REOPENING THE ECONOMY

Avoiding re-explosion of COVID19

There are many practices we can do to reduce the spread of COVID19: handwashing, wearing masks, social distancing, etc. But, to succeed, in preventing explosive growth of disease as we reopen the economy, we need to add effective **TTT** (Test/Trace/Timeout). Effective TTT requires three things that are all rapid and scalable: **Testing** aggressively for the virus; **Tracing** the contacts with a chance of infection; and **``Timeout''**-ing these traced contacts through evidence-based public health interventions based on level of exposure (e.g., immediate self-quarantine vs. serial symptom check). This Test/Trace/Timeout is the conventional epidemiological approach, which is only as strong as the weakest link. Our goal is to support the contact tracing component of this strategy through empowering users to know whether they have been exposed and what to do in a privacy preserving manner that supports population health management at national scale. We envision TTT as the 'backbone' of a combined response strategy as suggested by the WHO.

ACHIEVING SUCCESS IN WASHINGTON STATE

As the chain is only as strong as the weakest link, it is important to pin down the key factors for success, along with estimates for WA state:

1. *How many tests do we need and how fast should they come back?*

For WA state, as of this time, a plausible estimate is 20K tests/day. It is critical that notifications need to be returned within 12 hours or faster, both to the positive individual and to the contact tracing teams.[1] Over 48 hours will substantially decrease any chance that overall suppression will be successful.

2. *How many tracers do we need and how effective do they need to be?*

In WA state, a team of about 3K active tracers should be sufficient to trace the contacts of new cases. For each new positive case, a team of 5 tracers, should quickly respond so that within 12-36 hours they find and contact all at risk individuals. Longer than 48 hours will substantially decrease any chance that overall suppression is successful. The size of this work force can be estimated using the approximate rule "5 contact tracers per new case per day". It is critical that the people doing contact tracing interviews be someone that the interviewed

[1] With tests under 6 hours, the impact of not self-isolating (if any is even suggested) is minor.

person can trust, so recruiting from community groups is highly desirable and has proved effective in the AIDS epidemic.

3. How effective should follow up "timeouts" for at-risk individuals be?

The team of tracers must also follow up with those at risk with evidence-based public health interventions based on level of exposure, e.g. immediate self-quarantine vs. serial symptom check. This means that appropriate economic support should be provided to those that need to self-quarantine. If more than 20% fail to follow the tracers suggestions, then this substantially decreases any chance of overall suppression.

4. How fast do we have to move?

Let's define the "trace time". Suppose we give a test to person A and start the clock. We send this test out, get the test results back, person A has tested positive, we mobilize a trace team, they talk to A, they find a list of exposed people, they contact people on this list and get a test out to them. We give them a test. We stop the clock when half of the at-risk individuals have been given a test. All of this is the "trace time". This process needs to move fast — any delays to check and confirm will likely lead to more deaths than it saves. A trace time beyond 3 days is approximately useless in controlling the epidemic while a trace time of 1 day is plausibly typically effective.

DIGITAL ASSISTANCE FOR MANUAL TRACERS AND AUTOMATED TRACING

Although the primary thrust in contract tracing necessarily involves hiring many people to do interviews and conduct followup, digital assistance can potentially support and enhance the primary thrust. On the personal side, the **CovidSafe** project is creating a smartphone app and system to assist manual contact tracers by with more complete and faster interviews (by reminding users of where they have been), by providing a direct channel for public health authorities to communicate with the right set of people, and by creating a system allowing anonymous contacts (such as fellow commuters) to be informed of possible contact.

We believe it is also possible to substantially assist a contact tracing effort by supporting the backend workflows of the contact tracing process.

Appendix: Estimation and Avoiding

The below provides reasonable means to obtain guiding estimates. Refinements are possible, as we obtain better models.

TESTING

In addition to protecting frontline workers, the goal of testing is try catch as many new positive cases as possible. The conservative upper bound on the number of true positives per day can be estimated at roughly 500 new positives per day (we show to derive this estimate shortly). Estimates from South Korea, suggest they need to conduct 40 tests in order to correctly detect one positive case, so multiplying 500 by the 40 tests/positive case (used in South Korea) we get 20K tests per day in order to catch a high enough fraction of new positive cases. We can estimate 500 new positives per day as follows: using a case fatality rate (CFR) of 2% (which is estimated from South Korea[2]) gives us a way to estimate the number of new cases/day based on the number of deaths/day (we multiply by 50). As there are currently about 10 deaths per day in WA state, this suggests that there are about 500 new cases per day in WA about 2-3 weeks ago. As this is a lagging estimate, it is plausible that by the time TTT is deployed only 10K tests may be necessary.

A plausible number of tests/day we need (to reopen the economy) is a factor of 2000 x number of deaths/day (this is likely a lagging estimate but pretty reasonable after the peak).

Other concerns:

- *How do we decide who gets tested? The test should be decided in a data-driven manner in order to maximize the chance of finding true positives. Separately, there should also be tests for frontline workers and to protect high risk groups. Note that routine repeated testing with a low probability of finding a positive can be done extra efficiently using pool testing techniques.*

[2] South Korea is thought to be a reasonable estimate due to that it is under control with no lockdown, so they are likely not to be missing many cases in their testing, else they would not be under control. It is plausive that Infection Fatality Rate in South Korea is closer to 1%.

TRACING

In order to succeed with testing, we need to ensure that we can find those at risk contacts sufficiently fast before they can (unknowingly) go on to infect others. Here, the size of this work force can be estimated using the approximate rule "5 contact tracers per new case per day". The reason for this is that 1 tracer needs to do an interview (as soon as possible), and then a team of 5 people should spend the next 12 hours to try and find all those at risk and discuss with them how to take appropriate steps. Using the 500 new cases/day in Washington state leads to about 3K active tracers/day being sufficient. It is possible this needs to be slightly larger as the tracers must also do follow up check-ins to make sure those quarantined are staying at home.

TIMEOUT

The exact form of intervention (a test, a series of tests, a test + isolation, etc...) should be determined by epidemiologists based on data. Whatever the interventions are, these should be strongly supported so contacts are motivated and able to isolate. Tests should obviously be free and as convenient as possible. Hotels could be converted into coronavirus contact isolation places. Some support from contact tracers for the many details of life interrupted by isolation would be great. Salary support for people undergoing isolation is highly desirable.

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