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TEST, TRACE, REPEAT

A Five-Point Strategy to Reopen with Confidence

by Peter Nicholson and Jeff Larsen

This document outlines a strategy for emerging from the COVID-19 lock-down in a way that permits most social and economic activities to resume without sacrificing health and safety. The proposed strategy is described here in conceptual terms but is complemented with an extensive set of annotated references that provide supporting evidence and contain links to detailed accounts that can inform implementation. The proposal is presented in a Nova Scotia context but would be equally applicable in any jurisdiction.

The context

The COVID-19 lock-down has been achieving its purpose. The curve has more than flattened. New infections and deaths have trended down, although to varying degrees across provinces. But the emotional and economic toll is trending in the opposite direction. Now that summer is upon us and various jurisdictions relax their restrictions, growing numbers will refuse to remain cooped up. The dilemma is that neither will the virus remain cooped up. Public health experts know that the threat of a second wave still exists, and is inevitable without an effective containment strategy.[1] So the question everyone is grappling with is how to continue to safely restart social and economic life in a way that ensures we don't find ourselves right back where we've just been.

Complicating the decision is a polarization of attitudes between (1) those who believe that advocates of extensive reopening value dollars more than lives, and (2) those who believe that the economic, and even the health costs of continued restrictions have not been given enough consideration in reopening plans. Certainly health must not be sacrificed in hopes of quicker economic recovery because unless most Nova Scotians are confident that it is safe to venture out, economic life will remain stunted. That is why good health is also good economics. The polarization of attitudes nevertheless persists due to an implicit assumption that there is an inescapable trade-off between safety, on the one hand, and more nearly normal activity on the other, making it impossible to devise an approach to COVID-19 that would allow more of both. The purpose of this document is to show that there is such an approach.

[1] A widely available and effective vaccine is almost certainly more than a year off despite encouraging progress. An attempt, alternatively, to achieve herd immunity (i.e. when a sufficient proportion of the population has been infected—and presumably immune—to stop the spread of the virus) would result in far more disease and death than would likely be acceptable whether on political, social or economic grounds.

Balancing safety and openness through better information

The key to having more safety and more activity is to have more *information*. During the first wave of the pandemic, when information and understanding were limited, it was prudent to impose blanket restrictions on non-essential activity on the assumption that it was equally likely that the virus could be anywhere. By now we have learned a great deal from experience at home and from around the world. With much more timely and comprehensive information about the modes of transmission of the virus, who is infectious, who are their recent contacts, and who is likely to be immune, we can become far more targeted in combatting COVID-19. By combining better information with substantially increased public health resources, we can avoid trading-off safety against more normal activity. We can end up with both better health and better economics while minimizing the risk of future waves of the virus. How?

A Five-Point information-based strategy to cope with COVID-19

Think of a forest fire as a metaphor for the pandemic. The strategy is to first bring the blaze under control; reduce it to a smolder; then focus on spotting and snuffing out the sparks the moment they appear. The objective is to supress the virus and prevent a second wave while permitting the greatest feasible return to normal life. This approach has been described in different terms as "Hammer and Dance" and "Whac-a-Mole", the latter by analogy with the arcade game.[2] (For ease of reference we will refer to the strategy as "WaM.") There are five core elements.

1. ***Drive the Incidence of New Infections to Zero***: The first requirement is to maintain tight restrictions until the daily number of new cases has been reduced to zero, or close to it, for at least two weeks—e.g. as Manitoba, Nova Scotia, Newfoundland and Labrador, New Brunswick, and PEI already achieved.[3] This is an essential pre-condition for everything else. Although the virus may still be present, the potential number of new cases would then be small enough to make identification and contact-tracing manageable, thus minimizing the risk of a second wave and lock-down.
2. ***Mobilize and Enhance Public Health Resources:*** The strategy required for a safe reopening is very different from the blunt instrument of lock-down that was needed to suppress the initial epidemic. Public health resources—human, material and technological—urgently need to be beefed-up so as to keep the virus bottled up in the face resumed social and economic activity. The more effective the public health measures, the more complete can be the return to normal life. Public health capacity is therefore the linchpin of the reopening strategy. Whatever additional investment is needed is justified by the payoff (see point 5 below).
3. ***Sustain the Good Practices We Have Already Learned:*** Experience has shown that certain situations greatly increase the risk of transmission of the virus—for example, indoor

[2] See annotated references at the end of the document.
[3] Saskatchewan has also maintained low incidence of infection despite some flare-ups. New Brunswick, after eliminating new infections, has experienced a cluster of cases originating from outside the province.

gatherings of large numbers of people in close proximity with poor ventilation, talking loudly or singing. These and similar situations need to be prohibited unless there can be assurance that the risk is negligible. The limited number of prohibitions need to be complemented with more general risk-reduction practices—physical distancing where practical; mask-wearing in many public situations; rigorous hygiene.

4. ***Test and Trace and Keep Doing It*:** Implement repeated testing of those who work in high-risk environments—particularly long-term care and other health facilities, homeless shelters, prisons, and certain other situations where people are forced to work in close contact. These regular testing procedures need to be complemented with proactive testing of the general population but targeted more intensively in areas and situations determined to be of greater risk. Such determination would be based on continuous up-to-the-moment information on infection within the province as well as in areas from which visitors originate.[4] Testing must be followed up immediately by tracing the contacts of anyone who tests positive and then ensuring that those who are infected remain isolated for at least two weeks. Provision for alternative residence will need to be made in situations where isolation is not possible in the individual's normal location such as in shelters for homeless persons.
5. ***Create a "WaM Unit" to Organize and Direct the Strategy*:** The foregoing activities need to be conducted on the equivalent of a *war footing* in light of what is at stake in terms of lives saved, overall health, and social and economic well-being. To take just one example: if safe reopening were to reduce the otherwise anticipated economic loss by even three percentage points of GDP, COVID's toll on the Nova Scotia economy would be reduced by $1.4 billion over the next 12 months.[5] The achievement of such savings—including the social and psychological well-being that would result—requires a full-time group to manage execution of the strategy. A diversity of skills will be needed including: epidemiology, testing, contact tracing, infection control, data management and analysis, procurement and logistics, business economics, public communications, and an "intelligence group" to keep fully abreast of the latest research and practice worldwide. Many of the skills would be seconded from within government (provincial and possibly federal and municipal) but others will likely require secondment from the private sector, universities and retirees (e.g., nurses and doctors) for the period during which the WaM Unit remains on a "war footing."

Focus where the risks are concentrated

A defining feature of the WaM strategy is the application of what has already been learned in order to narrow the focus to the areas of significant risk. For example, about 80% of COVID-19

[4] The Public Health Agency of Canada has recommended a target of at least 60,000 tests per day nationwide which would translate to 1,600 per day in Nova Scotia. The federal government is working toward ensuring a peak national daily capacity of 200,000 tests (5,200 in NS). The WaM strategy might possibly require an even larger peak number. For context, NS conducted more than 1,200 daily tests in mid-April and in the range of roughly 300-600 per day since early May. About 2.5% of tests have been positive for the virus. (See chart at the end of the References.)

[5] The economic loss in Canada due to COVID restrictions has been variously estimated as likely between 6% and 12% of GDP in 2020, with the higher end of the range occurring if there is a significant second wave. Any mitigating measures would obviously have an enormous economic payoff.

deaths in Canada have been in long-term care facilities and in Nova Scotia about 90% have occurred in a single facility. Nowhere is there greater need for rigorous infection control and vigilance. Risk of infection is also high in hospitals; in those workplaces where large numbers are forced in close proximity such as in food processing plants; and in the families and other regular contacts of such workers. Sadly, COVID-19 has magnified with unprecedented clarity the cracks in Canada's health and social systems. These conditions have led to wildfire spread in some long-term care facilities and disproportionate rates of infection among those in the poorest and often racialized neighbourhoods. With increasing information about where infections are likely to surface, we need to act urgently to put adequate protection in place. This must be done with care and sensitivity so as not to stigmatize those communities that are the most vulnerable.

Fortunately, we now know from experience how to greatly reduce the risk of transmission in high risk institutional settings—i.e. distancing, masking, hygiene, infection control practices, daily monitoring for even the mildest symptoms, frequent testing. These practices require disciplined behavioural change but they have been implemented successfully in many situations in Canada and the US. Fortunately, managers have a powerful incentive. In the wake of several high-profile outbreaks businesses now realize they must establish workplace conditions that minimize the risk of infection in order to make employees feel confident in showing up for work, to avoid the possibility of shutdown, and to earn the public trust needed for successful reopening.[6]

Beyond institutional settings, the riskiest public encounters appear to be large gatherings where people are voluntarily in close quarters, usually indoors, for an extended period and talk loudly, sing, or cheer. These are activities that have been found to spread the virus even if infected people are not coughing and sneezing but simply "vocalizing" energetically. Such situations obviously include things like many sporting events, conventions, choir practices, and bars. These are situations that have given rise to "super spreader" events that resulted in large clusters of cases that some estimates suggest have been the ultimate source of 80% of all COVID-19 infections. Such activities will need continued restriction, the extent of which would depend on the circumstances. As information accumulates from experience worldwide, we are steadily refining our understanding of where the risk of transmission is greatest and can therefore focus testing and restrictions much more efficiently so as to allow a much broader range of normal activities to resume. [7]

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[6] Some larger business are using company-assigned phones, ID badges, computers and wearables, as well as sensors and cameras with computer vision, to monitor social distancing and for contact tracing. Some long-term care facilities in NS have begun to use these social distance monitoring and contact tracing technologies with success.

[7] Surprisingly, travel on crowded planes does not appear to have caused any significant super spreader events, perhaps because of the way airflow is controlled within the cabin together with the fact that most passengers keep pretty quiet, facing only the seat in front. Movie theatres—where patrons are usually quiet and facing forward—may also be less risky than one might have thought. Outdoor activity also appears, in most cases, to pose relatively low risk.

Extensive testing is the key

The WaM strategy requires much greater testing than has been undertaken so far. Testing must not only be available to all who request it but also administered *proactively*, guided by an assessment of relative risk. Tests are of two distinct types, each with a different purpose: (1) tests for the presence of an active infection ("viral" tests), and (2) tests that determine whether a person has been infected in the past and is likely to be immune for some period ("antibody" tests administered on a small blood sample). The latter are important to determine the demographic and spatial pattern of past infection; the distribution of disease severity; and progress toward (potential) immunity of the population. No test is perfect so there will always be risk of false negatives and false positives depending on the test itself and on the prevalence of the condition within the tested population. For example, the presently available antibody tests are not generally considered to be reliable enough to provide high assurance to an *individual* that a positive result guarantees prior exposure to the virus. The tests might nevertheless provide valuable information on patterns at the population level.

In addition to the standard RT-PCR viral test—which is highly accurate under ideal conditions but which requires a lab environment and usually takes at least 24 hours after administration to deliver a result—we need viral diagnostic tests that deliver results in real time at the local point of administration, ideally within about 15 minutes. For example, that would greatly facilitate regular screening of employees in high-risk environments.

One test that produces a result in under 15 minutes has been developed by Abbott Laboratories and several other rapid tests are in various stages of approval and roll-out. Initial evaluation suggests that accuracy needs to be improved to minimize particularly the likelihood of false negatives. Nevertheless, the new rapid testing technology is already an important advance in providing an alternative where it is impractical to wait for a result that takes hours to days, and also to provide widely distributed testing capacity that can be easily administered.[8] The challenge will be to acquire enough rapid test kits to meet the need. Because global demand will be intense, orders need to be placed immediately and new domestic supply urgently created.

Testing and Border Control

The central conundrum in a reopening strategy is how to implement *border control* to minimize the risk of importing infection via the limited number of entry points to Nova Scotia. The present two-week quarantine for almost all entrants is not a sustainable solution and, among other things, would decimate the province's tourism industry. Instead, the WaM strategy could require

[8] In the case of the Abbott test (ID NOW), the company claims that false negatives are likely due to a failure to correctly follow the test's protocol. This would be consistent with at least some early operational experience—for example, in Detroit where the ID NOW system is being used to test the entire municipal workforce of 8,000 (see Reference 35). In any event, the reliable administration of diagnostic tests depends on training procedures. This is a practical challenge when quickly rolling out very large numbers of tests. There are also logistical issues related to personnel to administer the tests and to ensure the proper recording and communication of results.

entrants to the province (other than those from a province that may be deemed to be within Nova Scotia's "bubble") to be screened and tested according to a risk-based protocol the details of which would be developed as part of the implementation procedure.[9] For example; visitors might be given an RT-PCR swab test on entry. This can be administered very quickly and can yield a result in about 24 hours. If negative, the visitor could be *retested* 2-3 days later via a rapid "point of care" test wherever they happened to be located. A second negative would increase the confidence that the individual was not infectious.[10]

Efficient and effective contact tracing is essential

Once an infected individual is identified, their recent significant contacts need to be identified and tested. Contact tracing and associated case management is labour intensive and psychologically demanding detective work yet it is essential that infected contacts be identified as quickly as possible. Typically, contact tracers are health professionals—often nurses with public health backgrounds. Nova Scotia does not currently have nearly enough to implement the WaM strategy. Hiring and training new tracers should of course not be constrained by budgetary considerations. The binding constraint would be availability of human resources, although there is a reserve of retired health professionals from which the appropriate skills could potentially be drawn as needed.[11]

Digital contact tracing technology, if employed appropriately, can potentially be of significant help. There are now dozens of apps that facilitate contact tracing, as well as "symptomatic surveillance" via mobile phones. It would be most efficient if there were one standard adopted Canada-wide. Based on experience in Alberta and in several countries, the main challenge is to achieve a sufficiently high usage rate of an app—probably over half the population—to make it an effective tracing tool.[12] Among candidates, Apple and Google are now rolling out a collaboratively-developed app that notifies a user if he or she has been in close proximity to another user who has tested positive for COVID-19. This information is not shared with public

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[9] Such screening might be accompanied by temperature testing and questionnaires but neither are a substitute for a viral test, although they could contribute to an infection risk profile. It will be important to pay close attention to the experience of other jurisdictions—e.g. Germany and Iceland—that are relaxing border restrictions, and to collaborate with other Provinces to develop common approaches to screening entrants both inter-provincially and internationally.

[10] A person usually becomes significantly infectious one to two days before the onset of symptoms and for roughly a week or so thereafter. Many cases present only very mild symptoms or none at all, yet are believed to spread the virus, although less readily than those who go on to develop significant symptoms. Testing for the virus early in the infection can yield a (false) negative result because the amount of virus present may fall below the threshold of detection. A negative test should be repeated dependent on an assessment of risk—e.g., development of any symptom of COVID-19; in the case of selected visitors; or in any circumstances that suggest elevated risk.

[11] A plan developed at Johns Hopkins University estimated that the US would need 100,000 contact tracers. By extrapolation, Canada would need about 11,400 and NS roughly 300. Since WaM is designed to keep the incidence of new infection very low, experience might show that Nova Scotia needed many fewer tracers. But the more contact tracers one has, the quicker the contacts of an infected person can be cleared or isolated.

[12] To achieve sufficiently high usage levels, a tracing app might be designed on an "opt-out" basis and automatically loaded on phones. A user could still delete the app but would require a proactive decision to do so. Other "nudges", including small financial incentives and social persuasion, should also be considered.

health authorities to assure user privacy in the belief that this will increase up-take. A Canadian application—dubbed COVID Shield—has recently been developed by volunteers from Shopify using the Apple-Google interface and may be united with another Canadian symptomatic surveillance app, Thrive Health, to provide better tracking of infection hot spots while preserving personal privacy.[13]

We would emphasize, nevertheless, that experience with tracing technology using mobile apps has shown that technology cannot begin to substitute for keeping trained humans in the loop. Public health procedures and expertise cannot simply be delegated to technologies.

Mobilizing resources on a "war footing" to reopen with confidence

We know that we will be living with COVID-19 for much longer than we can tolerate remaining heavily restricted. At the same time, we need to have confidence that the virus will remain securely bottled up. Otherwise people will not resume activities in sufficient numbers to sustain the viability of those businesses and social gatherings that rely on physical presence. After all, most stores and restaurants and many other businesses cannot survive with some fraction of the number of customers for which their business plans were designed. So it is not enough simply to "reopen." We need to reopen with confidence that the risk from venturing out is very, very small. The WaM strategy is designed to achieve precisely that. The public will nevertheless need to be assured, and this creates a significant communications challenge. Having convinced people of the need for lock-down owing to the serious danger from COVID-19, it will not be easy to now convince people that WaM largely eliminates that danger. In other words, it is a lot easier to scare people than it is to "unscare" them. That is why the "WaM Unit" that is proposed to oversee the strategy will need to include top-notch public communications talent.

The WaM strategy is organizationally demanding—much more so than a lock-down. That is why a dedicated, *full-time* WaM Unit is essential. The challenge of co-ordination within and among governments and private sector actors requires a mobilization of effort that can only be compared with wartime. In fact, the feature that distinguishes WaM from more conventional approaches to reopening is the sheer scale of testing and tracing and their information-based targeting. Thus far, the mobilization of testing and tracing, and the information systems to guide them, has fallen well short of what is needed to combine more safety with more nearly normal activity. Much greater ambition is called for because the payoff from being able to restart as much normal life as possible, as quickly as possible but with minimal risk, is worth whatever the cost and effort.

[13] New Zealand is using a location-based app supplemented with QR codes in high-traffic areas, including businesses, public events, entertainment venues, restaurants and bars. Users choose, or are sometimes required, to scan their location, much like a ticket scan going to a concert.

WaM delivers more safety, better health and better economics

It may appear that the strategy outlined here could not create a path to reopening that is actually *safer* than more cautious and gradual approaches. But the fact is that public frustration with a more limited pace and extent of reopening could lead to growing non-compliance, degenerating into a disorderly departure from the intended course, thus increasing the risk of transmission. There are already signs that this is what is what is happening in some parts of the US. There is also compelling evidence of the adverse health impacts associated with the restrictions that formerly needed to be imposed. The more that restrictions can be relaxed, without increasing the risk of an uncontrolled new outbreak, the greater the net *health* benefit. Implementing WaM would furthermore be failsafe in the sense that the option of re-imposing more general restrictions always remains if that were necessary—for example, if a second wave in the fall became uncontrollable. The WaM strategy does not foreclose other options but makes it much less likely they will be needed.

Implementing WaM requires both discipline and a resolve to stay the course when new cases inevitably arise—for example, as New Brunswick recently experienced despite an appearance that the virus had been thoroughly suppressed. The purpose of WaM is to deal with such circumstances *without* having to resort to widespread lock-down. That is why WaM emphasizes extensive testing to identify cases quickly and contact tracing to immediately ring-fence the spread. The measure of success is that sparks do not become fires.

Still, no strategy can be without risk and the public must be led to understand and accept that uncomfortable reality. Here is where effective public communications can deliver enormous dividends because, without widespread public confidence, economic recovery will be crippled.

The WaM approach needs to be evaluated against the alternatives. More restrictive approaches are unsustainable socially and economically and would eventually be undermined by non-compliant behaviour. Less restrictive approaches, on the other hand, will not inspire the widespread public confidence needed for economic recovery and will lead eventually to a major new outbreak. WaM strikes the best balance.

Conclusion

The pandemic has taught the world the essential importance of an excellent public health infrastructure. Post-pandemic, it will confer a new competitive advantage in attracting investment and new residents. With a total commitment to testing and tracing, Nova Scotia can implement a reopening strategy—WaM—that would earn the province a reputation as one of the leaders in the global effort to defeat COVID-19, and therefore make Nova Scotia even better positioned for the future than before the virus struck.

ANNOTATED REFERENCES

The following references—which comprise only a tiny fraction of the enormous and exponentially expanding literature on COVID-19—are an integral part of the main text They provide the principal evidence base (as at June 11) to support the proposal. The extensive excerpts fill in detail that enriches the story and in many cases provides sufficient detail to support policy design. The text associated with each reference is a verbatim (or very slightly edited) extract intended to capture the item's most relevant aspects. The order of the references corresponds roughly to the flow of the covering document.

A. ECONOMIC CONSIDERATIONS RELEVANT TO REOPENING

1. OECD Chief Economist: After the lockdown, a tightrope walk toward recovery

https://www.oecd-ilibrary.org/sites/0d1d1e2e-en/index.html?itemId=/content/publication/0d1d1e2e-en

June 10: As long as no vaccine or treatment is widely available, policymakers around the world will continue to walk on a tightrope**.** Physical distancing and testing, tracking, tracing and isolating (TTTI) will be the main instruments to fight the spread of the virus. TTTI is indispensable for economic and social activities to resume. But those sectors affected by border closures and those requiring close personal contact, such as tourism, travel, entertainment, restaurants and accommodation will not resume as before. TTTI may not even be enough to prevent a second outbreak of the virus…This Economic Outlook presents two possible scenarios: one where the virus continues to recede and remains under control, and one where a second wave of rapid contagion erupts later in 2020. These scenarios…help frame the field of possibilities. Both scenarios are sobering, as economic activity cannot return to normal under these circumstances. By the end of 2021, the loss of income exceeds that of any previous recession over the last 100 years outside wartime …Economies are diverging, depending on when and to what extent they were hit by the virus, the preparedness of their healthcare system, their sectoral specialisation and their fiscal capacity to address the shock. Everywhere, the lockdown has exacerbated inequality, with those able to telework generally highly qualified, while the least qualified and youth are often on the front line, unable to work or laid off, with the effects further compounded by unequal access to social protection. Private debt levels are uncomfortably high, and business failure and bankruptcy risks loom large…*Extraordinary policies will be required to walk the tightrope towards recovery.* Governments can provide the safety nets that allow people and firms to adjust, but cannot uphold private sector activity, employment and wages for a prolonged period. Capital and workers from impaired sectors and businesses will have to move towards expanding ones…We have previously called for a rise in public investment in digital and green

technologies to promote long-term sustainable growth and lift demand in the short term. This is even more urgent today with economies having been hit so hard…*Today's recovery policies will shape economic and social prospects in the coming decade.* Ultra-accommodative monetary policies and higher public debt are necessary and will be accepted as long as economic activity and inflation are depressed, and unemployment is high. …*The recovery will not gain steam without more confidence, which will not fully recover without global cooperation….Governments must seize this opportunity to engineer a fairer and more sustainable economy,* making competition and regulation smarter, modernising government taxes, spending, and social protection.

2. **A book-length assessment of the economic impact of COVID-19 and policies to cope**

   https://www.joshuagans.com/economics-in-the-age-of-covid19

   Economics in the Age of COVID-19: A guide to the pandemic economy March 2020: In this book, economist Joshua Gans (Univ. of Toronto) steps back from the short-term chaos to take a clear and systematic look at how economic choices are being made in response to COVID-19. He shows that containing the virus and pausing the economy…are the necessary first steps. Gans outlines the phases of the pandemic economy, from containment to reset to recovery and enhancement. Warning against thinking in terms of a "trade-off" between public health and economic health, Gans explains that containment gives us the opportunity to develop effective testing that will make it safe for people to interact. Once the virus is contained, we will need to pivot toward innovating, and, finally, we will come together to plan how to protect ourselves from future pandemics. Better information is the key. He looks at policy tools that might aid an economic recovery…Gans lays out the economic choices accessibly but with urgency, leaving politics out of it. An open access version of *Economics in the Age of COVID-19* for community commentary is available at https://economics-in-the-age-of-covid-19.pubpub.org/

3. **Lessons for the economy from the 1918 flu pandemic**

   https://ssrn.com/abstract=3561560

   Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu April 10, 2020: (Article Abstract): What are the economic consequences of an influenza pandemic and what are the economic costs and benefits of non-pharmaceutical interventions (NPI)? Using geographic variation in mortality during the 1918 Flu Pandemic in the U.S., we find that more exposed areas experience a sharp and persistent decline in economic activity. The downturn is driven by both supply and demand-side channels. Further, building on findings from the epidemiology literature establishing that NPIs decrease influenza mortality, we use variation in the timing and intensity of NPIs

across U.S. cities to study their economic effects. We find that cities that intervened earlier and more aggressively do not perform worse and, if anything, grow faster after the pandemic is over. Our findings thus indicate that NPIs not only lower mortality; they may also mitigate the adverse economic consequences of a pandemic.

4. **The geographical dispersion of COVID-19 incidence poses an economic dilemma**

   https://www.nytimes.com/interactive/2020/06/06/business/economy/high-unemployment-few-coronavirus-cases.html

   June 6: The coronavirus has brought much of the economy to a grinding halt…[but] in many parts of the country the dual health and economic calamities are not playing out in parallel. A New York Times analysis of coronavirus infections, official layoff notices and federal unemployment data highlights the sharp disconnect between extreme economic pain and limited health impact from the pandemic in many parts of the country… Some business owners and workers have embraced reopening as urgently overdue because of their firsthand experiences. Others plead for caution. But most agree the virus has not posed the local public health threat that so many were expecting — even while acknowledging that things could get worse. The Times focused the analysis on 726 counties in 45 states that fall within the lower half of infection rates nationwide. Those counties have had fewer than 140 cases of coronavirus per 100,000 residents and unemployment rates over 12 percent in April, the latest month for which official county data is available. (By contrast, New York City has had 2,483 cases per 100,000 residents.)

B. ORIGINS OF THE "WaM" STRATEGY

5. **"Hammer & Dance" as a reopening strategy** (Tom Pueyo)
   https://medium.com/@tomaspueyo/coronavirus-the-hammer-and-the-dance-be9337092b56 March 29: "During the Hammer, the goal is to get R as close to zero, as fast as possible, to quench the epidemic….If you hammer the coronavirus, within a few weeks you've controlled it and you're in much better shape to address it. Now comes the longer-term effort—the Dance—to keep this virus contained until there's a vaccine. This is probably the single biggest, most important mistake people make when thinking about this stage: they think it will keep them home for months. This is not the case at all. In fact, it is likely that our lives will go back to close to normal.

- If people are massively tested, they can be identified even before they have symptoms. Quarantined, they can't spread anything.

- If people are trained to identify their symptoms earlier, they reduce the number of days in blue, and hence their overall contagiousness
- If people are isolated as soon as they have symptoms, the contagions from the orange phase disappear.
- If people are educated about personal distance, mask-wearing, washing hands or disinfecting spaces, they spread less virus throughout the entire period.

  Only when all these fail do we need heavier social distancing measures."

6. **Informal proposal to implement "Hammer & Dance" in New Brunswick** https://huddle.today/new-brunswicks-re-opening-plan-a-draft-framework/ April 16: In this previous article, we asked, "Is New Brunswick Ready For "The Dance?" We highlighted the importance of developing a plan to help businesses prepare and we raised several key questions. Now we want to put forward a draft framework of what that plan could look like. This is a hypothetical scenario — to get us thinking. What would you change? [*Follow link to this paper to see details for a sustainable re-opening strategy*] **New Brunswick cluster challenges ability to identify cases and trace contacts (CTV News)** May 29: The Campbellton NB cluster of COVID cases was triggered when a doctor in the area travelled to Quebec and failed to self-isolate upon return. At least 100 staff and patients were exposed during the two weeks before it was confirmed he had COVID-19. … Two new cases on Friday brings the number of active cases to eight… "Public health has a rapid response team," Premier Higgs said. "We're using rapid test kits to give a response *within 45 minutes*."… "It is vital that if you are contacted you must be truthful with public health, and you must follow their directions to the letter," Dr. Russell, NB's Chief Medical Officer said….The cluster has led to the rollback of reopening measures in the northern region known as Zone 5, and a one-week delay in relaxing restrictions in the rest of the province….Dr. Russell said she understands the frustration, but it's too risky to proceed at this time... "This is a really big investigation that we're conducting, there are many contacts to trace," Dr. Russell said. "Some of those contacts are outside of Zone 5, so it would really not make sense to put others at risk, when we know that there's more contact tracing to be done and there are more cases that we expect to find."

7. **"Whac-a-Mole" as a reopening strategy** (Ed Yong in The Atlantic) https://www.theatlantic.com/health/archive/2020/04/pandemic-summer-coronavirus-reopening-back-normal/609940/ "As I wrote last month, the only viable endgame is to play whack-a-mole with the coronavirus, suppressing it until a vaccine can be produced. With luck, that will take 18 to 24 months." https://www.theatlantic.com/health/archive/2020/03/how-will-coronavirus-end/608719/

"Even a perfect response won't end the pandemic. As long as the virus persists *somewhere*, there's a chance that one infected traveler will reignite fresh sparks … The third scenario is that the world plays a protracted game of *whack-a-mole* with the virus, stamping out outbreaks here and there until a vaccine can be produced. This is the best option, but also the longest and most complicated."

C. A SAMPLE OF PROPOSALS ON HOW TO EMERGE FROM LOCKDOWN

8. **OECD Briefing: Testing for COVID-19: A way to lift confinement restrictions**
https://www.oecd.org/coronavirus/policy-responses/testing-for-covid-19-a-way-to-lift-confinement-restrictions-89756248/
This policy brief discusses the role of testing for COVID-19 as part of any plan to lift confinement restrictions. If all confinement restrictions are lifted without other measures to suppress new infections, the infection rate is expected to rebound rapidly. Crucially, quick suppression of infections requires testing more people to identify who is infected; tracking them to make sure they do not spread the disease further; and tracing with whom they have been in contact. This brief discusses how testing strategies can be used to achieve three main goals: 1) suppressing the resurgence of local outbreaks; 2) identifying people who have developed some form of immunity and can safely return to work; and 3) gaining intelligence on the evolution of the epidemic, including on when a threshold for herd immunity has been reached. The brief discusses what tests can be used for each goal, as well as practical implementation issues with testing strategies, including the opportunities and risks of using digital tools in this context.

9. **The Economist magazine observations on Lifting the Lockdown**
https://www.economist.com/leaders/2020/05/23/lifting-lockdowns-the-when-why-and-how May 21: As they seek to put lockdowns behind them, governments are not thinking hard enough about the costs and benefits of what comes next…To limit the risk requires an epidemiological approach that focuses on the places and people most likely to spread the disease. An example is care homes, which in Canada have seen 80% of all the country's deaths. In Sweden refugees turn out to be high-risk, perhaps because several generations may be packed into a household. So are security guards, who are often elderly and are exposed to many people in their work…. you need data from tests to provide a fine-grained picture of how the disease spreads. Armed with data, governments can continuously refine their policies ….The emergency phase of the pandemic is drawing to a close….Governments must identify groups at risk; devise and enact policies for them; explain these so that vulnerable people change their behaviour without becoming scapegoats…

10. **A road map for reopening (American Enterprise Institute)**

https://www.aei.org/research-products/report/national-coronavirus-response-a-road-map-to-reopening/ March 29: This report provides a road map for navigating through the current COVID-19 pandemic in the United States. It outlines specific directions for adapting our public-health strategy and are able to transition to new tools and approaches to prevent further spread of the disease…Our stepwise approach depends on our ability to aggregate and analyze data in real time….

11. **A road map for reopening (Bloomberg Center for Health Security at JHU)** https://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2020/200410-national-plan-to-contact-tracing.pdf April 10: To manage COVID-19 epidemics going forward, communities in the United States need: (1) ready access to rapid diagnostic tests for all symptomatic cases or those with a reasonable suspicion of COVID-19 exposure; (2) widespread serological testing to understand underlying rates of infection and identify those who have developed immunity and could potentially return to work or school without fear of becoming infected; and (3) the ability to trace all contacts of reported cases. In order to trace all contacts, safely isolate the sick, and quarantine those exposed, we estimate that our public health workforce needs to add approximately 100,000 (paid or volunteer) contact tracers to assist with this large-scale effort. This workforce could be strategically deployed to areas of greatest need. To do this, we also estimate that Congress will need to appropriate approximately $3.6 billion in emergency funding to state and territorial health departments. (Prorated to NS this would be about $10-12 M.)

12. A COVID-19 surveillance plan (Duke-Margolis Center for Health Policy)

https://jamanetwork.com/channels/health-forum/fullarticle/2765273 April 24: Building a COVID-19 surveillance system is crucial for containing transmission of the virus now and preparing for future waves of the infection, according to a new report issued by the Duke-Margolis Center for Health Policy… Every region of the country should aim for… a test-and-trace infrastructure, real-time syndromic surveillance, serologic testing for markers of infection, and rapid response in the form of isolation, contact tracing, and quarantine…. To enable early identification of small outbreaks, an important component of the test-and-trace infrastructure would be a regional sentinel surveillance system that would routinely monitor sample populations, particularly vulnerable populations or those in congregate settings…Systems established over the past decade allow for real-time monitoring of a sample of emergency department visits for influenza-like illness and other syndromes of interest…early experiences with COVID-19 suggest that building on such systems can provide indicators of COVID-19 trends.

D. SOME EXAMPLES OF NATIONAL REOPENING STRATEGIES

13. **New Zealand has successfully implemented a version of "WaM"**
https://www.washingtonpost.com/world/asia_pacific/new-zealand-edges-back-to-normal-after-routing-coronavirus-in-49-days/2020/05/15/c8f43f46-950e-11ea-87a3-22d324235636_story.html May 16**:** New Zealand had been in almost complete lockdown for 46 days, a step the government mandated when the country had only 100 coronavirus cases but modeling showed it was on a trajectory similar to Italy's. ….Health officials had prepared four options, ranging from extending the lockdown to reopening at various speeds. Prime Minister Ardern favored a middle option of a staggered reopening. Although some prominent epidemiologists had urged another week of restrictions, New Zealanders were getting antsy. And then there was the economy. "Our overarching concern was health," said Tracey Martin, the minister of internal affairs. "If health [officials] had come in and said we didn't have the systems in place, we wouldn't have moved."… "The problem with the staggered response was the potential for the message to be very confused, so simplicity and common-sense language was required….In that context, any staggering needed to be seriously limited." They decided to allow restaurants and movie theaters, gyms and shopping malls to reopen starting Thursday, but with strict social distancing. Schools will resume Monday…. While New Zealand was battened down, testing was rapidly stepped up. Following the example of places like Taiwan and South Korea, health authorities assembled the hardware and the workforce needed to conduct and process exponentially more tests. When life returned to something recognizable as almost normal Thursday, every business — from coffee shops to hair salons — began requiring customers to scan a code and register their details, or sign in with old-fashioned pen and paper….The government had considered asking New Zealanders to use a tracing app like Singapore's, but having seen the low take-up rate in Australia, it appears to have backed away from the idea. Instead, it is relying on people remembering whom they've seen and clipboards at doorways. …Health authorities are already tracing and isolating 80 percent of close contacts of infected people within 48 hours. The assumption is that, with the virus close to eliminated here, any cases from now on will be relatively easy to trace.

14. **Iceland provides lessons for smaller jurisdictions**
https://www.cbc.ca/news/canada/north/iceland-covid-19-success-1.5554605 May 4: Now, as summer approaches, residents hope life is getting back to some kind of normal. High schools, hair salons, dentists and other businesses across Iceland are reopening May 4 after six weeks of lockdown. Iceland (pop 364,000) has confirmed 1,800 cases of the virus, but just 10 people have died. The number of new COVID-19 cases each day has fallen from 106 at the peak of the outbreak to single digits. Iceland's success…reflects decisive action by authorities, who used a rigorous policy of testing and tracking to find and isolate infected people, even when they had no symptoms. That has helped Iceland weather the pandemic without resorting to the near-total social and economic shutdowns

enforced in many other European countries… Iceland may be remote, but it is far from isolated. Icelanders are enthusiastic travelers. …Iceland quarantined everyone returning from virus hotspots and began test-and-trace measures to locate and isolate every case…Over six weeks, Iceland managed to test almost 50,000 people, more than 13 per cent of the population. [On a comparable basis, NS would need to test an average of about 3,200 per day] The Icelandic biotech company deCODE used its facilities to test a cross-section of the population, and identified scores of new cases, including people with mild or no symptoms. Kari Stefansson, deCODE's CEO, said the approach showed that "with the use of modern science, even an epidemic like this one can be contained." …In a random sample of 848 children under the age of 10 none of them tested positive, which guided Icelandic authorities' decision to keep schools open for children under 16…Alongside the testing, civil defence authorities set up a Contact Tracing Team, including police officers and university students,…. A mobile phone tracing app was up and running a few weeks later…Starting May 4, gatherings of up to 50 will be permitted, high schools and colleges can resume classes and all businesses except bars, gyms and swimming pools can reopen. The entire country, however, must self-isolate from the rest of the world for the time being. Everyone arriving from abroad faces a 14-day quarantine. That means a bleak economic outlook for a country that depends on tourism. https://www.schengenvisainfo.com/news/iceland-to-offer-covid-19-tests-to-airport-passengers/ May 18: Iceland plans to offer Coronavirus tests to arriving travellers as a way to avoid the two weeks mandatory quarantine. The tests will be offered to travellers landing at the Keflavik airport. Travellers are to be given a choice between a 14-days quarantine or being tested for the virus upon arrival, or otherwise proving that they are free of coronavirus infection. All persons arriving at Iceland's airport who provide a medical document proving they are not infected with Coronavirus will not need to take tests…travellers would be required to use an official tracing app that is already in use by 40 per cent of people in Iceland….Iceland has estimated that it has successfully managed the Coronavirus situation…with only three confirmed cases (so far) during May.

15. **Lessons from Australia's strategy to manage COVID-19 after initial containment** https://www.medrxiv.org/content/10.1101/2020.04.19.20071217v1 April 23: Following successful implementation of strong containment measures by the community, Australia is [late April] close to the point of eliminating detectable community transmission of COVID-19. We aimed to develop an efficient, rapid and scalable surveillance strategy for detecting all remaining COVID-19 community transmission through exhaustive identification of every active transmission chain. We also identified measures to enable early detection and effective management of any reintroduction of transmission once containment measures are lifted to ensure strong containment measures do not need to be reinstated…The most important factor in determining the performance of such a

surveillance system is community participation in screening and follow up, and as such, appropriate community engagement, messaging and support to encourage presentation and compliance is essential. We provide operational guidance on implementing such a system.

16. Germany's path out of lockdown (CBC News)

May 30: Germany's robust response to the coronavirus crisis early on has been widely praised — a high number of infections, yes, but a much lower death rate compared to other Western countries…According to an OECD study, even before the pandemic hit, Germany had 33.9 intensive care beds per 100,000 people. That compares with England at 10.5, Spain at 9.7 and Italy at 8.6. The country's COVID-19 fatality rate is about 4.6 per cent while the fatality rate in France is 15.4 per cent and, in Italy, is 14.3 per cent. Germany's lockdown didn't come all at once. Measures were introduced gradually and sometimes varied from state to state. Schools were closed on March 13, four days after the country's first reported death from the coronavirus. Visits to care homes were prohibited at the same time. Now, care facilities are being tested across the board…After watching the pictures from Italy the population was really willing to follow [government] suggestions…The move to put a *test, trace and isolate* system in place early on is also credited with Germany's ability to cope…Germany slowly began opening up from lockdown around April 20, but its success in keeping the death toll relatively low has given rise to what has been called the "prevention paradox." It refers to people seeing how well the country coped and then starting to resent remaining in lockdown and physical distancing measures or questioning whether they were needed in the first place…And there are growing tensions between some German states as they emerge from lockdown at different speeds and between some states and the federal government…Merkel wants physical-distancing measures to remain in place until at least the end of June. **Germany to start easing border controls (CBC News)** May 13: On May 16 Germany will start to relax *some* border controls introduced in March, with the aim of having free travel in Europe from mid-June. The tentative step, aimed partly at helping the tourism sector, comes as the European Commission prepares to urge a return to "unrestricted free movement," though that push will stop if there is a major second wave of infections…Blanket border controls agreed with France, Switzerland and Austria due to end on May 15 would be extended to June 15, but as many crossings as possible would be reopened and *systematic checks* would give way to *spot checks*…Controls at the EU's *external* borders will remain until June 15 …Separately, the European Union pushed on Wednesday for a safe reopening of borders, while insisting on protective measures such as masks on planes, to try and salvage the ravaged tourism sector for the lucrative summer season…EU proposals are non-binding, and most European governments were pressing ahead with their own specific plans, at different speeds,

depending on national circumstances. Some were also heavily promoting more domestic tourism.

E. FUNDAMENTALS OF A RISK-FOCUSED APPROACH TO REOPENING

17. Factors that affect risk of infection by SARS-Cov-2

https://www.nytimes.com/2020/05/29/health/coronavirus-transmission-dose.html?action=click&module=Well&pgtype=Homepage&section=Health
May 29: A few viral particles cannot make you sick — the immune system would vanquish the intruders before they could. But how much virus is needed for an infection to take root? "The truth is, we really just don't know," said Angela Rasmussen, a virologist at Columbia University. "I don't think we can make anything better than an educated guess."…For SARS, also a coronavirus, the estimated infective dose is just a few hundred particles. For MERS, the infective dose is much higher, on the order of thousands of particles…Generally, people who harbor high levels of pathogens tend to have more severe symptoms and are more likely to pass on the pathogens to others. And coronavirus patients are most infectious two to three days before symptoms begin, less so after the illness really hits. Some people are generous transmitters of the coronavirus; others are stingy. So-called super-spreaders seem to be particularly gifted in transmitting it, although it's unclear whether that's because of their *biology* or their *behavior*. On the receiving end, the shape of a person's nostrils and the amount of nose hair and mucus present — as well as the distribution of certain cellular receptors in the airway that the virus needs to latch on to — can all influence how much virus it takes to become infected. A higher dose is clearly worse… Touching a contaminated surface and then putting one's hands on the nose or mouth " isn't thought to be the main way the virus spreads," according to the Centers for Disease Control and Prevention….Coughing, sneezing, singing, talking and even heavy breathing can result in the expulsion of thousands of large and small respiratory droplets carrying the virus. One doesn't have to be sick and coughing and sneezing for transmission to occur ….Apart from avoiding crowded indoor spaces, the most effective thing people can do is wear masks, all of the experts said. "This is not a virus for which hand washing seems like it will be enough," Dr. Rabinowitz said. "We have to limit crowds, we have to wear masks."

18. Where infection is most likely to spread (Tom Pueyo has written a series of detailed and well researched papers providing operational recommendations relevant to WaM)

https://medium.com/@tomaspueyo/coronavirus-prevent-seeding-and-spreading-e84ed405e37d May 13: All around the world — we see the same pattern time after time. Close proximity, social interaction, singing, talking, dancing, hugging, kissing, all for long periods of time in a confined environment… A pattern consistent with the model

that most infections happen through droplets or droplet clouds while coughing, talking or singing. We have not heard of outbreaks coming from movie theaters, for example, where people are mostly silent and stay in one seat the entire time…."The best-available evidence suggests multiple-day events with crowded communal accommodations are most associated with increased risk. Mass gatherings are not homogenous and risk should be assessed on a case-by-case basis." *Nunan and Brassey (March 2020), Oxford University, not peer-reviewed*....Another paper looked at how infectious diseases actually spread in social groups. The bigger the group, the faster the infection spread to the entire group. Big events are not just worse than small events. They are much, much worse. [*Note*: See graphic at the end of this document that presents the risk and relative importance to a community of various common activities]

- Social gatherings should be avoided if a lot of people are close to each other, sing, talk a lot, or commingle.
- Indoor, confined areas are much worse than outdoors activities.
- Time matters. A short time is probably ok. Hours probably not.
- Mixing different social groups is especially bad.
- Conversely, small outdoors events where people don't talk or interact are probably safe.

…we can probably draw conclusions…:

- Stopping infections at home can have a dramatic effect on the epidemic
- You are not very likely to catch the virus from random people on the street.
- You are, however, very likely to catch it from your spouse, your kids, your parents or the friends you visit.

Transit also has an impact, although it's unclear if it's due to traveling with family members or caught in transit from other people….The role of children in the coronavirus epidemic is unclear. It looks like they are infected less frequently, and when they are they don't die of it or infect other people much. As a result, it looks like school closures would only have a small effect on limiting the spread of the virus. On the other side, we're not sure, because most countries closed them, so it's hard to compare…One country that only closed schools in a few regions and only for a few weeks is Australia, which has now controlled the epidemic.

19. Role of "superspreading" in transmission of COVID-19: An overview

https://www.sciencemag.org/news/2020/05/why-do-some-covid-19-patients-infect-many-others-whereas-most-don-t-spread-virus-all

May 19: Many "superspreading events" have occurred in the COVID-19 pandemic. SARS-CoV-2, like two of its cousins, SARS and MERS, seems especially prone to attacking groups of tightly connected people while sparing others. It suggests that restricting gatherings where superspreading is likely to occur will have a major impact on transmission, and that other restrictions—on outdoor activity, for example—might be eased. Most of the discussion around the spread of SARS-CoV-2 has concentrated on the *average* number of new infections caused by each patient. But in real life, some people infect many others and others don't spread the disease at all. In fact, the latter is the norm. In a recent preprint, Adam Kucharski of LSHTM estimated that "Probably about 10% of cases lead to 80% of the spread". That could explain why the virus did not take off around the world sooner after it emerged in China, and why some very early cases elsewhere—such as one in France in late December 2019, reported on 3 May—apparently failed to ignite a wider outbreak… most chains of infection die out by themselves and SARS-CoV-2 needs to be introduced undetected into a new country at least four times to have an even chance of establishing itself, Kucharski says. "If public health workers knew where clusters are likely to happen, they could try to prevent them and avoid shutting down broad swaths of society. Shutdowns are an incredibly blunt tool."…The factor scientists are closest to understanding is where COVID-19 clusters are likely to occur. Clearly there is a much higher risk in enclosed spaces than outside. Researchers in China identified 318 clusters of three or more cases between 4 January and 11 February, only one of which originated outdoors. A study in Japan found that the risk of infection indoors is almost 19 times higher than outdoors. Some situations may be particularly risky. Meatpacking plants are likely vulnerable because many people work closely together in spaces where low temperature helps the virus survive. But it may also be relevant that they tend to be loud places…one thing links numerous clusters: They happened in places where people shout or sing. Although Zumba classes have been connected to outbreaks, Pilates classes, which are not as intense, have not….Countries that have beaten back the virus to low levels need to be especially vigilant for superspreading events, because they can easily undo hard-won gains. The research [on supercluster transmission] is prone to bias. People are more likely to remember attending a basketball game than, say, getting a haircut, a phenomenon called recall bias that may make clusters seem bigger than they are…Privacy is another concern…Some clubs involved in the new South Korean cluster were gay venues, which resulted in an antigay backlash and made contact tracing harder.

20. Aerosol transmission (would facilitate super spreading)

https://science.sciencemag.org/content/early/2020/06/02/science.abc6197.1

May 27: Traditional respiratory disease control measures are designed to reduce transmission by droplets produced in the sneezes and coughs of infected individuals…The U.S. CDC recommendations for social distancing of 6 ft. and hand

washing to reduce the spread of SARS-CoV-2 are based on studies of respiratory droplets carried out in the 1930s…When these studies were conducted, the technology did not exist for detecting submicron aerosols. Measurements now show that intense coughs and sneezes that propel larger droplets more than 20 ft. can also create thousands of aerosols that can travel even further (*1*)…A large proportion of the spread of COVID-19 appears to be occurring through airborne transmission of aerosols produced by asymptomatic individuals during breathing and speaking (*1*–*3*). Aerosols can accumulate, remain infectious in indoor air for hours, and be easily inhaled deep into the lungs. For society to resume, measures designed to reduce aerosol transmission must be implemented, including universal masking and regular, widespread testing to identify and isolate infected asymptomatic individuals.

21. **"Super spreader" events play a disproportionate role in transmission**

https://quillette.com/2020/04/23/covid-19-superspreader-events-in-28-countries-critical-patterns-and-lessons/ April 23: As SSE (Super Spreader Events) expert Richard Stein put it in a definitive 2011 article, roughly "20% of the individuals within any given population are thought to contribute at least 80% to the transmission potential" of typical pathogens. …In the absence of any comprehensive database of COVID-19 superspreading events, I built my own, cataloguing 58 SSEs in 28 different countries (plus ships at sea). …I simply spent several weeks scanning the scientific and lay press for any information I could find….Of the 38 SSEs for which dates could be usefully identified, about 75 percent (29/38) took place in the 26-day span between February 25th and March 21st, roughly corresponding to the period when thousands of infected COVID-19 individuals were already traveling around the world, but before social distancing and event-cancelation policies had been uniformly implemented in many of the affected countries….so far, April has been almost entirely bereft of publicly reported SSEs….The truly remarkable trend that jumped off my spreadsheet has nothing to do with the sorts of people involved in these SSEs, but rather the extraordinarily narrow range of underlying *activities*. And I believe it is on this point that a close study of SSEs, even one based on such a biased and incomplete data set as the one I've assembled in my lay capacity, can help us…Of the 54 SSEs on my list for which the underlying activities were identified, no fewer than nine were linked to religious services or missionary work…Nineteen of the SSEs involved parties or liquor-fueled mass attendance festivals of one kind or another, including celebrations of weddings, engagements and birthdays. Five of the SSEs involved funerals. Six of the SSEs involved face-to-face business networking. This includes large-scale events such as Biogen's notorious Boston leadership meeting in February, as well as one-on-one business meetings. These parties, funerals, religious meet-ups and business networking sessions all seem to have involved the same type of behaviour: extended, close-range, face-to-face conversation—typically in crowded, socially animated spaces….Of the 54 SSEs for which underlying activities

could be identified, only 11 did not involve either religious activity, a party, a funeral, a cruise or extended face-to-face professional networking. But even in this minority of cases, one can observe almost identical interpersonal dynamics. Three of the SSEs—in Japan, Skagit County, WA, and Singapore—involved concert-goers and singing groups belting out tunes together over a period of hours….Four of the SSEs were outbreaks at meat-processing plants, in which densely packed workers must communicate with one another amidst the ear-piercing shriek of industrial machinery. But high levels of *noise* do seem to be a common feature of SSEs, as such environments force conversationalists to speak at extremely close range. (Related factors may be at play in old-age homes. These tend to be quiet places. But the reduced speaking volume and hearing functions of some elderly residents lend themselves to conversations held at much closer range than is socially typical in the general population.)

22. **Risk of transmission of SARS-Cov-2 on flights appears to be low**

    https://www.hsph.harvard.edu/news/features/coronavirus-covid-19-press-conference-with-joseph-allen-05-19-20/ May 19: While you're in your seat on an airplane, the air quality, the air exchange rate is very high… The airflow is designed to minimize the entire cabin from being a well-mixed space…The air only moves within your row and maybe a row or two beyond. So even though there are a lot of people in a tight space, the airflow dynamics prevent widespread transmission even if someone is sick. If you add on masks, one study showed that it reduced risk by another factor of 10. Then if you start to do other strategies like not using middle seat preventing or discontinuing meal and drink service during the flight, in other words, you grab a water and snack when you board and that's it …The bigger concern is from the travel experience. Every time you fly, you wait in long queues in security, you're at the jetway, you're in their waiting area, maybe in a restaurant at the airport …People do get sick when they travel, but it's not the time in the airplane that's driving risk…Airports are going to have to do more in terms of keeping people spread out, managing queues differently, providing more opportunity for hand-washing and hand sanitizer.

23. **Example: Non-transmission of SARS-Cov-2 on a long flight with infected passengers**

    https://www.cmaj.ca/content/192/15/E410 April 14: Case details have been published.2 The patients travelled from Wuhan to Guangzhou, then Guangzhou to Toronto, Canada, arriving on Jan. 22, 2020. The index patient was symptomatic with dry cough during the flight. His wife developed cough on Jan. 23. Both sets of throat and nasopharyngeal swabs collected were positive for COVID-19. There were approximately 350 passengers on board the airplane. The public was notified through the media that the index case was symptomatic during the 15-hour flight. Close contacts included 25 individuals sitting within 2 m of the index case during the flight, flight crew members, and 1 close contact on arrival in Toronto. Close contacts received active daily contact

monitoring by local public health officials for 14 days from the flight's arrival in Toronto. Non-close-contact passengers were advised to self-monitor and contact public health if they became symptomatic; 5 of these passengers became symptomatic, were tested and found by nasopharyngeal and throat swabs to be negative for COVID-19….Studies of airplane transmission are commonly biased by contacts sharing exposure risks before boarding the aircraft.5 In our investigation, transmission may have been mitigated by mild symptoms and masking during the flight. However, the lack of secondary cases after prolonged air travel exposure supports droplet transmission, not airborne, as the likely route of spread of the COVID-19.

24. **A regimen to stop transmission in workplaces** (Dr. Atul Gawande) https://www.newyorker.com/science/medical-dispatch/amid-the-coronavirus-crisis-a-regimen-for-reentry Is there any place that has figured out a way to open and have employees work safely, with each other and with their customers? Well, yes: in health care. The Boston area has been a *COVID*-19 hotspot. Yet the staff members of Mass General Brigham, have been at work throughout the pandemic. We have seventy-five thousand employees. In April, two-thirds of us were working on site. Yet we've had few workplace transmissions. Not zero: we've been on a learning curve, to be sure, and we have no way to stop our health-care workers from getting infected in the community. But, in the face of enormous risks, American hospitals have learned how to avoid becoming sites of spread. When the time is right to lighten up on the lockdown and bring people back to work, there are wider lessons to be learned from places that never locked down in the first place…. These lessons point toward an approach that we might think of as a combination therapy—like a drug cocktail. Its elements are all familiar: hygiene measures, screening, distancing, and masks. Each has flaws. Skip one, and the treatment won't work…. Environmental transmission may account for as little as six per cent of *COVID*-19 infections. *COVID*-19, spreads primarily through respiratory droplets emitted by infected people when they cough, sneeze, talk, or simply exhale; the droplets are then breathed in by others. (Loud talking has even been shown to generate measurably more droplets than quieter talking.)… Exposure time matters: we don't know exactly how long is too long, but less than fifteen minutes spent in the company of an infected person makes spread unlikely…. Practices begun in Asia, and adopted by my health system, call for instituting daily screening of all employees, patients, and visitors for symptoms of *COVID*-19. Any time I want to enter a hospital building, I have to go to a Web site and confirm that I have not developed a single sign of the disease—a new fever, cough, sore throat, shortness of breath, loss of taste or smell, or even just nasal congestion or a runny nose. (Administrators could also have added a formal temperature check with an infrared touchless thermometer, but, although ninety per cent of symptomatic *COVID*-19 patients eventually develop fevers, early on, fever is present less than half the time. So it's the mild symptoms that are most important to screen for.) A green pass on my phone

indicates no symptoms and grants me access to the hospital. Otherwise, I can't work. … This self-screening is obviously far from foolproof. Anyone could lie. Through the first week of May, symptoms, often mild, prompted more than eleven thousand staff members to stay home and receive testing…. The virus can make people infectious *before* they develop symptoms of illness. Studies now consistently indicate that infectivity starts before symptoms do, that it peaks right around the day that they start, and that it declines substantially by five days or so. It seems that there are also plenty of people who are infected by the virus that causes *COVID*-19 who never become symptomatic, especially children. So far, studies of transmission networks have not revealed such silent carriers to be a major source of spread. Nonetheless, patients who do not yet show symptoms, or have just begun to, are turning out to be important vectors of disease…. What seems to matter isn't where you work in the hospital—say, in the *COVID*-19 unit—but where you live. Workers who test positive are more likely to have a home Zip Code in known hot spots—such as Chelsea, a town across the river from Boston, where intergenerational housing is common and where random testing has found a thirty-per-cent infection rate…. As political leaders push to reopen businesses and schools, they are beginning to talk about the tools that have kept health-care workers safe. The science says that these tools can work. But it's worrying how little officials are discussing what it takes to deliver them as a whole package and monitor their effectiveness.

F. TESTING FOR SARS-Cov-2

25. Background: Basics of COVID-19 testing technology (OECD)

https://www.oecd.org/stories/policy-responses/testing-for-covid-19-a-way-to-lift-confinement-restrictions-89756248/

May 4: Two types of testing are key to tackle the #Coronavirus properly: (1) *Molecular testing* to help identify people who are infected, and (2) *Serologic testing* that detects those who have already had the infection & developed antibodies…**Molecular diagnostic tests**: RT-PCR tracks the presence of viral genetic material in a patient sample. Samples are taken from places likely to have high virus concentration, using a swab to collect samples from the back of the nose or mouth. The RT-PCR test involves binding sequences on the genetic material that only are found in the virus and repeatedly copying everything in between. This process is repeated many times, with a doubling of the target region with each cycle. A fluorescent signal is created when amplification occurs, and once the signal reaches a threshold, the test result is considered positive. If no viral genetic material is present, amplification cannot occur, resulting in a negative result….This technique is generally very sensitive (i.e. able to detect true positive cases) and specific (i.e. able to avoid false negative results). If an RT-PCR is positive, the result is most likely correct (the only case of false positive could be happening if a non-positive

sample is contaminated by viral material, during test processing for instance). False negative results are also possible with RT-PCR, but are most frequently the result of a wrong patient sampling….The main constraints related to RT-PCR have to do with logistics. The procedure is labour intensive, and quite long… Some companies have developed RT-PCR techniques which are actually faster than the standard procedure and can also be used at the point of care, such as in a hospital, instead of being sent to a lab….Other means to detect viral material are currently under development. For example, direct viral antigen detection is a technique that aims at detecting proteins of the virus called antigens. Such tests would be quick to run (sometimes less than 15 minutes) and could be used at the point-of-care. … as of 8 April 2020, five viral antigen tests received a CE IVD1 marking**…Serologic tests**: The means to test patients for a prior infection is to check for their immunological status vis-à-vis the virus. The development of an antibody response to infection may still take some time and it may be host dependent (i.e. vary according to the general characteristics of the tested person, such as their health status and previous exposure to similar pathogen agents). Early studies suggest that the majority of Covid-19 patients seroconvert (i.e. start producing antibodies) between 7 and 11 days post exposure to the virus, although some patients may develop antibodies sooner…Immunologic testing can be done via two different techniques: ELISA (enzyme-linked immunosorbent assay) and immunochromatographic assays**.** Both techniques require a blood sample. The types of tests under development mainly correspond to immunochromatographic assays and are frequently referred to as "rapid tests". At the moment, these "rapid tests" are reserved for professional use, but it is possible that they could at some point be sold to the general public for personal use….These tests have not been fully developed for SARS-CoV-2 and their true clinical performance is mostly unknown…The interpretation of these tests requires a substantial amount of further analysis before they can be considered ready for utilisation at scale. Despite this, some regulatory authorities have recently changed their guidance to allow the launch of tests without approvals, so long as they are not used as the sole diagnostic. As of 8 April 2020, only one serologic rapid test received an Emergency Use Authorization from the U.S. FDA 2. A further 64 manufacturers have notified the agency that they have validated similar tests and may market them in the near future.

26. What policy makers need to know about COVID-19 protective immunity

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7185915/ May 16: Current discussion addresses the notion that scaled up antibody testing will determine who is immune, thus giving an indication of the extent of herd immunity and confirming who could re-enter the workforce…A study of survivors of SARS showed that about 90% had functional, virus-neutralising antibodies and around 50% had strong T-lymphocyte responses.[10] These observations bolster confidence that most survivors of severe COVID-19 would have protective antibodies…How long is immunity to COVID-19 likely to last? The best

estimate comes from the closely related coronaviruses and suggests that, in people who had an antibody response, immunity might wane, but is detectable beyond 1 year after hospitalisation.[10, 11, 12] …Most of the available COVID-19 serology data derive from people who have been hospitalised with severe infection.[8, 18] In this group, around 90% develop IgG antibodies within the first 2 weeks of symptomatic infection and this appearance coincides with disappearance of virus,[18] supporting a causal relationship between these events. However, a key question concerns antibodies in non-hospitalised individuals who either have milder disease or no symptoms. Anecdotal results from community samples yield estimates of under 10% of tested "controls" developing specific IgG antibodies. We await larger seroprevalence datasets, but it seems likely that natural exposure during this pandemic might, in the short to medium term, *not* deliver the required level of herd immunity and there will be a substantial need for mass vaccination programmes.

27. **Canada needs more proactive, smarter testing** (Andre Picard)
https://www.theglobeandmail.com/canada/article-we-have-to-test-and-trace-more-to-end-lockdowns-safely/ May 24: Governments also have to monitor vigilantly to ensure we don't have flare-ups of cases that wipe out the gains that have come from our sacrifices. The first case of coronavirus in Canada was more than four months ago. And we're still not getting the basics – test-trace-isolate – right?...British Columbia did a tremendous job of embracing the test-trace-isolate public health mantra … Alberta showed us that testing can be ramped up quickly and shared lots of data. Saskatchewan and Newfoundland and Labrador snuffed out worrisome outbreaks with dogged contact tracing. Sixteen weeks and almost 25,000 cases later, Ontario is still struggling to actually test people…. Testing has to be targeted and proactive….There are more than 1,000 new cases of COVID-19 reported daily in Canada. Where are the new cases occurring? At supermarkets? On buses? In the workplaces that are already open? If we don't have that basic information, how can we reopen the economy smartly and safely? The relaxing of rules needs to be accompanied by…not just more testing, but smarter testing. We have to go find the infected, not wait for them to come forward. And every single positive test has to be followed by a seek-and-destroy mission.
28. **Testing those who do not have symptoms**.
https://www.cbc.ca/news/health/asymptomatic-testing-1.5585699
May 26: COVID-19, research conducted with subjects in Singapore found that there are three categories of *asymptomatic* people who can test positive:

    - Pre-symptomatic people who are incubating the disease, but don't yet show symptoms. Studies suggest people can test positive up to three days before developing symptoms.
    - Post-symptomatic people who have recovered and no longer have symptoms, but still test positive (although there is evidence these people may not be contagious).

- Completely asymptomatic people, who have been exposed to the virus and test positive, but never show symptoms.

A positive test doesn't necessarily mean a person is contagious. They may be shedding genetic material from dead viruses, especially if they have recovered….A study published in Science in April used mathematical modelling to estimate that people with mild symptoms or no symptoms were only half as infectious as people with symptoms, but were responsible for about 80 per cent of the transmission to people who went on to have more severe infections….Widespread testing in Vò, Italy, found that well over half of approximately 3,400 people who tested positive never showed symptoms. In other studies, the number of asymptomatic people has ranged from five per cent to 80 per cent. One difficulty is that some people who are asymptomatic when they test positive later develop symptoms. Children, young adults, and women are more likely to be asymptomatic than older people and men….Strategies for testing asymptomatic people vary from province to province. Some are targeting high-risk groups in an effort to catch infections in places they are most likely to arise. For example: Ontario has started to test asymptomatic health care workers, and plans to add first responders, taxi drivers, workers in meat-packing and auto plants and school-aged children. In Saskatchewan and in Calgary, tests are also being offered to anyone working outside the home or those about to return to work as the economy reopens even if they don't have symptoms. Manitoba is doing "asymptomatic surveillance," where anyone going to a *randomly selected* health-care facility, such as a doctor's office, will be offered a test. It's similar to what the province already does for influenza, and is intended to get a random sample of community transmission….False negatives, which can represent up to 10 per cent of tests, are a problem, especially since they're often caused by testing too early. People tend not to test positive until one to three days before the onset of symptoms. Because of that, a negative test result in an asymptomatic person doesn't hold much weight, and they would need to be retested if they start to show symptoms. Most experts agree on the need to test asymptomatic people at the site of outbreaks and asymptomatic contacts of people who have been diagnosed with COVID-19 … Dr. Alex Wong, an infectious disease researcher at Regina General Hospital, said he doesn't think widespread testing of asymptomatic people is useful for monitoring the epidemic in places where very few people have the disease…[because] in places with low disease prevalence, widespread testing of asymptomatic people could turn up more false positives than real positives.

29. Need to test asymptomatic people in risky situations.

https://www.nejm.org/doi/full/10.1056/NEJMe2009758

May 28 [NEJM Editorial]: Asymptomatic transmission of SARS-CoV-2 is the Achilles' heel of Covid-19 pandemic control. Symptom-based screening has utility, but

epidemiologic evaluations of Covid-19 outbreaks within skilled nursing facilities strongly demonstrate that our current approaches are inadequate. This recommendation for SARS-CoV-2 testing of asymptomatic persons in skilled nursing facilities should most likely be expanded to other congregate living situations, such as prisons and jails, enclosed mental health facilities, and homeless shelters, and to hospitalized inpatients. Current U.S. testing capability must increase immediately for this strategy to be implemented. Ultimately, the rapid spread of Covid-19, the clear evidence of SARS-CoV-2 transmission from asymptomatic persons,[5] and the eventual need to relax current social distancing practices argue for broadened SARS-CoV-2 testing to include asymptomatic persons in prioritized settings. These factors also support the case for the general public to use face masks[10] when in crowded outdoor or indoor spaces.

30. **Willingness to seek testing for SARS-CoV-2**
https://www.medrxiv.org/content/10.1101/2020.05.06.20093005v1 May 10: A cross-sectional, *online* survey in the United States measured willingness to seek testing if feeling ill under different specimen collection scenarios: home-based saliva, home-based swab, drive-through facility swab, and clinic-based swab. *Results*: Of 1,435 participants, 92% were willing to test with a home saliva specimen, 88% with home swab, 71% with drive-through swab, and 60% with clinic collected swab. Moreover, 68% indicated they would be more likely to get tested if there was a home testing option. There were no significant differences in willingness items across sociodemographic variables or for those currently experiencing COVID-19 symptoms. *Conclusions*: We observed a hierarchy of willingness to test ordered by the degree of contact required. Home specimen collection options could result in up to one-third more symptomatic persons seeking testing, facilitating contact tracing and optimal clinical care. Remote specimen collection options may ease supply chain challenges and decrease the likelihood of nosocomial transmission. As home specimen collection options receive regulatory approval, they should be scaled rapidly by health systems.

31. **Tests that yield rapid results**
https://www.nbcnews.com/health/health-news/questions-about-covid-19-test-accuracy-raised-across-testing-spectrum-n1214981 May 26, 2020: Since March, nearly 70 tests have received emergency use authorization from the U.S. Food and Drug Administration. Many of these tests were developed at a breakneck pace in an effort to get tests out…Experts told NBC News that tests used to diagnose COVID-19 may be missing up to 20 percent of positive cases. “The false negatives are mainly due to specimen acquisition, not the testing per se,” said Dr. Alan Wells, medical director for the University of Pittsburgh Medical Center clinical laboratories. “You’re sampling blindly. You have to be at the right place at the right time,”…A May 13 study in Annals of Internal Medicine, from researchers at the Johns Hopkins School of Public Health, found

that test timing is also essential to getting an accurate result….Testing too early after exposure to the virus substantially raises the risk of a false negative….the study found that three days after the onset of symptoms is when the test is most likely valid….Abbott Labs' popular ID NOW point-of-care test, has come under fire in recent weeks, after the FDA issued an alert that it may not always be accurate. The test can deliver results in five to 13 minutes. One small study by NYU Langone Health found that the test returned false negatives for nearly 50 percent of certain samples. The study has not yet been peer-reviewed….In response, Abbott last week released interim data on several of its own studies finding that accuracy was significantly better, in some cases nearly 100 percent, especially when performed in patients who were tested early after their onset of symptoms….NBC News spoke with 10 medical centers and hospitals across the country; seven said they weren't using the Abbott test…. citing issues with accuracy …Some hospitals continuing to use the Abbott test, such as Sutter Health Hospitals in California, said they often will confirm any negative results with another PCR test if there is clinical suspicion of COVID-19. Abbott said in a statement that to date, the company has delivered more than 2 million tests to all 50 states. "Our customers are telling us that they're seeing positivity rates from ID NOW testing at or above local community infection rates, which means that ID NOW is detecting the virus at the same level as lab-based testing."

32. False Negative Tests for SARS-CoV-2 Infection — Challenges and Implications

https://www.nejm.org/doi/full/10.1056/NEJMp2015897?query=featured_home

June 5: We draw several conclusions. First, diagnostic testing will help in safely opening the country, but only if the tests are highly sensitive and validated under realistic conditions against a clinically meaningful reference standard. Second, the FDA should ensure that manufacturers provide details of tests' clinical sensitivity and specificity at the time of market authorization. Third, measuring test sensitivity in asymptomatic people is an urgent priority. It will also be important to develop methods (e.g., prediction rules) for estimating the pretest probability of infection (for asymptomatic and symptomatic people) to allow calculation of post-test probabilities after positive or negative results. Fourth, negative results even on a highly sensitive test cannot rule out infection if the pretest probability is high, so clinicians should not trust unexpected negative results (i.e., assume a negative result is a "false negative" in a person with typical symptoms and known exposure). It's possible that performing several simultaneous or repeated tests could overcome an individual test's limited sensitivity; however, such strategies need validation.

33. NYU study casts doubt on sensitivity of ID NOW

https://doi.org/10.1101/2020.05.11.089896.

May 12: Abstract The recent emergence of the SARS-CoV-2 pandemic has posed formidable challenges for clinical laboratories seeking reliable laboratory diagnostic confirmation. The swift advance of the crisis in the United States has led to Emergency Use Authorization (EUA) facilitating the availability of molecular diagnostic assays without the more rigorous scrutiny to which tests are normally subjected to prior to FDA approval. The need to identify the COVID-19 positive cases quickly and accurately has propelled the release of a variety of assays intended to meet the urgent demand. Several Nucleic Acid Amplification Tests (NAAT) platforms are currently available. Our laboratory currently uses two real time RT-PCR platforms, the Roche Cobas and the Cepheid Xpert Xpress. Both platforms demonstrate comparable performance; however the run times for each assay are 3.5 hours and 45 minutes, respectively. In search for a platform with shorter turnaround time, we sought to evaluate the recently released Abbott ID NOW COVID-19 assay which is capable of producing positive results in as little as 5 minutes. We present here the result comparisons between Abbot ID NOW and Cepheid Xpert Xpress using nasopharyngeal swabs transported in VTM as well as dry nasal swabs for the Abbott assay. Regardless of method of collection and sample type, Abbot ID NOW missed a third of the samples detected positive by Cepheid Xpert Xpress when using NP swabs in VTM and over 48% when using dry nasal swabs. [*Note: This study has not been peer reviewed*]

34. Statement by FDA on errors in Abbott's rapid diagnostic test for COVID-19

https://www.prnewswire.com/news-releases/coronavirus-covid-19-update-fda-informs-public-about-possible-accuracy-concerns-with-abbott-id-now-point-of-care-test-301059882.html

May 14: The U.S. Food and Drug Administration is alerting the public to early data that suggest potential inaccurate results from using the Abbott ID NOW point-of-care test to diagnose COVID-19. Specifically, the test may return false negative results. "We are still evaluating the information about inaccurate results and are in direct communications with Abbott about this important issue...This test can still be used and can correctly identify many positive cases in minutes. Negative results may need to be confirmed with a high-sensitivity authorized molecular test"…No diagnostic test will be 100% accurate due to performance characteristics, specimen handling, or user error, which is why it is important to study patterns and identify the cause of suspected false results so any significant issues can be addressed quickly... so agency staff must meticulously comb through the reports to identify crucial data to support any signals or patterns about device

use… Abbott has agreed to conduct post-market studies for the ID NOW device that each will include at least 150 COVID-19 positive patients in a variety of clinical settings... The information gathered from the studies can…inform any additional actions the company or the FDA should take. SOURCE U.S. Food and Drug Administration

35. City of Detroit experience provides validation of ID NOW

https://www.detroitnews.com/story/news/local/detroit-city/2020/05/15/detroit-officials-defend-reliability-rapid-testing-kits-covid-19/5197067002/

May 15: The Detroit News--Detroit Mayor Mike Duggan said the city has used 15-minute testing from Abbott Laboratories to screen more than 8,000 individuals, over half of which have been front-line city workers including the majority of Detroit's 2,500-member police force. "Our experience has been that the Abbott tests are catching the sick people and that they are not having any significant false-negative rates. We're entirely confident."…The tests are relied on heavily in Detroit for clearing first responders, vulnerable seniors and other essential city staff…Abbott…said studies are being conducted on the test "in ways that it was not designed to be used" and that the NYU results "are not consistent with other studies." Duggan has rejected other assessments of Abbott technology, saying studies that have been critical weren't looking at processing the kits the way they are handled in Detroit. The company added that it's clarifying product information to better guide health care providers and reinforcing proper sample collection and handling. ..The Michigan Department of Health and Human Services said Friday that there are "some concerns" regarding the study methodology and sample types used in some recent reports. "While we agree that rapid tests have lower sensitivity and specificity as a whole than traditional tests, it should be noted that all tests have some problems," Bob Wheaton, a spokesman for MDHHS, said. The state has performed side-by-side comparison testing using both rapid and standard COVID-19 tests across samples from several geographic areas of the state. Of 82 patients to receive both an Abbott ID Now dry swab test and traditional test, 81 were provided the same result, Wheaton said.

36. Abbott ID NOW test shows promising interim results in "real world" setting

https://abbott.mediaroom.com/2020-05-21-Abbott-Releases-Interim-Clinical-Study-Data-on-ID-NOW-COVID-19-Rapid-Test-Showing-Strong-Agreement-to-Lab-Based-Molecular-PCR-Tests

May 21: Abbott announced today an interim analysis of an ongoing multi-site clinical study that indicates its ID NOW COVID-19 rapid test is showing strong agreement to lab-based PCR instruments. The interim results are demonstrating test performance is ≥94.7% in positive agreement (sensitivity) and ≥98.6% negative agreement (specificity) when compared to two different lab-based PCR reference methods. The study is examining test performance at five urgent care clinics…and is one of the first studies

conducted on the test in a real-world setting as it is intended to be used, compared with other studies that have used banked or retained samples…In these subjects, the mean number of days from symptom onset is 4.1 days with 90% of subjects tested within 7 days post symptom onset, when patients typically show up for care…Data from these studies suggest ID NOW performs best in people tested earlier after they first begin experiencing symptoms. This is consistent with a recent study published in the Annals of Internal Medicine, where researchers from Johns Hopkins found that even the most sensitive lab-based molecular tests can have false negatives when viral load levels are ramping down, near the end of the infection cycle when viral load winds down and patients may no longer be infectious. Abbott will report full results from these studies when the studies and analyses are completed.

37. GeneXpert PCR test yields results in about 45 minutes—avoids shipment to lab

https://spectrum.ieee.org/view-from-the-valley/the-institute/ieee-member-news/a-rapid-test-for-covid19-arrives-via-a-20yearold-technology-already-in-many-hospitals

April 7: In late March, the FDA approved the use of Cepheid's GeneXpert rapid molecular diagnostic machines to test for the new coronavirus. The automated modules—5000 of which are already installed in U.S. health facilities, while 18,000 are in operation in other countries—don't require a lab facility or special training to operate. What's more, they generate accurate results in about 45 minutes. The modules use disposable cartridges, pre-filled with the required chemicals that are channeled around test chambers using microfluidics….The company's GeneXpert has been adapted to test for flu, strep, norovirus, chlamydia, tuberculosis, MRSA—and now, COVID-19… The GeneXpert test starts with a nasal sample taken with a swab. The person collecting the sample drops the swab into a liquid-filled specimen transfer tube. To start the test, liquid containing the sample is pipetted into a disposable test cartridge, and the cartridge is inserted into the test machine; this takes no special training. After this, the process is automatic.

38. Antigen viral testing for COVID-19

https://theconversation.com/antigen-tests-for-covid-19-are-fast-and-easy-and-could-solve-the-coronavirus-testing-problem-despite-being-somewhat-inaccurate-137977

May 29: On May 9, the U.S. Food and Drug Administration approved the first antigen test for emergency use made by the pharmaceutical company Quidel Corporation…These tests are starting to be available across the country and could dramatically change the COVID-19 testing landscape when they become widely available…Antigen tests look for antigens [viral proteins that generate an antibody response]. To identify these antigens, antigen tests use antibodies. You may have performed one yourself if you've ever used a home pregnancy test…The main selling points of antigen tests are that they are far faster

and easier to perform than PCR tests…A COVID-19 antigen test might take only 15-30 minutes to complete and requires very little expertise… The problem is their accuracy. Quidel reports that their test produces about a 20% false negative rate. At a large scale, this may result in missing many infected individuals. The Quidel test is not currently widely available due to production capacity. As production ramps up and other companies begin to produce antigen tests, they will become more available. Once laboratories around the country begin processing the antigen tests, public health officials will also get a better sense of the real-world false negative rate.

39. Rapid diagnostic tests based on antigen detection: WHO Statement

https://www.who.int/news-room/commentaries/detail/advice-on-the-use-of-point-of-care-immunodiagnostic-tests-for-covid-19

April 8: One type of rapid diagnostic test (RDT) detects the presence of viral proteins (antigens) expressed by the COVID-19 virus in a sample from the respiratory tract of a person. If the target antigen is present in sufficient concentrations in the sample, it will bind to specific antibodies fixed to a paper strip enclosed in a plastic casing and generate a visually detectable signal, typically within 30 minutes. The antigen(s) detected are expressed only when the virus is actively replicating; therefore, such tests are best used to identify acute or early infection... Based on experience with antigen-based RDTs for other respiratory diseases such as influenza…the sensitivity of these tests might be expected to vary from 34% to 80%... Half or more of COVID-19 infected patients might be missed by such tests, depending on the group of patients tested. These assumptions urgently require further study to understand whether they are accurate…If antigen detection tests demonstrate adequate performance, they could potentially be used as triage tests to rapidly identify patients who are very likely to have COVID-19, reducing or eliminating the need for expensive molecular confirmatory testing. WHO does not currently [April 8] recommend the use of antigen-detecting rapid diagnostic tests for patient care, although research into their performance and potential diagnostic utility is highly encouraged.

40. **EU approves rapid test by Irish company**
https://www.irishtimes.com/business/health-pharma/rapid-covid-19-test-by-irish-group-hibergene-gets-eu-approval-1.4257587 May 20: Irish company HiberGene Diagnostics has secured European approval for a highly accurate, low-cost, rapid test for coronavirus. The test promises to deliver results for patients who have Covid-19 within 30 minutes. The test avoids the need to send samples to specialised laboratories but still delivers results that are 96 per cent to 97.5 per cent accurate, in line with those produced by the most sophisticated lab tests. The test has now secured a CE mark that authorises its sale across the European Union. The test works by mixing patient swab samples with a

solution that is heated for five minutes. A freeze-dried reagent is then applied and the sample put through the company's portable diagnostic instrument, the HG Swift, which delivers confirmation of positive tests in 10 minutes. If a patient is negative for the virus the result will be available within an hour. By not having to strip DNA from the samples in order to test, HiberGene avoids having to source specialised reagents for that process. …The test works best for patients with moderate or high viral load – those who have been displaying symptoms for some days….The company is working to examine its efficacy in those who are not yet showing any symptoms.

G. CONTACT TRACING

41. Covid-19 contact tracing fundamentals

https://www.bmj.com/content/369/bmj.m1859.full May 13: A substantial proportion of contact tracing comprises telephone interviews with an infected person's recent contacts—people who have been within 2 metres for 15 minutes or more,3 as suggested by the European Centre for Disease Prevention and Control (ECDPC). In South Korea, contact tracing has also involved detective work such as scouring CCTV footage, GPS location data from smartphones, and even credit card transaction records to find out who came into contact with whom…. The ECDPC notes that calls with each contact can take around 20 minutes. The manual process is "too slow," given the transmissibility of covid-19, according to researchers at the University of Oxford.10…[But] manual tracing allows for a human voice that can be comforting when breaking bad news of a positive result, and it also reaches people that might not use or be comfortable with smartphones or electronic data sharing. In practice, a contact tracing programme might rely on both automatic and manual approaches….One major stumbling block for these apps is that they require a large proportion of people in a population to download and use them. In the UK, experts advising the NHS say that 80% of smartphone users—roughly 56% of the total population—would need to use the app for it to be effective.12

42. Contact tracing technology also needs human tracers

https://www.technologyreview.com/2020/04/28/1000714/five-things-to-make-contact-tracing-work-covid-pandemic-apple-google/ April 28: Task 1: Hire 100,000 manual tracers **(**On a per capita basis this would be equivalent to about 300 in NS)…When Apple and Google release their system for building exposure notifications into their own smartphones, it will be the most significant development globally. The two companies are responsible for the software on more than 99% of phones on the planet, and eight out of 10 Americans own a smartphone. Apps built directly into iOS and Android, especially if they are interoperable, could dramatically increase the reach of the public health authorities in one swoop. But those building automated services are keen to stress that

they are *not* trying to replace manual tracing; they're trying to aid it. For example, smartphone alerts can help filter out those at low or no risk so that manual tracers can spend their time investigating genuine cases, people at higher risk, or those who are harder to contact. (But to date, Taiwan for example has not employed any automated contact tracing apps.) In Singapore, one of the lead developers of TraceTogether, Jason Bay, made his feelings on the subject extremely clear. "If you ask me whether any Bluetooth contact-tracing system deployed or under development anywhere in the world is ready to replace manual contact tracing, I will say, without qualification, that the answer is, 'No. Any attempt to believe otherwise is an exercise in hubris, and technology triumphalism."

43. **A model of transmission timing suggests importance of digital contact tracing**

https://science.sciencemag.org/content/368/6491/eabb6936 May 8: We developed a mathematical model for infectiousness to estimate the basic reproductive number R_0 and to quantify the contribution of different transmission routes…We analyzed 40 well-characterized source-recipient pairs …The contributions to R_0 included 46% from presymptomatic individuals, 38% from symptomatic individuals, 10% from asymptomatic individuals (who never show symptoms), and 6% from transmission via contamination. Results on the last two routes are speculative. According to these estimates, *pre*symptomatic transmissions alone are almost sufficient to sustain epidemic growth. To estimate the requirements for successful contact tracing, we determined the combination of two key parameters needed to reduce R_0 to less than 1: the proportion of cases who need to be isolated, and the proportion of their contacts who need to be quarantined. Given the high proportion of transmissions from presymptomatic individuals, controlling the epidemic by manual contact tracing is infeasible. The use of a contact-tracing app that builds a memory of proximity contacts and immediately notifies contacts of positive cases would be sufficient to stop the epidemic if used by enough people… An intervention of this kind raises ethical questions regarding access, transparency, the protection and use of personal data, and the sharing of knowledge with other countries. Careful oversight by an inclusive advisory body is required.

44. **Contact tracing mobile apps from Google + Apple**
https://www.cbc.ca/news/technology/apple-google-covid-app-1.5577166

May 20: Apple and Google released long-awaited smartphone technology Wednesday to notify people automatically if they might have been exposed to the coronavirus. The companies said 22 countries and several U.S. states are already planning to build *voluntary* phone apps using their software. It relies on Bluetooth wireless technology to detect when someone who downloaded the app has spent time near another app user who later tests positive for the virus. Many governments have already tried, mostly

unsuccessfully, to roll out their own phone apps. Many have encountered technical problems on Apple and Android phones and haven't been widely adopted. They often use GPS to track people's location, which Apple and Google are banning from their new tool because of privacy and accuracy concerns….Governments have said privacy restrictions will be a hindrance, because public health workers will have no access to the data. "User adoption is key to success and we believe that these strong privacy protections are also the best way to encourage use of these apps," the companies said…The new technology solves some of the main technical challenges that governments have had in building Bluetooth-based apps. It will make it easier for iPhones and Android phones to detect each other, work across national and regional borders… So far in Canada, tracing has mostly been done manually, other than Alberta's ABTraceTogether app. Other provinces have expressed interest in similar programs, while Prime Minister Trudeau said he hasn't seen the right technology "so far," for a national contact tracing strategy. [*Note*: AB Trace has some technical deficiencies that the new Google/Apple app is designed to fix. Also uptake of the app has to be much greater than has occurred so far (mid-May, about 3-4% of the Alberta population). Some studies estimate that roughly 60% uptake is needed for this kind of app to be really effective.]

45. Contact tracing apps and data privacy law

https://academic.oup.com/jlb/advance-article/doi/10.1093/jlb/lsaa034/5848138?searchresult=1 May 28: Google and Apple recently announced the intention to build interfaces to allow Bluetooth contact tracking using Android and iPhone devices. In this article we look at the compatibility of the proposed Apple/Google Bluetooth exposure notification system with Western privacy and data protection regimes and principles, including the General Data Protection Regulation (GDPR). Somewhat counter-intuitively, the GDPR's expansive scope is not a hindrance, but rather an advantage in conditions of uncertainty such as a pandemic.

46. New Zealand adopts its own tracking app

https://9to5mac.com/2020/05/18/coronavirus-location-tracking/ May 18: The Apple/Google API deliberately takes a privacy-protecting approach, in which locations are not captured at all. But some governments argue that they need location data to identify infection hotspots in order to focus healthcare resources. New Zealand will launch a contact-tracing app on Wednesday… Prime Minister Ardern said the app can be best described as a 'digital diary' helping people to record their personal movements, adding the data would not be shared to anyone else besides the user. …It means that when someone gets a positive test, they will be able to access an accurate record of their prior movements. This can prompt them to contact people with whom they were in

contact, and they can choose to share details with healthcare workers in order to identify problematic locations. Several European countries have adopted the Apple/Google API.

47. Evaluation of contact tracing approaches (Tom Pueyo)

https://medium.com/@tomaspueyo/coronavirus-how-to-do-testing-and-contact-tracing-bde85b64072e I believe apps that require bluetooth *opt-in* are worthless. QR codes that aren't enforced are slightly better, because at least a user can scan it and record where he's been. But if it's not mandated, few people and businesses will use it, so few contacts will be recorded. Manual contact tracing is necessary to have, so we should do it. But they will trace only part of the contacts, and it will take time. They will also invade the privacy of both the infected and their contacts. Then we have a series of tech solutions that substantially help contact tracers. Whether through automatic access to users' GPS and credit card data, adding mobile operator-led GPS matches, or *opt-out* bluetooth contact tracing apps, these provide a substantial amount of information really fast, at a low cost to privacy. The best options are mandatory QR code or bluetooth apps. They give an immediate dump of contacts, while privacy can be reasonably maintained since the only thing that authorities receive is the person's information and the list of matches, along with where and when they happened. For these solutions, authorities wouldn't need to have more information than this. No need to track every movement for months and store that in a database. Just the matches for the last two weeks, once somebody is proven infected. [Note: https://testandtrace.com/ links to a very extensive set of resources to help public authorities implement state-of-the-art test and trace procedures—although from a US vantage.]

H. INDIRECT HEALTH CONSEQUENCES OF THE PANDEMIC

48. U.N. Warns of Global Mental Health Crisis Due to COVID-19 Pandemic

https://www.nytimes.com/reuters/2020/05/13/world/europe/13reuters-health-coronavirus-mentalhealth.html May 13: A mental illness crisis is looming as millions of people worldwide are surrounded by death and disease and forced into isolation, poverty and anxiety by the pandemic of COVID-19, United Nations health experts said on Thursday. "The isolation, the fear, the uncertainty, the economic turmoil - they all cause or could cause psychological distress," said Devora Kestel, director of the World Health Organization's (WHO) mental health department...Kestel said an upsurge in the number and severity of mental illnesses is likely, and governments should put the issue "front and centre" of their responses. The report highlighted several regions and sections of societies as vulnerable to mental distress - including children and young people isolated from

friends and school…Domestic violence is rising, and health workers are reporting an increased need for psychological support….Millions of people are facing economic turmoil, having lost or being at risk of losing their income and livelihoods, it added. And frequent misinformation and rumours about the pandemic and deep uncertainty about how long it will last are making people feel anxious and hopeless about the future.

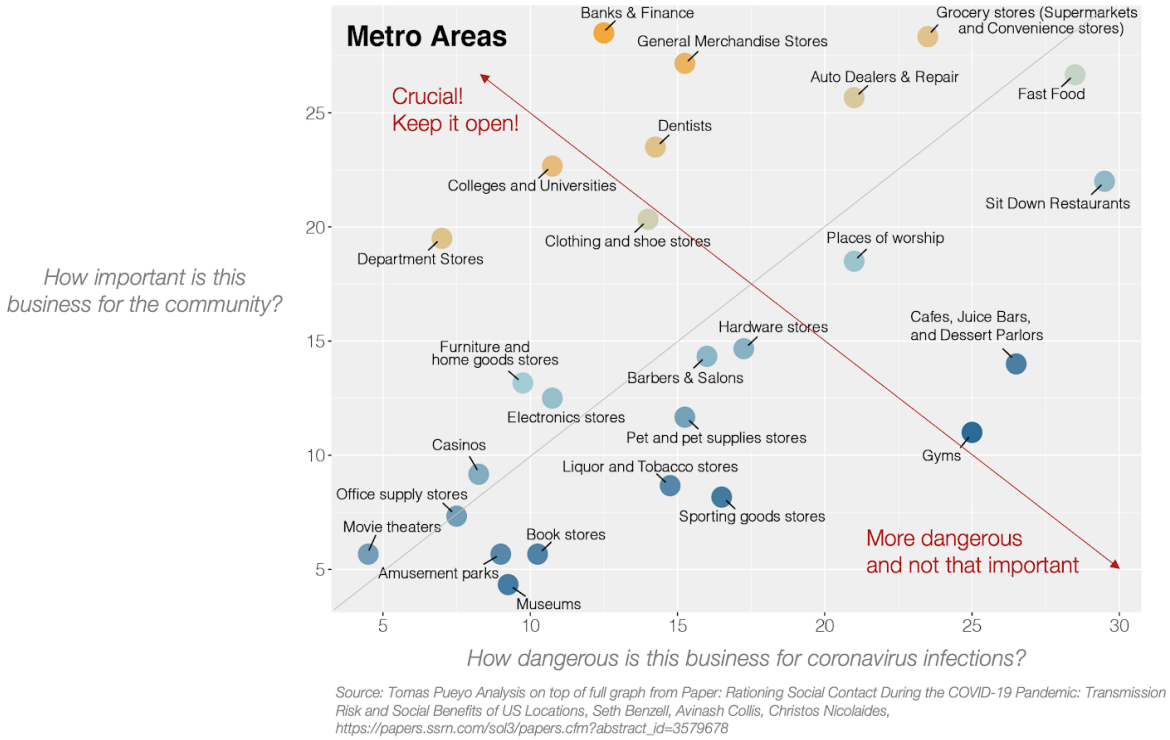
49. Some US experience on the health costs of deferred care during COVID emergency

https://www.nytimes.com/2020/06/09/opinion/coronavirus-hospitals-deaths.html

June 9: More than 100,000 Americans have died from Covid-19. Beyond those deaths are other casualties of the pandemic — Americans seriously ill with other ailments who avoided care because they feared contracting the coronavirus at hospitals and clinics…complicated by the loss of employer-provided health insurance as people lost their jobs …We have seen sizable decreases in new cancer diagnoses (45 percent) and reports of heart attacks (38 percent) and strokes (30 percent). Visits to hospital emergency departments are down by as much as 40 percent, but measures of how sick emergency department patients are have risen by 20 percent, according to a Mayo Clinic study. Meanwhile, non-Covid-19 out-of-hospital deaths have increased, while in-hospital mortality has declined….In the case of cancer alone, our calculations show we can expect a quarter of a million additional preventable deaths annually if normal care does not resume. Outcomes will be similar for those who forgo treatment for heart attacks and strokes…Over the past 12 weeks, hospitals deferred nonessential care to prevent viral spread, conserve much-needed personal protective equipment and create capacity for an expected surge of Covid-19 patients…we are gradually returning to normal activities while also mitigating risk for both patients and staff members…Patients who need care at a clinic or hospital or doctor's office should know they have reduced the risk of Covid-19 through proven infection-control precautions…The novel coronavirus will not go away soon, but its systemic side effects of fear and deferred care must. *Tomislav Mihaljevic is the chief executive and president of the Cleveland Clinic. Gianrico Farrugia is chief executive and president of the Mayo Clinic.*

The chart below is from reference #18

Chart 33.a: How Should We Prioritize the Opening of Businesses?



Source: Tomas Pueyo Analysis on top of full graph from Paper: Rationing Social Contact During the COVID-19 Pandemic: Transmission Risk and Social Benefits of US Locations, Seth Benzell, Avinash Collis, Christos Nicolaides, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3579678

NOVA SCOTIA COVID-19 TESTING DATA: MARCH 15-MAY 30

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Nova_Scotia