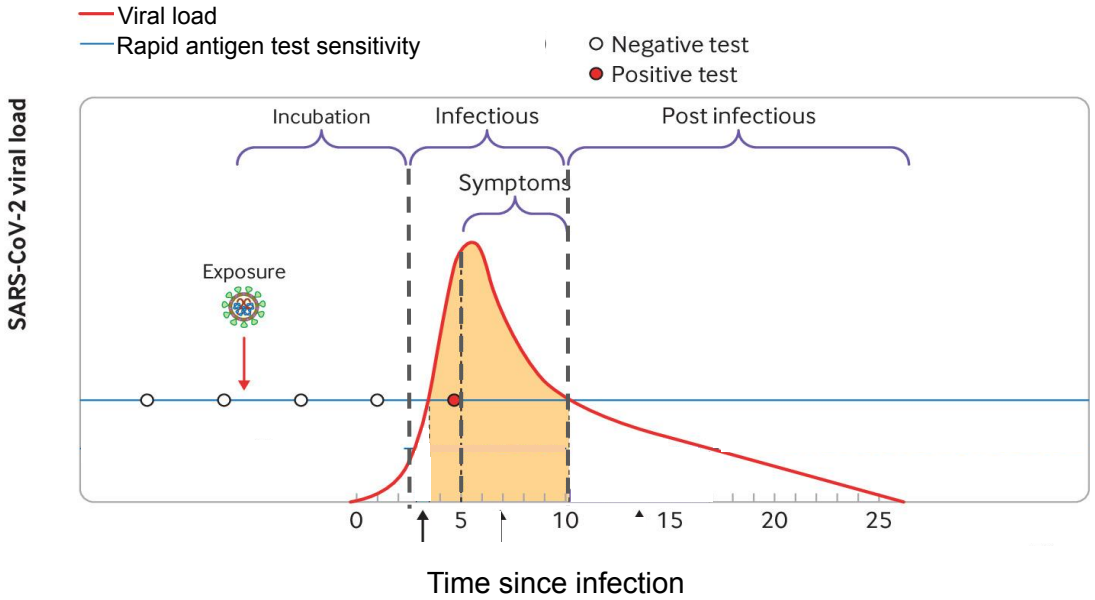
Rapid Antigen Tests for Preventing COVID Transmission

[BC COVID-19 Modelling group]

@bcCOVID19group

Rapid antigen tests and infectiousness during COVID-19 infection



People can transmit COVID before they have symptoms and even if they never develop symptoms at all. Rapid tests can detect COVID before symptoms develop, though they may not pick up low levels of virus.

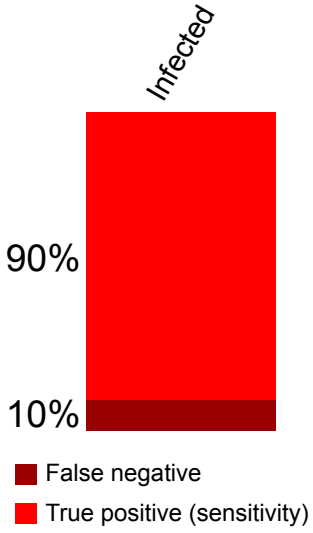
Image adapted from Crozier et al. *BMJ* 2021; https://doi.org/10.1136/bmj.n208

One Concern about Rapid Tests

- *Rapid tests aren't sensitive enough. We'll miss too many cases.*
  Abbot Panbio is about 90% sensitive for infectious cases.

Often much lower sensitivities are reported, but these are in comparison with a positive PCR test, which can detect cases that aren't infectious. On cases with a high viral load, who are likely to be infectious, the test is much more accurate.

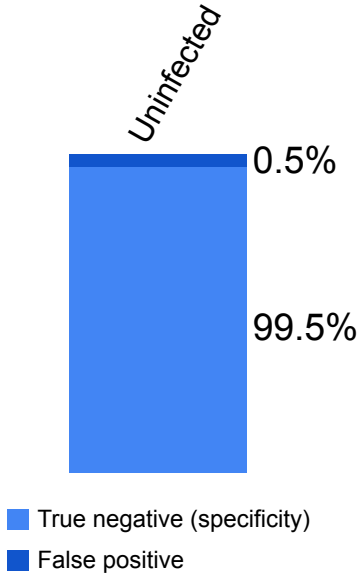
If the alternative is no testing, 90% sensitivity is much higher than the 0% from not testing at all.



Study	Criteria for being infectious	Sensitivity Reported (95% CI)
Krüger et al	Ct-values <30	93.5% (86.6%-97.0%)
Gremmels et al	Ct-values <32	95.2% (89.3%–98.5%) in Utrecht 98.0% (89.2%–99.95%) in Aruba
Akingba et al	Ct-values <30	>90%
Linares et al	Ct-values <30	88.9%

Another Concern about Rapid Tests

- *Rapid tests aren't specific enough. We'll have too many false positives.*
  Abbot Panbio is about 99.5% specific. 1 in 200 times an uninfected person will receive a positive test.



Study	Criteria for being infectious	Specificity Reported (95% CI)
Krüger et al	Ct-values <30	99.9% (99.4%-100%)
Gremmels et al	Ct-values <32	100% (99.7%–100%)
Akingba et al	Ct-values <30	99.02% (98.78%- 99.26%)
Batra et al	Ct-values <30	99.4%

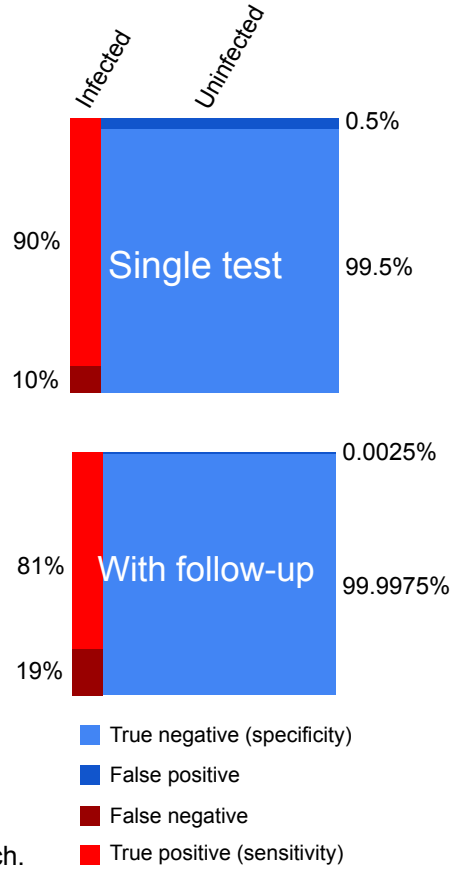
Rapid Antigen Test with a follow-up test for positives

A 0.5% false positive rate is relatively high - current prevalence in BC is ~0.1-0.2%.

Alternative protocol - all positives take a second rapid test. *Assuming the second test result is independent of the first**,

- Sensitivity drops from 90% to 81% (some true positives come back negative on the second test)
- Specificity rises to 99.9975% (1 in 40000 false positives)

If rapid testing is only done on people who would not have otherwise been tested, this protocol catches ~4 out of 5 infections that would have been missed otherwise.



*As far as we are aware, data on the independence of repeated tests is lacking, which warrants further research.

Example of Use 1: Identifying infectious cases among exposed individuals.

Currently in BC if there is a COVID exposure in a classroom or workplace, action is typically taken primarily with close contacts of the case (see for example BC's COVID-19 safe schools).

But COVID can be transmitted to other students in the room with lower but non-zero risk.

Is there a way to detect additional asymptomatic infectious individuals?

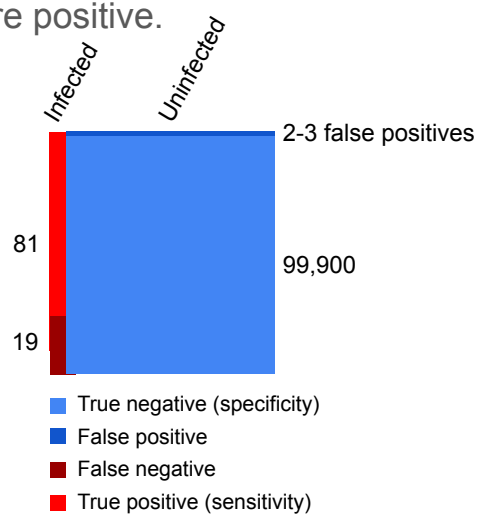
Suppose we use rapid antigen tests with all the students. If a test comes back positive, we do a second test to confirm, and then we only take action if both are positive. The same approach could be taken in workplaces.

What rate of true positives and false positives do we expect to see?

If prevalence is 1 in 1000 (e.g. large population, low prevalence area)

- Suppose 1 in 1000 are infectious (rough estimate of current background rate in BC).
- We test 100,000 people.
- 100 of them will be infectious, on average.
- We compare number of true positives, false negatives, and false positives for doing a single test, and for doing two tests and only considering the result positive if both are positive.

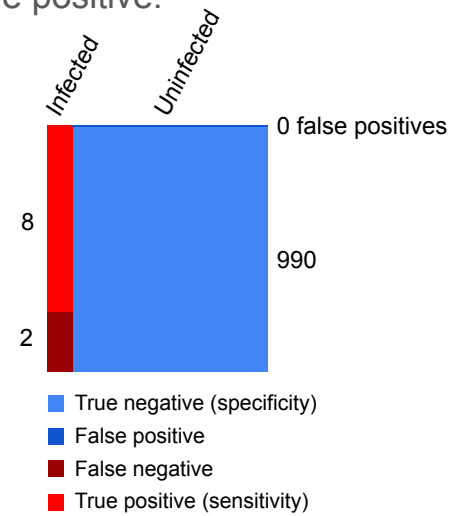
	No testing	Single test	Double test
Number of true positives detected	0	90 (90% of 100)	81 (81% of 100)
Number of false negatives (infections we missed)	100	10 (10% of 100)	19 (19% of 100)
Number of false positives	0	500 (0.5% of 99,900)	2 or 3 (0.0025% of 99,900)



If prevalence is 1 in 100 (e.g. a school or workplace with an outbreak)

- Suppose 1 in 100 are infectious.
- We test 1,000 people.
- 10 people will be infectious, on average.
- We compare the number of true positives, false negatives, and false positives for doing a single test, and for doing two tests and only considering the result positive if both are positive.

	No testing	Single test	Double test
Number of true positives detected	0	9 (90% of 10)	8 (81% of 10)
Number of false negatives (infections we missed)	10	1 (10% of 10)	2 (19% of 10)
Number of false positives	0	5 (0.5% of 990)	0 (0.0025% of 99,0)



Example of Use 2: One-off use for special occasions

Suppose I want my child to meet my elderly mother for her birthday. The visit is allowed under current COVID restrictions, and the risk is worth it for everyone involved. But can I reduce the small risk of COVID transmission even further?

Proposed use: Test child before event and cancel if test is positive. (Use just one test.)

Situation

Action	**Child infectious**	**Child not infectious**
Use rapid test	10% grandparent exposed (test gives false negative)	0.5% chance event cancelled needlessly
Don't use rapid test	100% grandparent exposed	0% chance event cancelled needlessly

For many, the substantial reduction in risk to the grandparent may be worth the cost and inconvenience of the test and the small risk of a false positive.

Uses of rapid antigen tests

- Supplemental testing of lower risk individuals in an outbreak setting (e.g. schools, workplace).
- Extra layer of protection in one-off circumstances (visiting grandparents).
    - Used among some social groups, academic conferences, religious gatherings, work environments with close and repeated contacts where masking isn't always possible (e.g., film industry).
- As a substitute for PCR testing
    - where PCR is not available (e.g. people have symptoms, but cannot access PCR testing because they do not have a car, or there's no testing site available),
    - to scale up testing (e.g., among travellers) without requiring more expensive and less available techniques.

Key messages

- Rapid tests can detect about 90% of infectious cases. They can detect cases among the asymptomatic and presymptomatic. To avoid compensatory risky behaviour among false negatives, best to use in populations who would not otherwise be changing their behaviour.
- False positives can be minimized by confirming a positive result with a second test, at the cost of reduced sensitivity.
- The number of true positives you get for every false positive is highest when the prevalence is highest.
- Whether a rapid testing is worthwhile depends on prevalence. For low enough prevalence, the high rate of false positives and the low rate of detected cases will reduce the usefulness of rapid tests.
- When worthwhile, rapid tests should be available and affordable. At present, costs in Canada pose an obstacle to equitable access to health information.