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International Border Surveillance Study

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The COVID-19 International Border Surveillance Study

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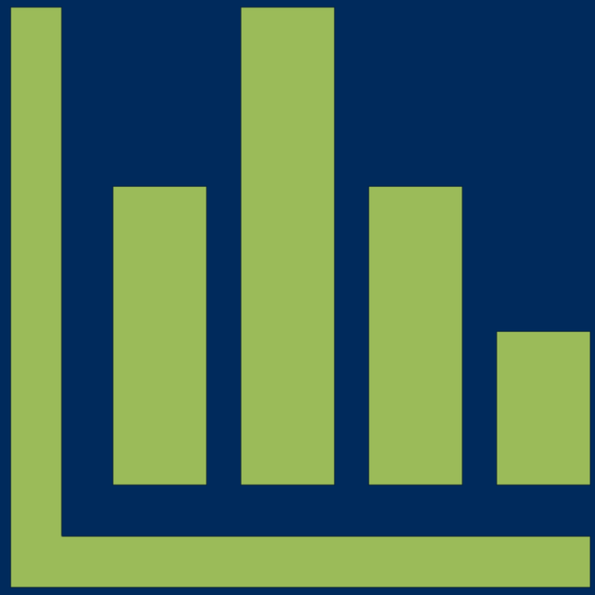


Disclosures: Study financial support

- McMaster Health Labs is a not-for-profit corporation set up by McMaster University and the Research Institute at St. Joseph's Hamilton
- McMaster University received a peer-reviewed grant from the Canadian Institutes for Health Research for this study
- MHL received funding from Air Canada and the Greater Toronto Airport Authority to conduct this study
- Sponsored research agreements were developed for conduct of the study:
  - Research St. Joe's for the laboratory work
  - University of Toronto for the independent data analysis
  - The agreements ensured that the investigators had authority over the conduct of the research, data analysis and preparation of study reports
  - MHL and study funders cannot alter or withhold any study results

Disclosures: Investigators and Presenter (Vivek Goel)

- None of the study investigators, including the presenter, received any direct personal benefit from the study funders.
- Vivek Goel is a Professor at the Dalla Lana School of Public Health
  - member of the COVID-19 Immunity Task Force
  - Chair of the Pan-Canadian Health Data Strategy Expert Advisory
  - Vice-Chair of the Board of the Canadian Institute for Health Information
  - Vice-Chair of the Board of Canada Health Labs
  - Member of the Board of the Vector Institute

Disclosures: Presenter (Peter Jüni)

- Peter Jüni serves as unpaid member of steering group or executive committee of trials funded by Abbott Vascular, Astra Zeneca, Biotronik, Biosensors, St. Jude Medical, Terumo and The Medicines Company, has received research grants to the institution from Appili Therapeutics, Astra Zeneca, Biotronik, Biosensors International, Eli Lilly, The Medicines Company, and honoraria to the institution for participation in advisory boards and/or consulting from Amgen, Ava and Fresenius, but has not received personal payments by any pharmaceutical company or device manufacturer.

Mitigating Potential Bias

- Study methods peer-reviewed by CIHR
- Study methods were presented to PHAC, Health Canada, MOH, PHO prior to commencement and feedback incorporated
- Interim results were presented to PHAC, Health Canada, MOH, PHO and Ontario Science Table and feedback incorporated
- Interim results publicly released
- Final results will be submitted for peer-reviewed publication and posted on preprint server
- An open data set will be prepared with appropriate safeguards to protect personal information of participants

Background

- Canada has maintained a fourteen day quarantine requirement for arriving international travelers, other than essential workers
  - As of January 6 arriving international travellers are required to have a pre-departure test 72 hours prior to the flight
- A number of countries and airports have launched pilots to examine the feasibility of using testing to screen travelers to determine whether quarantine time can be reduced
  - Most of these programs involve a test and release approach
  - Some have an arrival and follow-up test, usually at day 5 or 7, with or without maintenance of quarantine in the interval
  - Some require a pre-departure test, with or without an entry test, or one a few days later
  - Risk-based approaches have also been developed with reduced or no quarantine and/or test for travelers from low risk regions, test regimes and/or quarantine for higher risk countries
- Modelling studies have examined whether testing can be combined with reduced quarantine
- Compliance with quarantine is reported as being variable but rarely is 100% reported
- Quarantine has social, psychological and economic consequences

Study Objectives

Pilot Phase

- Feasibility of establishing a study method including in-aircraft consenting and registration, a registration and testing booth in the CBSA area of the Terminal and follow up at the participant's place of quarantine
- To determine the acceptability and quality of serial self-collected specimens for detection of COVID-19 infection

Main Study

- To assess the proportion of arriving international travelers that have COVID-19 infection
- To assess the proportion of international travelers that test positive at day 7 and day 14 of quarantine
- To assess the health well-being and attitudes of quarantined travelers
- To evaluate the potential for a Canada-wide Airport COVID-19 surveillance program that is robust and cost-effective

Study Methods

- Cohort of arriving international passengers at Toronto Pearson Airport Terminal 1 arriving in September and October 2020
- Inclusion criteria: age ≥18; GTA final destination and live within 100 km of airport, speaks English and French and provides consent
- Exclusion criteria: taking a connecting flight, no internet access, symptoms of COVID-19 on arrival, exempted from quarantine
- Eligible and consenting passengers were shown how to self-collect a nasal/cheek swab on arrival and provided with two additional kits for day 7 and day 14
  - Couriers dispatched to pick up test kits
- Questionnaires completed at baseline and follow-up
- PCR conducted at Research St. Joseph's in Hamilton
- Those that tested "non-negative" were referred to an assessment centre

Study Methods-Specimen Collection

- **Self-collected oral (buccal)- nasal swab**
  - Flocked nylon universal swab (sourced, sterilized, QC)
  - Oral collection: between gums and cheek, turn X3, both sides
  - Deep nasal: parallel to floor, insert to comfort, turn X3, both sides
- **McMaster Molecular Medium (MMM)**
  - Guanine isothiocyanate-based transport medium
  - Inactivates virus—biosafety
  - Stabilizes RNA—stable for >4-6 months at room temperature
- **Bar coded** for registration, lab accessioning and resulting

- **Research St. Joe's Hamilton**: Hamilton Robotics extraction
  - Multiplex PCR for E-gene, UTR and RNase P (adequacy marker)
  - Up to 1000 specimens/day TAT 12-24 hours
  - All Positive specimens repeated
  - All Results accessible online after text/email alert

Data Analyses

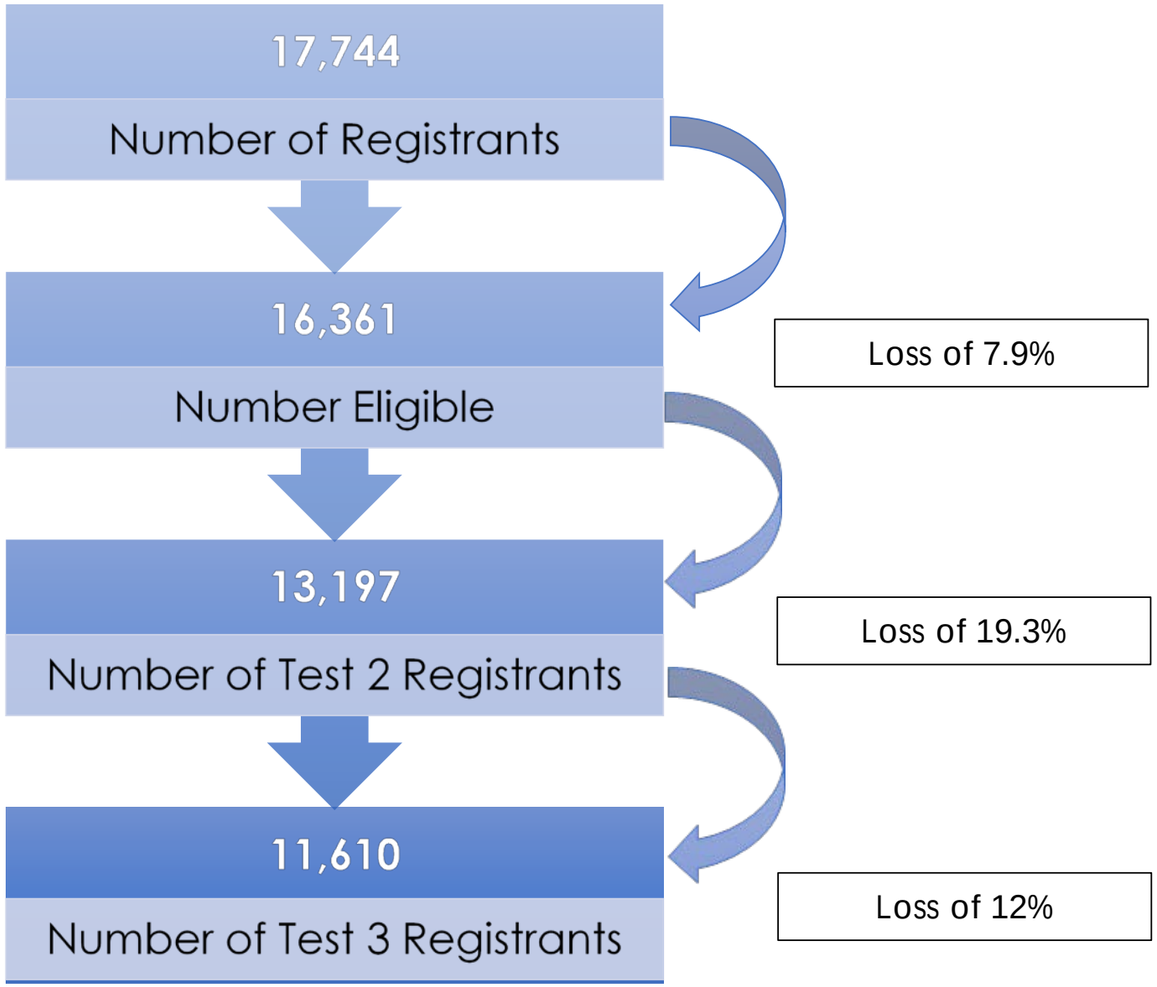
- Descriptive Statistics
  - Frequencies and percentages
  - Tests of Independence – Chi Square test and Fisher's exact test

- Imputations
  - Multiple Imputation
    - MI was used to impute age and gender
    - In this approach, using logistic and multinomial logistic regression, 4 datasets were created with temporary predicted values
    - In the final imputed dataset, averages across these temporary values are taken as the final imputed value
    - Variables that were used in the prediction: gender, age, continent of origin, mental health, risk category, and handwashing

  - Grouped Imputation
    - For a respondent's country of origin, groups of 20 were made around missing values and the most common country of origin within these groups were imputed as the most likely country of origin due to registrations likely occurring in groups
    - Multiple imputation for the country of origin was not possible given the diversity of responses

- Case Counts and Rates
  - The number of first non-negative test results were calculated by various characteristics and then converted into rates per 100k
  - 95% confidence intervals were calculated using the binomial exact method

Participation and follow-up: Two-Week Cohort



Participants for this analysis were recruited ***between September 3rd and November 6th***

Current estimated flight load for the study period is ~ ***85,500***

We do not know how many were eligible

Exclusion criteria*: Connecting passengers, those outside GTA, can't speak English/French, under 18, exempt passengers*

Demographics

		Case		
Variable	**Overall, N = 16,361**	**Yes, N = 248 (1.5%)**	**No, N = 16113 (98%)**	**P[1]**
Age Category, n (%)				0.55
18 to 29	5,012 (31%)	88 (35%)	4,924 (31%)	
30 to 49	6,915 (42%)	100 (40%)	6,815 (42%)	
50 to 69	4,121 (25%)	56 (23%)	4,065 (25%)	
70 to 79	298 (1.8%)	4 (1.6%)	294 (1.8%)	
80+	15 (<0.1%)	0 (0%)	15 (<0.1%)	
Gender, n (%)				0.13
Female	8,055 (49%)	107 (43%)	7,948 (49%)	
Male	8,289 (51%)	141 (57%)	8,148 (51%)	
Other	17 (0.1%)	0 (0%)	17 (0.1%)	
Continent, n (%)				**0.002**
Africa	661 (4.0%)	15 (6.0%)	646 (4.0%)	
America	9,165 (56%)	120 (48%)	9,045 (56%)	
Asia	2,176 (13%)	53 (21%)	2,123 (13%)	
Europe	4,315 (26%)	60 (24%)	4,255 (26%)	
Oceania	44 (0.3%)	0 (0%)	44 (0.3%)	
Risk Category, n (%)				0.21
Green	796 (4.9%)	8 (3.2%)	788 (4.9%)	
Orange	3,129 (19%)	38 (15%)	3,091 (19%)	
Red	11,217 (69%)	180 (73%)	11,037 (68%)	
Grey	1,219 (7.5%)	22 (8.9%)	1,197 (7.4%)	

[1]Statistical tests performed: Fisher's exact test; chi-square test of independence

Notes:

Risk Category

- **Created by using the ECDC country risk definitions**

Questionnaire Responses

Characteristic	Case	
	Yes, N = 248[1]	No, N = 16,113[1]
q1_covid		
yes	7 (6.4%)	267 (2.7%)
no	103 (94%)	9,575 (97%)
Unknown	138	6,271
q1_covidhousehold		
yes	3 (2.7%)	120 (1.2%)
no	110 (97%)	9,773 (99%)
Unknown	135	6,220
q1_covidsymptoms		
yes	3 (2.7%)	25 (0.3%)
no	109 (97%)	9,883 (100%)
Unknown	136	6,205

[1]Statistics presented: n (%)

How the Questions Were Asked:

Q1_covid
- **To your knowledge, have you ever tested positive for covid"?**

Q1_covidhousehold
- **Has anyone in your household had COVID-19?**

Q1_covidsymptoms
- **Do you currently have COVID-19 Symptoms? These include fever, sore throat, cough, loss of smell, tiredness, difficulty breathing, tightness in the chest, etc.**

Questionnaire Responses

Characteristic	Case	
	Yes, N = 248[1]	No, N = 16,113[1]
q1_covidtestrequired		
very acceptable	54 (50%)	5,513 (57%)
acceptable	40 (37%)	3,021 (31%)
neither acceptable nor unacceptable	7 (6.5%)	804 (8.2%)
unacceptable	5 (4.7%)	285 (2.9%)
very unacceptable	1 (0.9%)	132 (1.4%)
Unknown	141	6,358
q1_vaccinationrequired		
very acceptable	33 (31%)	3,685 (38%)
acceptable	33 (31%)	2,631 (27%)
neither acceptable nor unacceptable	25 (24%)	1,615 (17%)
unacceptable	7 (6.6%)	928 (9.6%)
very unacceptable	8 (7.5%)	828 (8.5%)
Unknown	142	6,426

[1]Statistics presented: n (%)

How the Questions Were Asked:

Q1_covidtestrequired
- **If a negative COVID-19 test were required for international travel in the future how acceptable would you find that?**

Q1_vaccinationrequired
- **If proof of a COVID-19 vaccination were required for international travel in the future, how acceptable would you find that?**

Demographics of Subjects Lost to Follow-up

		Loss to Follow-up	
Variable	**Overall, N = 16,361**	**Loss, N = 4661 (28%)**	**No_Loss, N = 11700 (72%)**
Gender, n (%)			
Female	8,055 (49%)	2,237 (48%)	5,818 (50%)
Male	8,289 (51%)	2,417 (52%)	5,872 (50%)
Other	17 (0.1%)	7 (0.2%)	10 (<0.1%)
Age Category, n (%)			
18 to 29	5,012 (31%)	1,674 (36%)	3,338 (29%)
30 to 49	6,915 (42%)	1,875 (40%)	5,040 (43%)
50 to 69	4,121 (25%)	1,026 (22%)	3,095 (26%)
70 to 79	298 (1.8%)	81 (1.7%)	217 (1.9%)
80+	15 (<0.1%)	5 (0.1%)	10 (<0.1%)
Continent, n (%)			
Africa	661 (4.0%)	207 (4.4%)	454 (3.9%)
America	9,165 (56%)	2,780 (60%)	6,385 (55%)
Asia	2,176 (13%)	673 (14%)	1,503 (13%)
Europe	4,315 (26%)	990 (21%)	3,325 (28%)
Oceania	44 (0.3%)	11 (0.2%)	33 (0.3%)
Risk Category, n (%)			
Green	796 (4.9%)	213 (4.6%)	583 (5.0%)
Orange	3,129 (19%)	787 (17%)	2,342 (20%)
Red	11,217 (69%)	3,285 (70%)	7,932 (68%)
Grey	1,219 (7.5%)	376 (8.1%)	843 (7.2%)

Loss
- Patients who do not have a subsequent test result for.

No_Loss
- Patients that we have all three tests for

Overall
- Full cohort

Overall positivity

Time	Cases	N	Rate/100,000	Lower CI	Upper CI	Proportion of positives by time
Overall	248	16361	1515.8	1334.18	1714.94	100%
Arrival	167	16361	1020.72	872.4	1186.82	67.3%
Day 7	67	13197	507.69	393.66	644.31	27%
Day 14	14	11610	120.59	65.94	202.24	5.6%

Symptoms by Timepoint

	First Test Non-Negative		
Variable	**1, N = 167 (67%)[1]**	**2, N = 67 (27%)[1]**	**3, N = 14 (5.6%)[1]**
Symptoms on Arrival			
Yes	3 (4.0%)	0 (0%)	0 (0%)
No	72 (96%)	31 (100%)	6 (100%)
Unknown	92	36	8
Symptoms on Day 7			
Yes	30 (40%)	12 (30%)	0 (0%)
No	45 (60%)	28 (70%)	11 (100%)
Unknown	92	27	3
Symptoms on Day 14			
Yes	14 (23%)	14 (44%)	3 (38%)
No	46 (77%)	18 (56%)	5 (62%)
Unknown	107	35	6

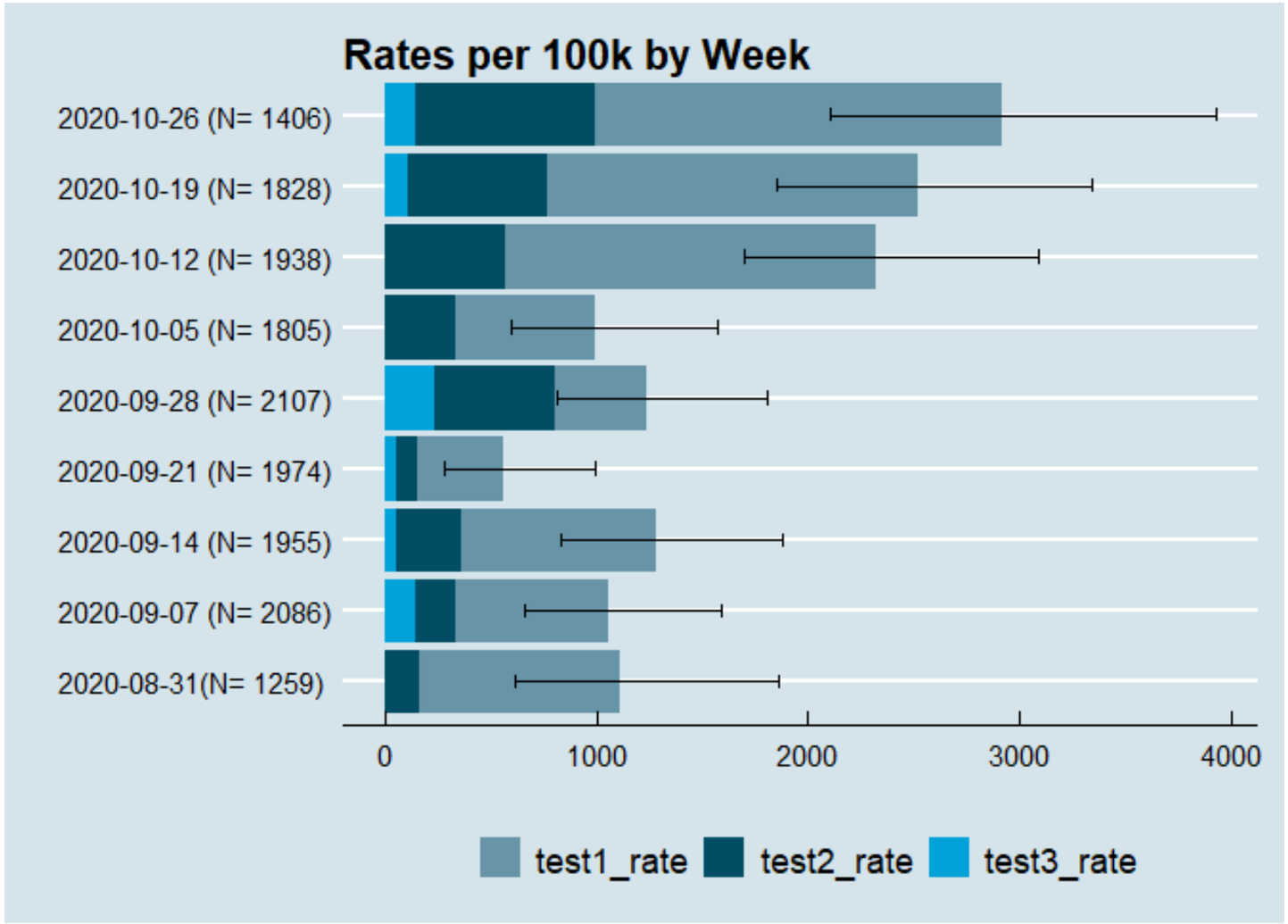
[1]Statistics presented: n (%)

Question that was asked in the questionnaire at each stage of the quarantine period:

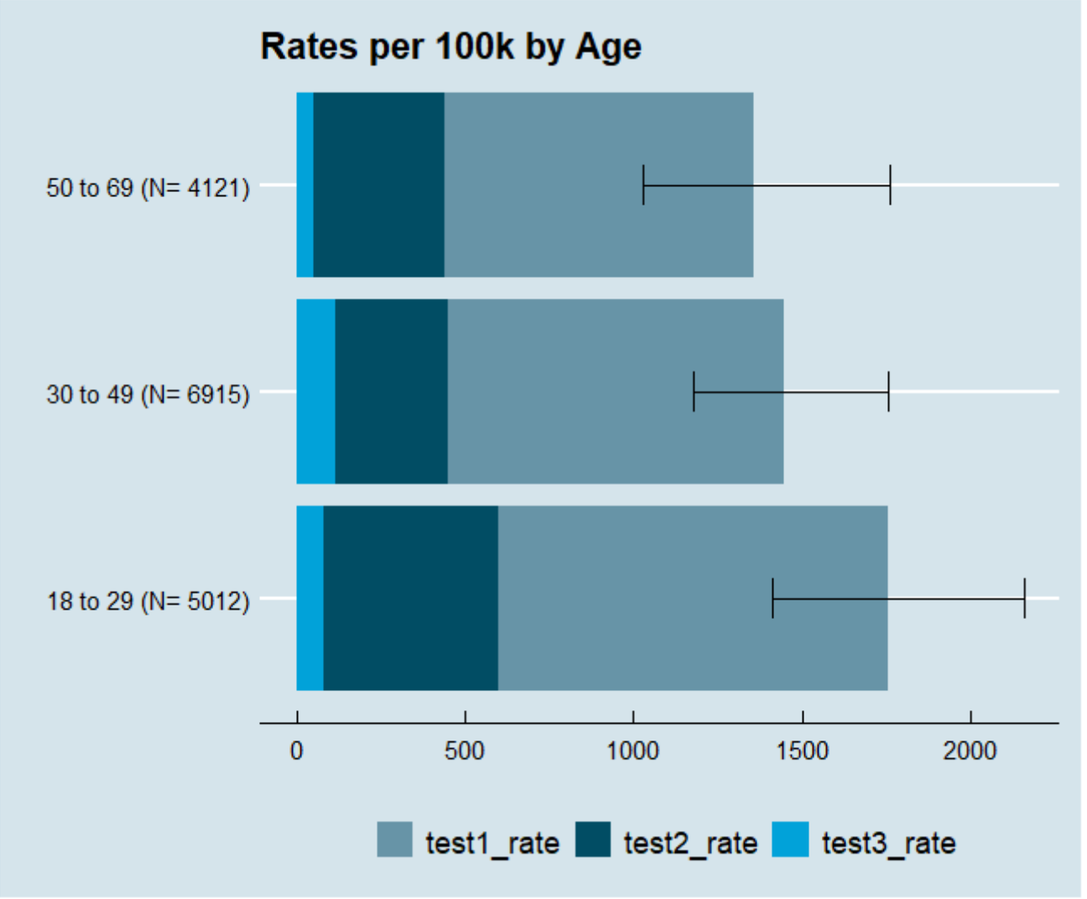
Do you currently have COVID-19 Symptoms? These include:

- Fever
- Sore throat
- Cough
- Loss of smell
- Tiredness
- Difficulty breathing
- Tightness in the chest, etc.

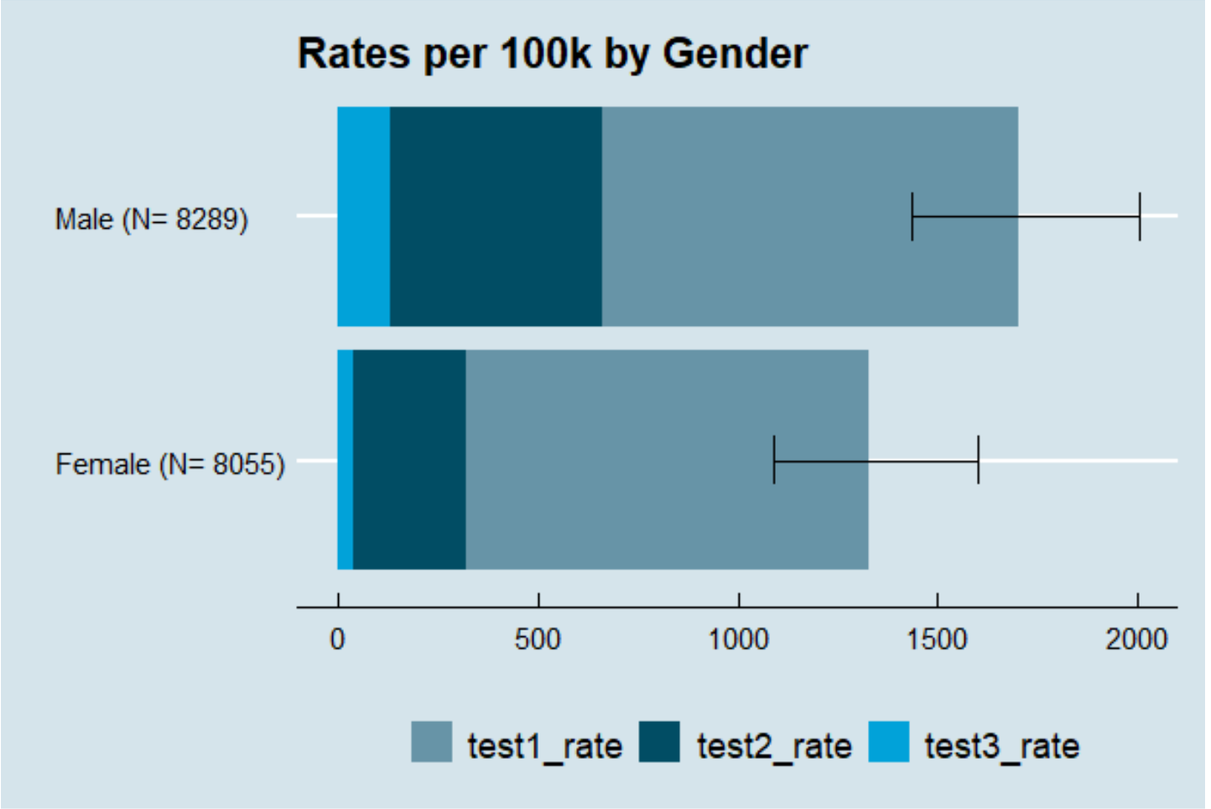
Cases By Week of Registration (Rate per 100k)



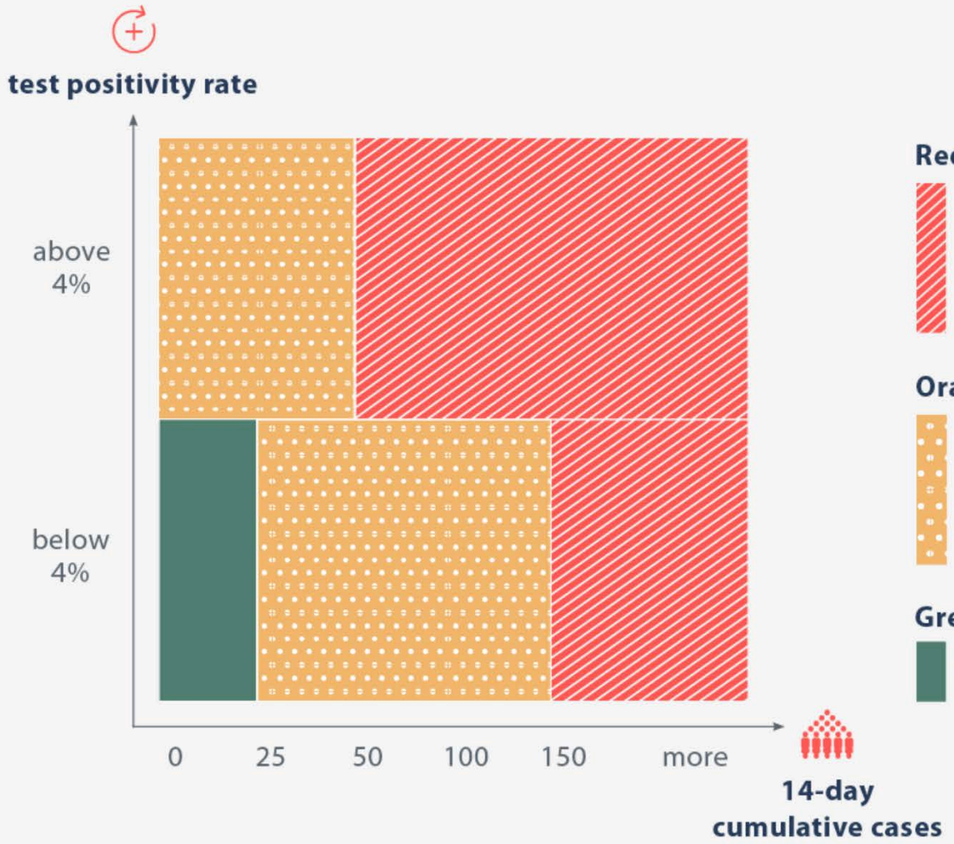
Cases by Age Group (Rate per 100k)



Cases by Gender (Rate per 100k)



Common colour codes: mapping of risk areas



Red area: high risk

More than 50 cases / 100.000 people
Positive test: 4% or more

More than 150 cases / 100.000 people
Positive test: less than 4%

Orange area: medium risk

Less than 50 cases / 100.000 people
Positive test: 4% or more

Between 25 and 150 cases / 100.000 people
Positive test: less than 4%

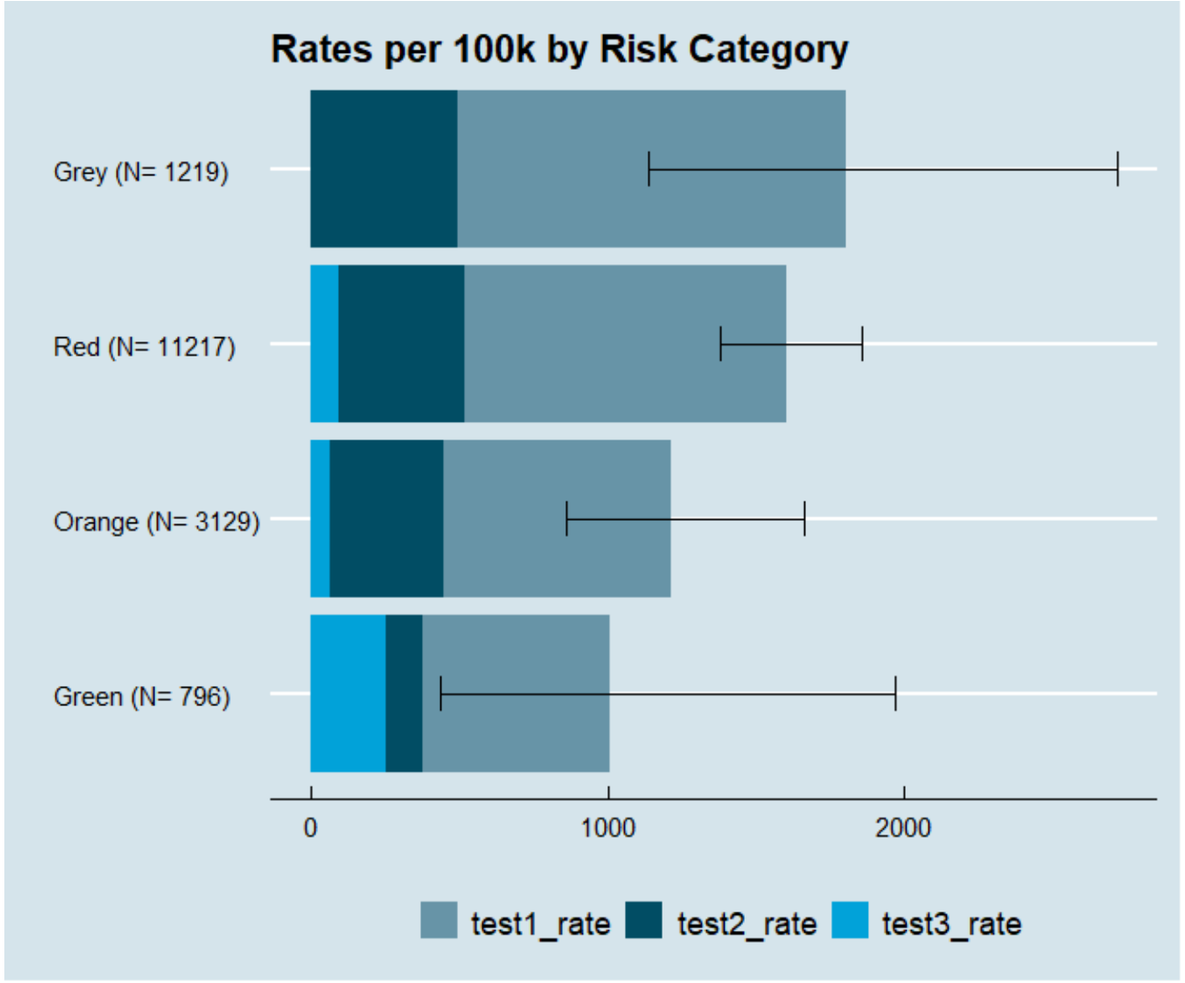
Green area: low risk

Less than 25 cases / 100.000 people
Positive test: less than 4%

If insufficient data or less than 300 tests/100,000 classified as grey

https://www.consilium.europa.eu/en/infographics/a-common-approach-on-covid-19-measures/

Cases by Country of Origin Risk Category (Rate per 100k)

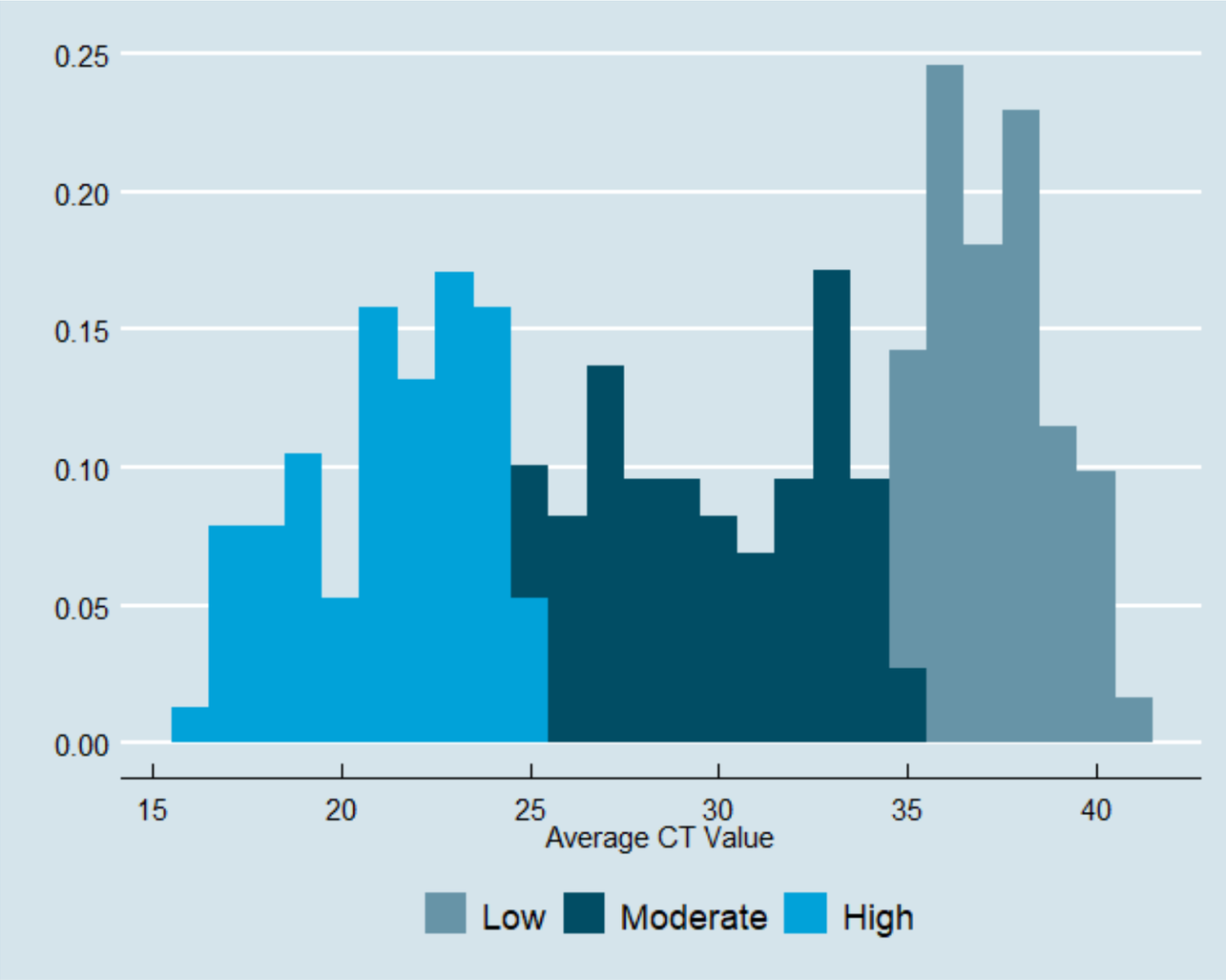


Most frequent countries of positive cases by risk group

Green	Orange	Red	Grey
Germany	UAE	USA	Egypt
Nigeria	Turkey	India	Bermuda
Poland	Germany	Mexico	Barbados
Serbia	Russia	Jamaica	Benin
	Greece	UAE	Albania
	Ireland		Syria
			Tajikistan

Cases by Continent of Origin (Rate per 100k)

Distribution of Viral Load (Preliminary)



Viral load by time point (Preliminary)

Characteristic	Arrival, N = 167[1]	Day 7, N = 67[1]	Day 14, N = 14[1]
Average CT Across All Targets	32 (26, 38)	27 (22, 36)	30 (27, 37)
Viral Load			
Low	60 (36%)	20 (30%)	6 (43%)
Moderate	71 (43%)	21 (31%)	6 (43%)
High	36 (22%)	26 (39%)	2 (14%)

[1]Statistics presented: Median (IQR); n (%)

Fully Adjusted Logistic Regression: Odds of positive

Fully Adjusted with Mental Health

Characteristic	OR[1]	95% CI[1]	p-value
Gender			
female	—	—	
male	1.40	1.04, 1.90	**0.029**
other	0.00		>0.9
Age			
18 to 29	—	—	
30 to 49	0.79	0.56, 1.12	0.2
50 to 69	0.80	0.53, 1.18	0.3
70 to 79	0.55	0.09, 1.77	0.4
80+	0.00		>0.9
Risk Category			
Green	—	—	
Orange	1.15	0.53, 2.87	0.7
Red	1.42	0.71, 3.37	0.4
Grey	1.64	0.70, 4.29	0.3
Mental Health	0.96	0.90, 1.02	0.2

[1]OR = Odds Ratio, CI = Confidence Interval

Fully adjusted model includes variables:

- Gender
- Age
- Risk Category
- Mental Health

Other location variables (i.e. continent or country of origin) were left out of the model due to collinearity with Risk Category.

Furthermore, Risk Category is a more relevant variable due to additional risk factors built into the definition that a continent of origin variable would miss (e.g. test positivity rate of the country of origin in the previous two weeks before arrival).

Behaviour Responses

Characteristic	Overall, N = 16,361[1]	Case: Yes, N = 248[1]	Case: No, N = 16,113[1]
Wears a Mask			
always	8,387 (78%)	102 (81%)	8,285 (78%)
usually	2,173 (20%)	22 (17%)	2,151 (20%)
rarely	146 (1.4%)	2 (1.6%)	144 (1.4%)
Unknown	5,655	122	5,533
Avoid Resturants			
yes	6,994 (65%)	94 (75%)	6,900 (65%)
usually	2,621 (25%)	24 (19%)	2,597 (25%)
no	1,078 (10%)	8 (6.3%)	1,070 (10%)
Unknown	5,668	122	5,546
Regular Handwashing			
true	10,109 (94%)	118 (94%)	9,991 (94%)
false	595 (5.6%)	7 (5.6%)	588 (5.6%)
Unknown	5,657	123	5,534
Visit Friends and Family			
true	798 (7.5%)	9 (7.2%)	789 (7.5%)
false	9,869 (93%)	116 (93%)	9,753 (93%)
Unknown	5,694	123	5,571

[1]Statistics presented: n (%)

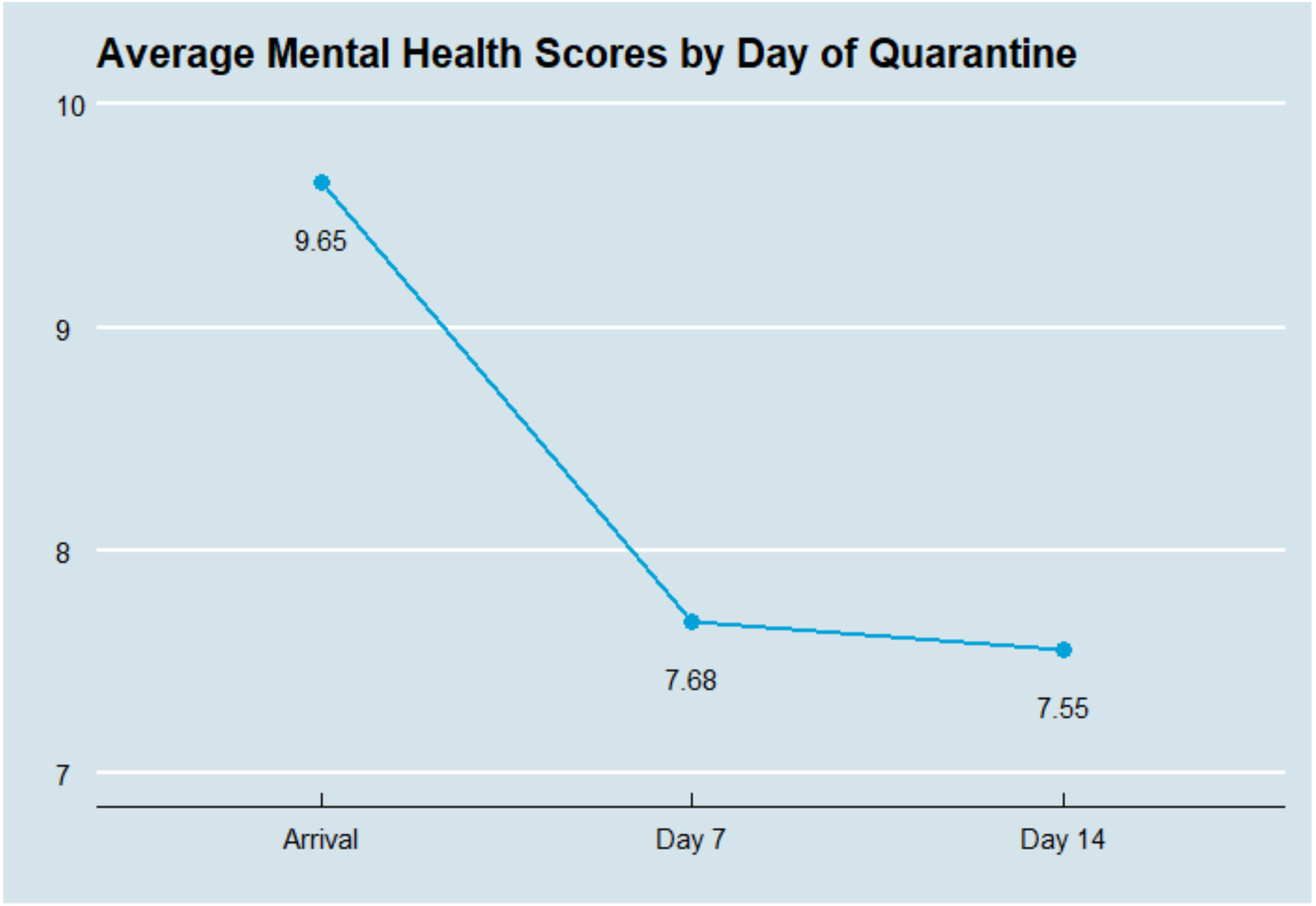
How the Questions Were Asked:

Wears a Mask
- **"I wear a mask around other people"**

Avoid Restaurants
- **"I avoid restaurants and bars now"**

Regular Handwashing
- **"I wash my hands more often than I did before COVID-19"**

Visit Friends and Family
- **"I see my friends and family about as often as I did before COVID-19"**



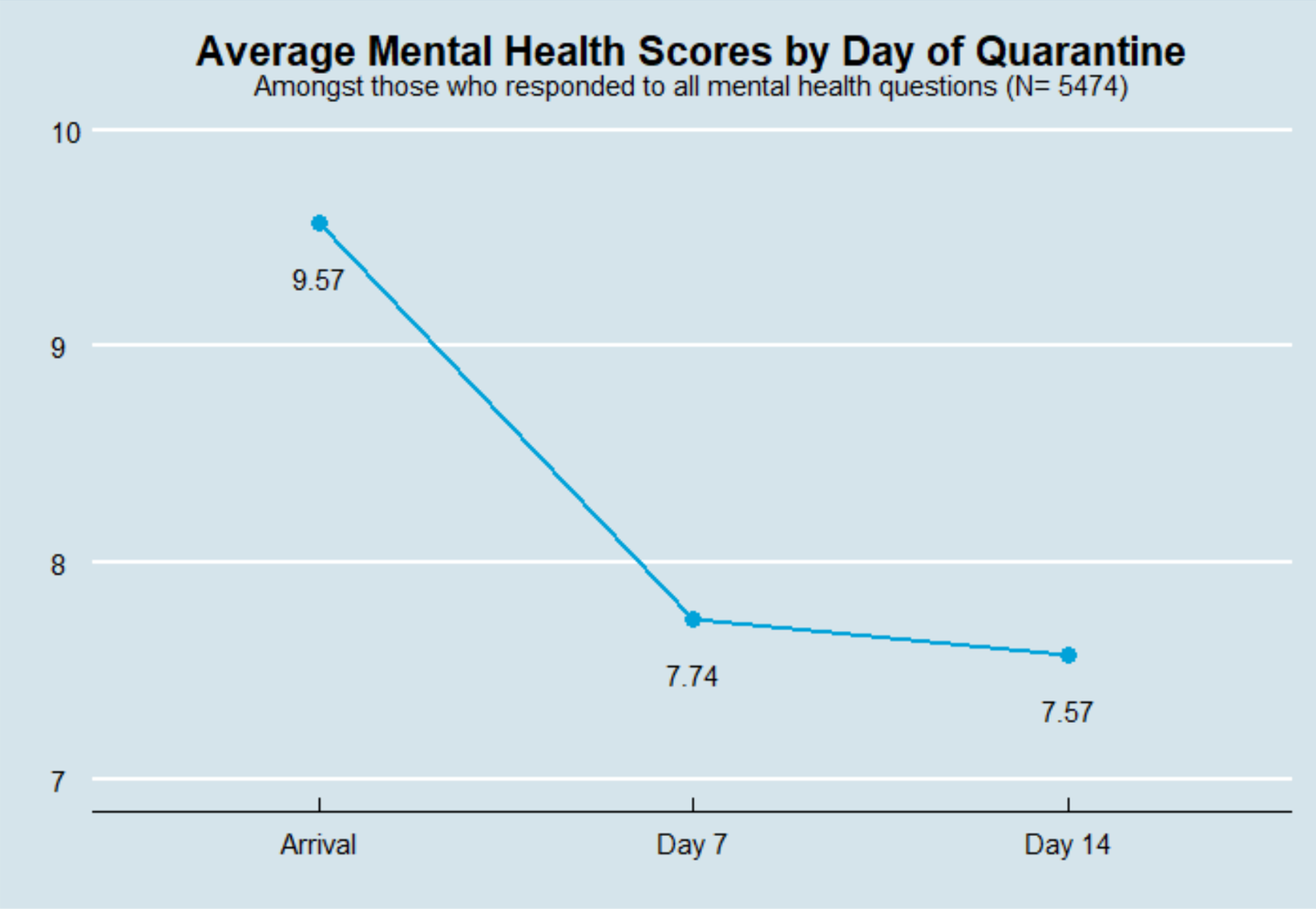
Questions:

- Over the past 2 weeks, I have felt cheerful and in good spirits
- Over the past 2 weeks, I have felt calm and relaxed
- Over the past 2 weeks, My daily life has been filled with things that interest me

Scale:

- All of the time – 4
- Most of the time – 3
- Less than half the time – 2
- Some of the time – 1
- Never – 0

Therefore, **12** is the maximum possible value for each week



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Therefore, **12** is the maximum possible value for each week

		Case	
Characteristic	**Overall, N = 16,361[1]**	**Yes, N = 248[1]**	**No, N = 16,113[1]**
Quarantine Difficulty			
very difficult	835 (8.6%)	7 (7.0%)	828 (8.6%)
difficult	1,851 (19%)	15 (15%)	1,836 (19%)
a little difficult	4,913 (51%)	55 (55%)	4,858 (50%)
not difficult at all	1,796 (18%)	18 (18%)	1,778 (18%)
i'm not sure	333 (3.4%)	5 (5.0%)	328 (3.4%)
Unknown	6,633	148	6,485

[1]Statistics presented: n (%)

How the Question Was Asked:

How difficult are you finding the quarantine experience?

Key insights

- 1.5% of travelers test positive
  - 67% detected on arrival test; 27% at day 7
- Rates are related to expected level of risk
- Rates are above expected levels, with a variety of assumptions
  - Travelers are younger
  - false positives; given low prevalence even with a very high specificity this is a significant issue
- <0.1% on day 14
  - Most are weakly positive?
  - Are they infectious?
  - Did they break quarantine?
  - Are they in long tail of incubation period?

Options for border pilots

- These results support a test and reduced quarantine approach
- An arrival PCR test would detect about 70% of positives
  - A second test likely gets most positives
  - *Could experiment with interval, eg 5 versus 7 days*
- Rapid tests can be considered but likely require high sensitivity in asymptomatic individuals
- Pre-departure testing could be coupled with an arrival test, but a mechanism for confirming the validity of the test is necessary
- A risk-based approach is possible
  - But feasibility of region based approach is affected by rapidly changing conditions in different parts of the world
  - Could also examine risk by expected activities, eg, business travelers with focused meetings
- Close monitoring of activities following arrival, as with Alberta pilot

Future research

- Follow-up on positives
- Rapid Antigen Tests evaluation
- Whole genome sequencing
  - Phylogenetic analysis
  - Variant surveillance

International Border Surveillance Study

Discussion

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Scientific Director, Ontario COVID-19 Science Advisory Table

Director, Applied Health Research Centre (AHRC)
Li Ka Shing Knowledge Institute, St. Michael's Hospital

Professor of Epidemiology & Medicine, University of Toronto

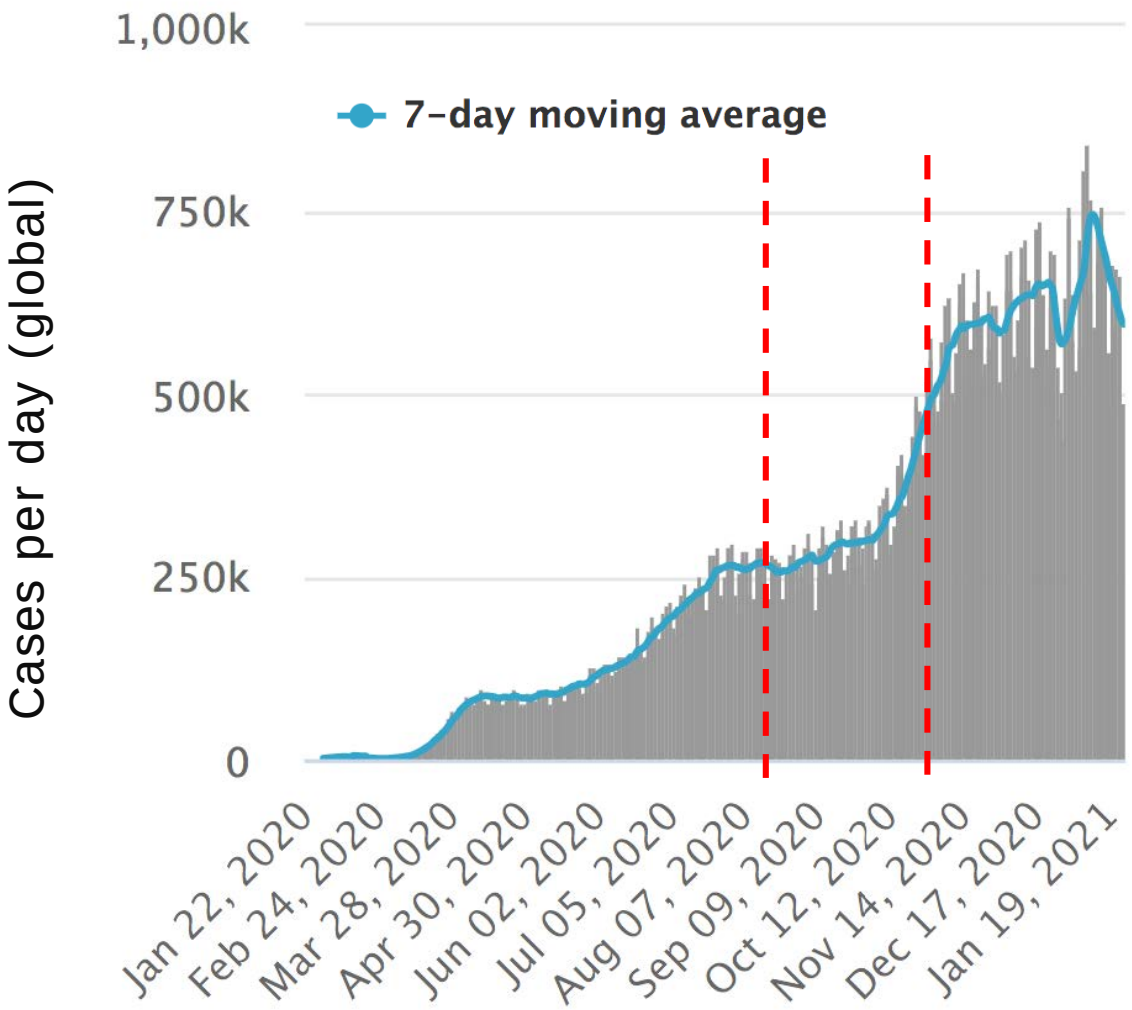
Tier 1 Canada Research Chair in
Clinical Epidemiology of Chronic Diseases

UNIVERSITY OF TORONTO

Final results, Oct / Nov 2020

Time	Cases	N	Rate/100,000	Lower CI	Upper CI	Proportion of positives by time
Overall	248	16361	1515.8	1334.18	1714.94	100%
Arrival	167	16361	1020.72	872.4	1186.82	67.3%
Day 7	67	13197	507.69	393.66	644.31	27%
Day 14	14	11610	120.59	65.94	202.24	5.6%

Timeframe



https://www.worldometers.info/coronavirus/

Absolute risk

Relative risk

Transformation of table

	Positive	Negative	Total	Percentage
PCR positive ever	248	16'113	16'361	1.52%
PCR positive arrival	167	16'194	16'361	1.02%
PCR positive day 7	67	13'130	13'197	0.51%
PCR positive day 14	14	11'596	11'610	0.12%

$$\text{Relative risk} = 0.0012/0.0152 = 0.08$$

Strategies to reduce the risk of SARS-CoV-2 re-introduction from international travellers

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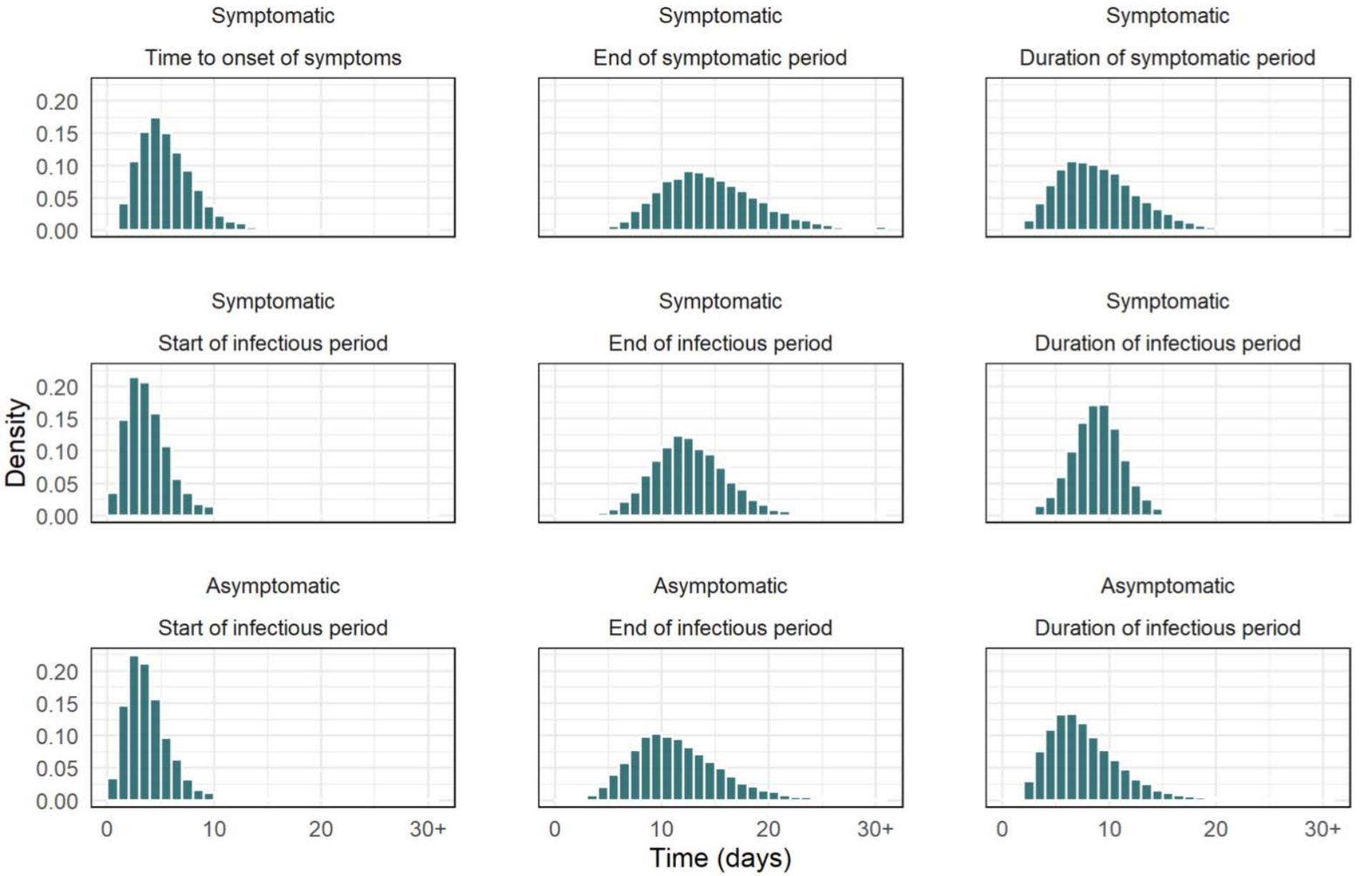
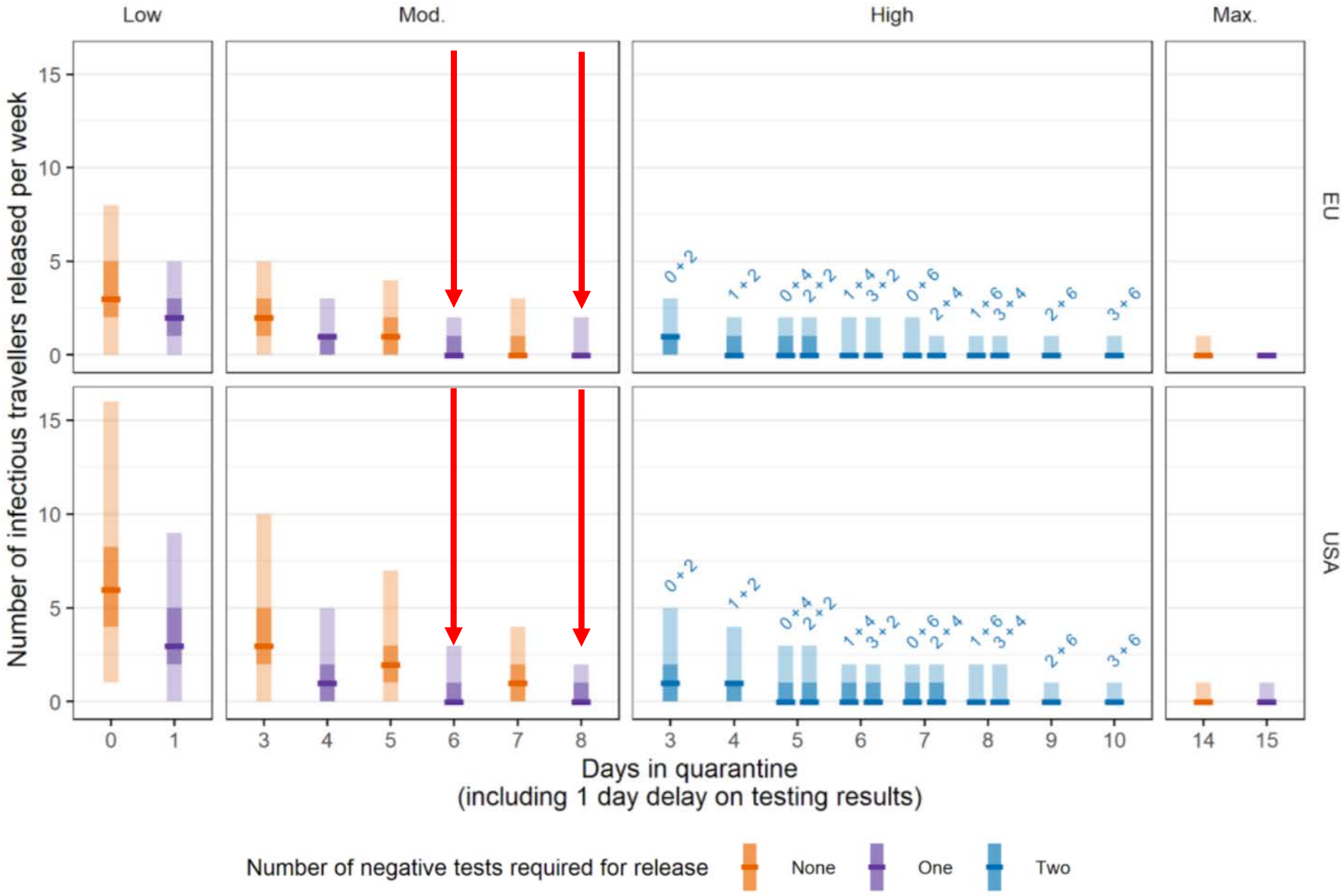
Clifford et al, medrxiv 2020



Clifford et al, medrxiv 2020

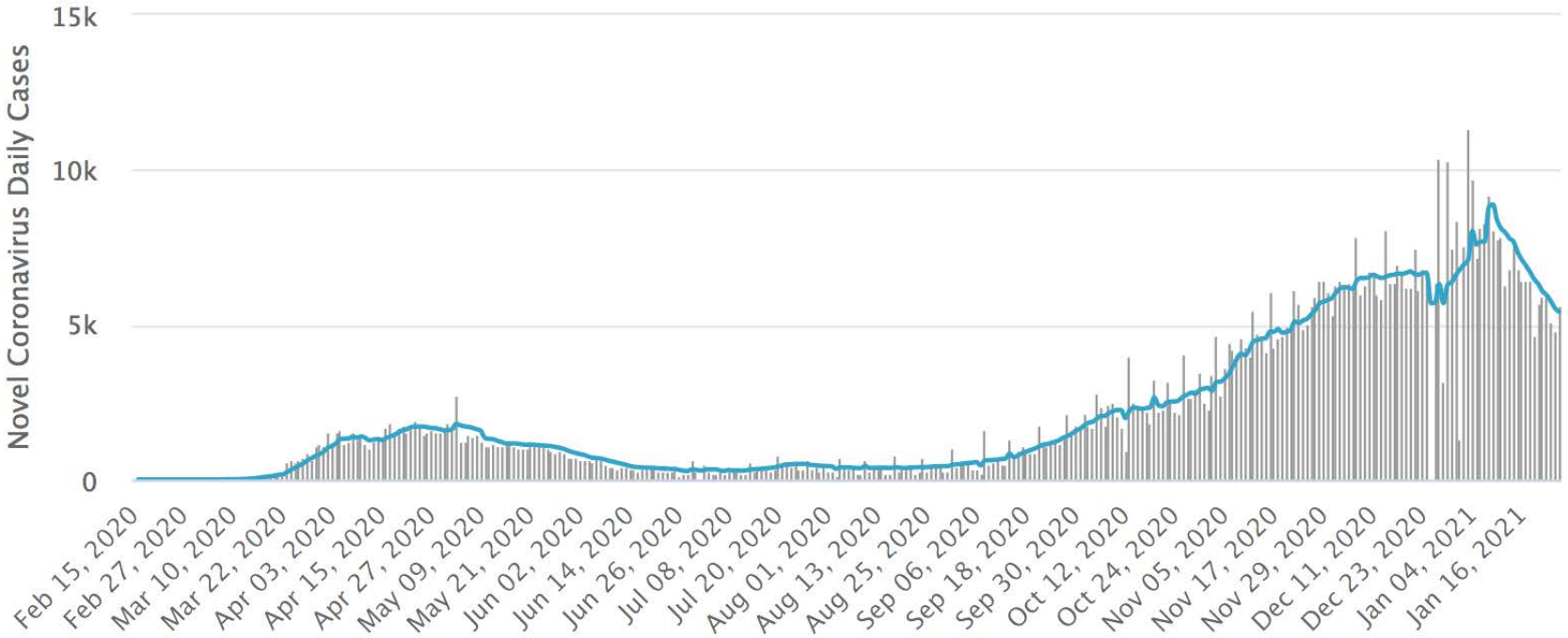


Clifford et al, medrxiv 2020

Risk reduction after negative PCR on days 0 & 7

- Clifford et al ~10-fold
- Goel et al ~10-fold

Canada

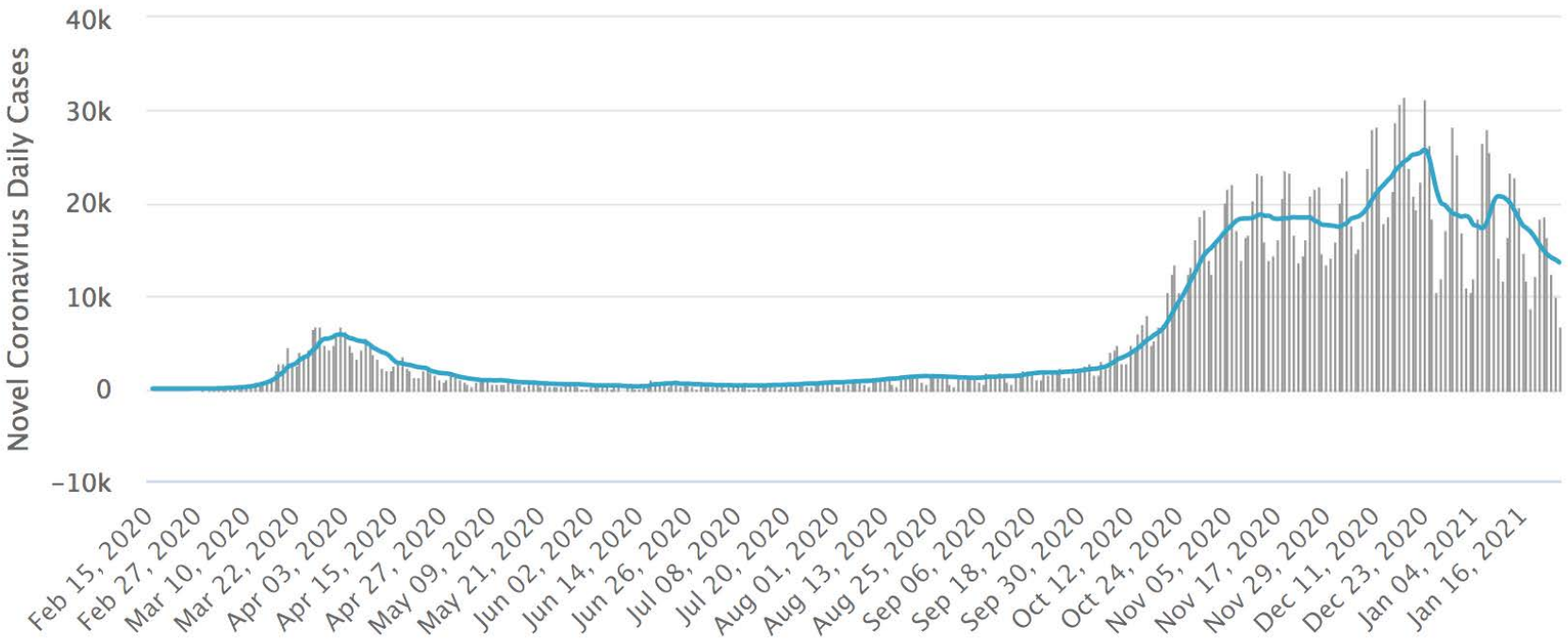


https://www.worldometers.info/coronavirus/

Ontario at Peak

Cases/day, 7-day average	3,500
Cases/100,000/week	168
Probability infectious case/1000	6.0

Germany



https://www.worldometers.info/coronavirus/

Germany at Peak

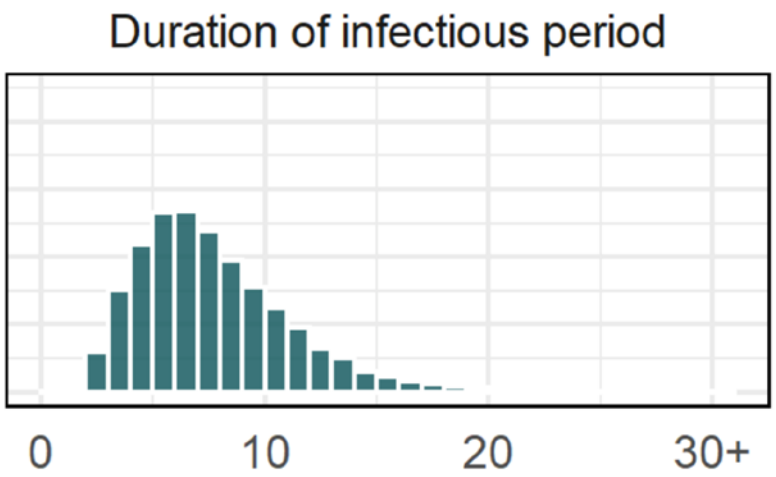
Cases/day, 7-day average	24,200
Cases/100,000/week	204
Probability infectious case/1000	7.3
Probability after travel/1000	20.4
Probability after 2 neg. tests/1000	2.0

Travel

Community

Difference between travel and known exposure

- Travel
  - Time of exposure unknown
  - Risk low
- Known exposure
  - Time of exposure known
  - Risk moderate to high
- Household contact
  - Imperfect isolation of index case



Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 69 / No. 51-52
January 1, 2021

Implications of Shortened Quarantine Among Household Contacts of Index Patients with Confirmed SARS-CoV-2 Infection — Tennessee and Wisconsin, April–September 2020

Melissa A. Rolfes, PhD[1]; Carlos G. Grijalva, MD[2]; Yuwei Zhu, MD[2]; Huong Q. McLean, PhD[3]; Kayla E. Hanson, MPH[3]; Edward A. Belongia, MD[3]; Natasha B. Halasa, MD[2]; Ahra Kim, MPH[2]; Jennifer Meece, PhD[3]; Carrie Reed, DSc[2]; H. Keipp Talbot, MD[2]; Alicia M. Fry, MD[1]

To prevent further transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), CDC currently recommends that persons who have been in close contact with someone with SARS-CoV-2 infection should quarantine (stay away from other persons) for 14 days after the last known contact.* However, quarantine might be difficult to maintain for a prolonged period. A shorter quarantine might improve compliance, and CDC recommends two options to reduce the duration of quarantine for close contacts without symptoms, based on local circumstances and availability of testing: 1) quarantine can end on day 10 without a test or 2) quarantine can end on day 7 after receiving a negative test result.† However, shorter quarantine might permit ongoing

were asymptomatic through day 7, there was an 81% chance (95% confidence interval [CI] = 67%–90%) of remaining asymptomatic and receiving negative RT-PCR test results through day 14; this increased to 93% (95% CI = 78%–98%) for household members who were asymptomatic with negative RT-PCR test results through day 10. Although SARS-CoV-2 quarantine periods shorter than 14 days might be easier to

Rolfes et al, MMWR Morb Mortal Wkly Rep 2021

Findings

Household contacts	185
PCR test+ within 14 days	109 (59%)
Relative risk reduction after	
neg. PCR on day 7	57%
neg. PCR on day 10	72%

Rolfes et al, MMWR Morb Mortal Wkly Rep 2021

Household Exposure

Probability infectious case/1000	300
Probability after 1 neg. test at day 10, per 1000	84*

*Assuming 72% relative risk reduction found by Rolfes et al

Non-Household Exposure

Probability infectious case per 1000	50
Probability after 1 neg. test at day 10, per 1000	5.0*

*Assuming 90% relative risk reduction found by Goel et al

Conclusions

Travel

- In general, strategies with at least 5 days quarantine and at least one negative PCR test effective
- 2 negative PCR tests on day 0 and day 7
  - 90% risk reduction (Goel et al, Air Canada Study)
- Negative PCR tests enable shortening of quarantine

Known exposure (preliminary)

- Strategies with negative PCR test on day 7 or 10 after last contact insufficient for household contacts
  - 57% risk reduction on day 7 (Rolfes et al)
  - 72% risk reduction on day 10 (Rolfes et al)
- Strategies with negative PCR test on day 10 potentially sufficient for **non**-household contacts
  - Assuming 90% risk reduction on day 10 (extrapolated from Goel et al)
- Conclusions do not take into account UK VOC

Thank you