, 2021)
- Coming out of the second wave, the majority of the Québec adult population remained susceptible to infection from SARS-CoV-2.
- Data confirm that most of the vaccinated donors developed antibodies to SARS-CoV-2.

Dr. David Buckeridge

COVID-19 Immunity Task Force Scientific Lead
Data Management & Analysis

CITF immunity monitoring: goal

Provide **regular estimates** of the cumulative proportion of Canadians with immunity to SARS-CoV-2

CITF immunity monitoring: methods

- Triangulate sporadic seroprevalence results with regular epidemiological indicators to estimate cumulative proportion immune to SARS-CoV-2

$$Immunity \propto previously\ infected\ +\ vaccinated$$

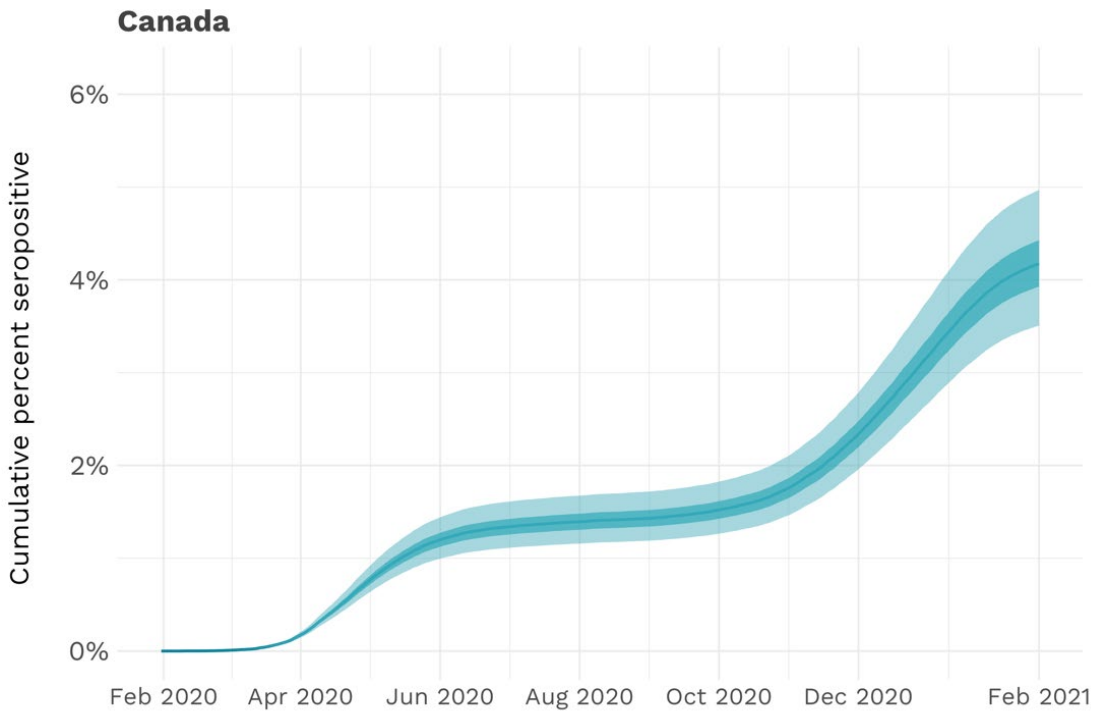
- Current implementation builds on published model (O'Driscoll, 2020)

  Ensemble Bayesian statistical model of geographical regions

  Estimates true (unobserved) cumulative seroprevalence from
  - daily mortality data
  - cumulative age-sex death counts (excluding LTC)
  - age-sex specific infection fatality ratios (IFR)
  - seroprevalence results

  Immunity through vaccination not currently included

Results: Canada



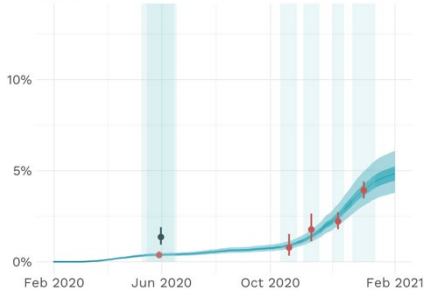
4.2%

(95% CI: 3.5, 5.0)

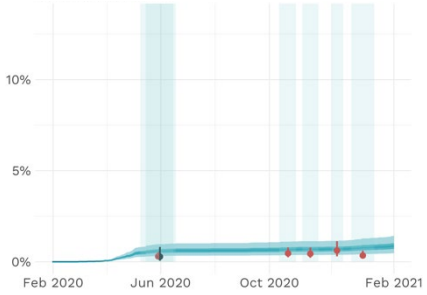
Cumulative percent of Canadian population with immunity to SARS-CoV-2 from natural infection (until Feb 18, 2021)

Results: provinces and regions

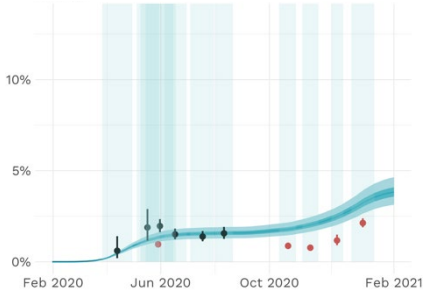
Alberta



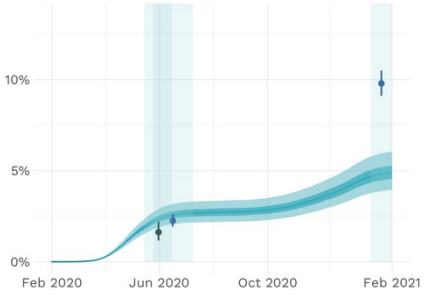
Atlantic provinces



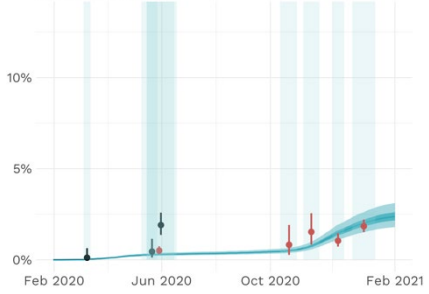
Ontario



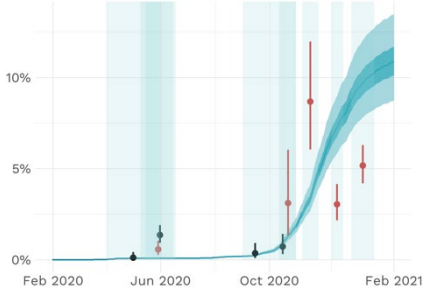
Quebec



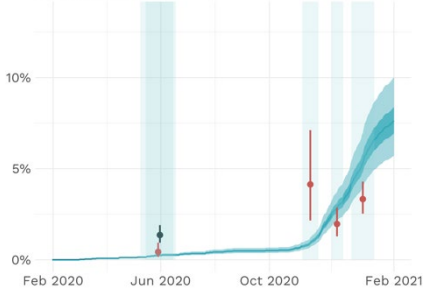
British Columbia



Manitoba

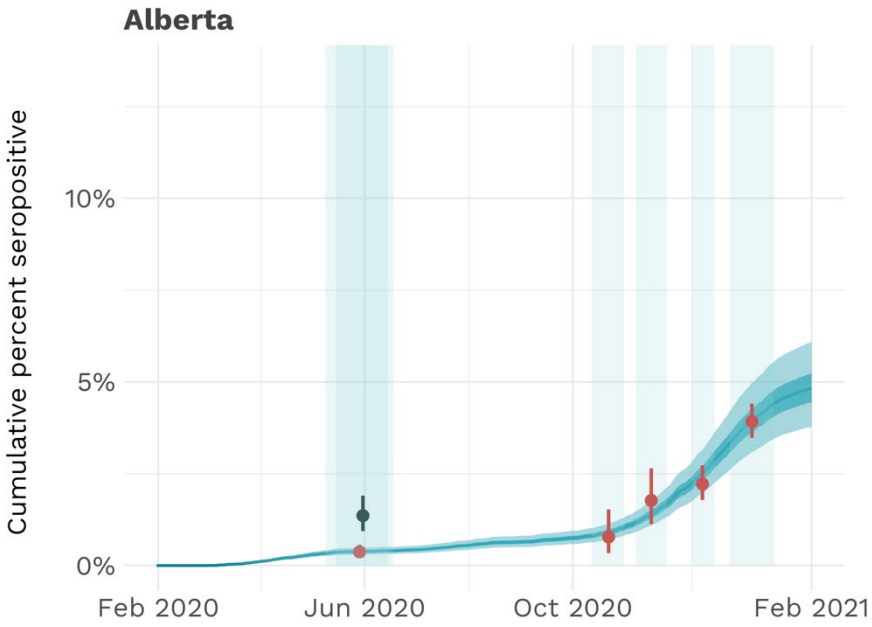


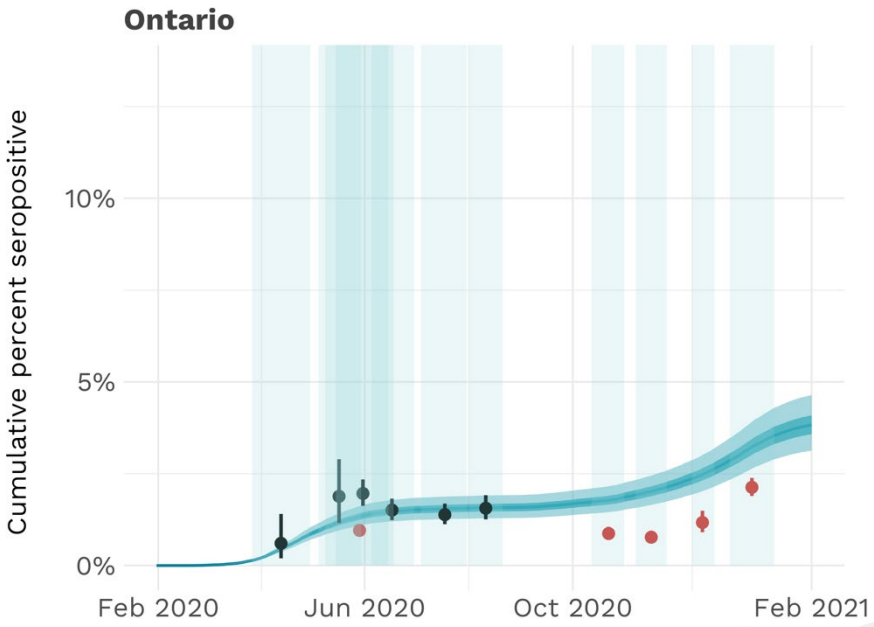
Saskatchewan



By province or region, cumulative percent of population with immunity to SARS-CoV-2 from natural infection until February 18, 2021

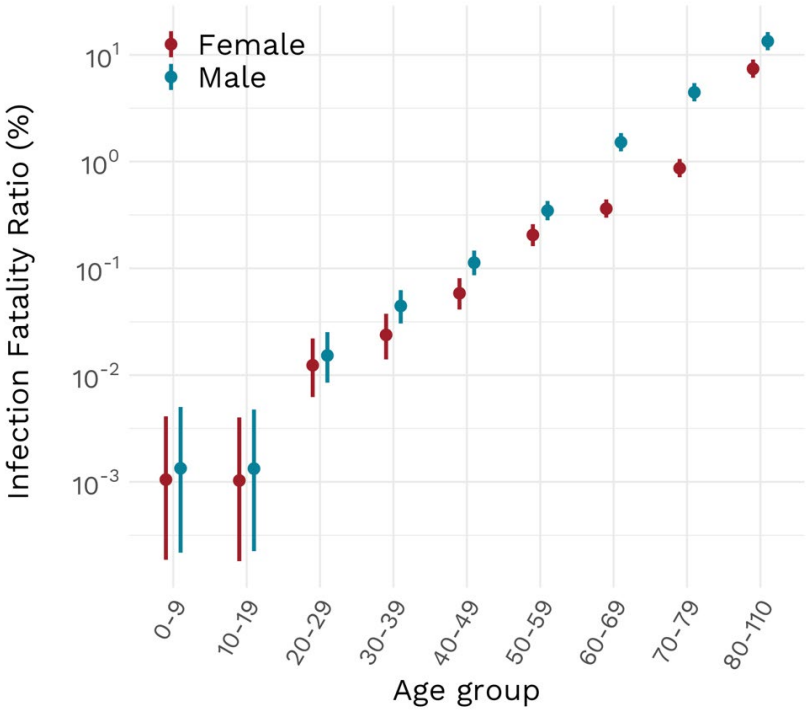
Alberta and Ontario





Cumulative percent of population with immunity from natural infection (teal) with supporting seroprevalence studies (coloured points)

Model validation and limitations



Multiple approaches used to validate model results by comparison to estimates from other sources

- Infection Fatality Ratio
- Age-specific Mortality
- Cumulative seroprevalence
- Cumulative infections

Limitations

- Small number of seroprevalence estimates
- Sero-reversion not accounted for in model
- Assays not adjusted to common reference panel
- Partial adjustment for sampling bias

Overall immunity and next steps

Incorporate data about vaccination into model

- Vaccine coverage time series
- Antigen specific seroprevalence results

Improve adjustment of seroprevalence estimates for

- Sampling biases
- Test characteristics

Improve estimation of true infections

- Add case time series and triangulate in similar manner to deaths
- Incorporate sero-reversion

Summary

- Immunity modelling synthesizes and triangulates multiple data sources to estimate cumulative seroprevalence
- Initial estimates indicate
  - Low levels of natural immunity
  - Variation in natural immunity across geographical regions
- Updated estimates will be released on a monthly basis incorporating vaccination and ongoing refinements to the model

Dr. Timothy Evans

COVID-19 Immunity Task Force

Executive Director

Conclusions

- Herd immunity remains far off, mass vaccination the only means out of the pandemic
- Massive attention must be placed on at risk communities
  - Racialized communities
  - Low socioeconomic areas
  - Canadians, aged 17-24
- Efforts must continue to increase vaccination rates in these populations

Measuring waning immunity

- Blood operator serosurveys detect antibodies due to vaccination
  - Both Canadian Blood Services and Héma-Québec found about 95% of donors who had been vaccinated at least two weeks before donating blood had vaccine-induced antibodies
- Blood collection agencies can measure waning immunity by age group
  - Inform as to timing of booster

Questions?