The Jackson Laboratory
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Report to the Consensus Economic Forecasting Commission: Economic Recovery in the Times of COVID-19

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What we know:

1. SARS-CoV-2, which is the pathogenic coronavirus for the COVID-19 pandemic, is a highly transmissible virus that causes significant mortality.
    a. The infectivity of SARS-CoV-2 exceeds that of influenza.
    b. Severity of illness may also be dependent on the load of viral exposure. So that even if exposed, an individual is likely to have a milder case if the viral load of the initiating infection is low.
    c. Mortality has been estimated to be between 1-7% using country-based data and when all individuals are assessed. A single mortality figure is misleading because there is a huge differential in mortality rates by age. Individuals <50 years of age have <<1% mortality and more likely to be ~0.1-0.2%, whereas those over 65 years of age commonly have between ~3-27% mortality (some overseas estimates are higher and up to 40%). Deaths amongst children are extremely uncommon. (Note: Odds of dying ex-COVID means the odds of dying in the absence of COVID-19 pandemic.
    d. As a single example, in the Diamond Cruise and the USS Theodore Roosevelt experience, the mortality in young adults (in their 20's) was less than 0.1% whereas the death rate for the passengers with a median age of 69 was 2.1%.

2. The clinical presentation COVID-19 varies widely:
    a. Symptoms range from mild to very severe to asymptomatic.
    b. Asymptomatic shedders account for ~40-50% of all individuals who test positive.
    c. Asymptomatic shedders are either pre-symptomatic (will develop symptoms later) or totally asymptomatic. They are clearly able to transmit disease, but it is not clear how efficient they are in doing so.

d. There are indeed individuals who are super spreaders of the disease who can infect many individuals (more than usual), but they are likely to be rare.
e. Certain ethnic groups (African American and Latinos) appear to be more susceptible to COVID-19 infections, likely caused by a variety of factors. For example, in Maine, African-Americans account for only 1.6% of the population yet 24% of Maine's COVID-19 cases are among African-Americans.

3. The mode of transmission is primarily (and thus far, maybe exclusively) through aerosols and larger droplets from the respiratory tract. These droplets can settle on the hands and on surfaces, but how transmissible are these viral traces is unclear. Talking, shouting, and/or singing in enclosed spaces will enhance transmission.

4. Contrary to earlier recommendations, masks, even cloth masks, can reduce spread. This has been shown in detailed laboratory studies (https://pubmed.ncbi.nlm.nih.gov/32329337/.) and in population observations (see below).

5. Social distancing policies absolutely work. In every jurisdiction (country or state), the imposition of stringent social distancing policies causes a "flattening of the case curve" of COVID-19 within 2 weeks of imposition. But the timing of the policy launch seems to be important. States that started social distancing by as little as one week before hospitalizations became evident, fared much better than those States that waited.

6. Until a vaccine is available, the most effective means for control of COVID-19 pandemic is the strategy of test, trace, isolate, and support. This widespread testing and the isolation of infectious individuals is key. Countries with effective testing and contact tracing (Iceland, Singapore, South Korea, etc. have had consistently fewer COVID-19 cases relative to their populations, and many fewer deaths.

7. Second and even third "waves" of SARS-CoV-2 spread are inevitable.

Can we bring the economy back safely? Yes, but:

- Widespread testing is the key: Test, trace, isolate, support. Advance to testing asymptomatic individuals/workers to isolate inadvertent spreaders and to assess sentinel events. See the section below to understand the optimal use and the limitations of viral testing.

- Selective protection: Focus on protecting the vulnerable (elderly, nursing homes).
- Adapt and learn: Be ready to apply the "circuit breaker" to activities if testing shows a rise in cases: sentinel test populations. In addition, with widespread testing, we can learn what works and what doesn't. For example, people can gather outdoors with masks (note Minneapolis experience).
- There is no going back to the "old normal": Some physical distancing policies will need to be maintained even as we seek to recover the economy: Masks and no indoor crowd activities.

Realities of testing:

- There are two types of tests: an antibody test and a viral test. The antibody test assesses whether someone has been exposed to the virus but cannot determine if the individual is infectious. Because we don't even know where having antibodies means someone is protected or immune from being infected, antibody tests currently cannot be used to make individual health decisions. The second, more prevalent test is the viral PCR test. This test assesses if someone is shedding the virus and therefore can be infectious. This is the test commonly used.
- Current viral tests are very accurate. The remarks of the high false negative or positive rates in viral testing are either untrue or due to misinterpretation of test specifications.
- Frequent testing is the only way we can determine the scope and the dynamics of the pandemic. The assertion that more testing means more positivity is wrong. In fact, every indication across the world is the more universal the testing, the lower the test positivity. Once widespread testing was mandated in Connecticut the positivity rate plummeted from 35% to 1%.
- Testing is not one process: There are three parts to completing a test: the first is to access the sample (e.g. a nasal swab), the second is to molecularly test the sample for the presence of the SARS-CoV2 virus, and the third is to provide the report to a responsible individual (physician or patient). Since JAX does all three, we know the difficulties in implementation. By the end of July, we will have the capacity to perform 20,000 molecular tests per day (second part of the testing process). This molecular technology is actually the easiest to implement by experts because it is centralized and automated.

Accessing samples and returning information is the biggest roadblock for asymptomatic worker or client testing in the U.S. The accession of the sample and the return of the information are the most difficult challenges. Hospitals are already overtaxed either because of COVID19 or by the financial impact of the pandemic. The informatics have become a major limiting factor since thus far, the sample accession must be obtained through a medical provider and the information must go back to the provider. This has been such a roadblock for Connecticut to quickly implement widespread testing, that Governor Lamont mobilized the National Guard to do the first phase of test accession in nursing homes and extended care facilities. This is now being transitioned to private organizations.

What we need to do:

Absolute control of the pandemics will mandate lockdown of activity until a vaccine is available. This is neither practicable nor will it be acceptable to the populace. Viral testing, tracking infected individuals, and isolating them from the general population is the only approach that can allow for "surgical" diminution of a pandemic risk.

The ideal setting is that all front-line staff and all participants/customers/students who partake in restaurants, stores, schools, activities are tested. Universal testing followed by contact tracing and quarantine works and have been proven in countries that have pursued these strategies. But perfection is the enemy of the good and not all communities have either the wherewithal or the social conditions to impose stringent government mandates for testing and quarantine. Thus, tailored approaches to different sectors of the economy are warranted.

Sectorize the economy: Identify closed vs. open economic activities. Closed systems include companies that produce exportable items and whose workers do not physically face the public research Institutions, manufacturing plants, call centers). Here, worker safety measures (such as plexiglass, de-densify offices/labs and conference rooms, masking and physical distancing) can effectively contain viral spread in the workplace and maintain business continuity. Once safety is assured, then activity can resume to levels that approach pre-COVID days. Open systems are industries that require physical interaction with the general public. These include tourism, hospitality businesses, performing arts, and schools/universities. Here limiting transmission of the virus is the key, which will require attenuating client and public access and a change in the business model (e.g., take out vs. inside seating).

Closed systems: At The Jackson Laboratory (JAX) we reduced the concentration of workers at the workplace early in the pandemic. ~1000 workers of our 2,400 were sent home to work remotely. This required enhancement of our IT systems and an orderly transition. We provided masks to all employees at a time when the authorities were claiming they did not work (they do, and the recommendations changed). We gave the workforce a steady stream of information and access to portals to have their questions answered (reduced anxiety and confusion). We changed onsite systems to enhance physical distancing and required masks. No visitors are permitted on site. Upon returning onsite we provided universal asymptomatic viral testing to all employees so that the workplace will have a starting point of being COVID-free. To date, we found ~0.2% positivity in the campuses in three states (ME, CA, CT) and all shedders were asymptomatic. This rate is lower than the test positive rates in the general population (~1%). The affected workers were self-isolated and are now virus free. An adaptive retesting schedule based on mathematical models is being implemented.

What have we learned? Communications and coordination are key, as is a consistent and reassuring voice from the leadership. Functional and professional Human Resources and IT Departments have proven essential. Attention to employment laws and regulations is also important. Testing remains the backbone of targeted risk mitigation. Such programs can keep the workforce safe and reduce employee fear and anxiety.

Open Systems: The solutions are more difficult to implement and, by necessity, more diverse. The practicality of implementing airtight restrictions and mandated universal testing will modulate the execution of any plan.

Model 1: Assumptions – a) client testing is limited, and b) most clients are primarily honest and will adhere to your requests.

- Require masks and limit indoor crowding.
- Exclude individuals with any symptoms. For hotels, ask guests to sign a disclaimer that they are not symptomatic and will inform the front desk if they develop symptoms.
- Make sure that businesses have a direct line to a hospital system to refer clients for symptomatic testing.
- Test all front-line workers to ensure the workforce is COVID free.
- Retest front-line workers to keep the workforce safe from internal transmission. Moreover, this information will help determine when to slow down business operations if an increase in test positivity is noted amongst workers and the resident population.

- Establish expectations by making clear to clients the requirements.
- Provide clear options for testing and medical care. The business and the local medical systems must now be coordinated.
- Restrict large gatherings.
- Review population and workforce testing data regularly so that the decision to slow activity down ("circuit breaker" concept) can be made in a timely fashion.

Model 2: Assumptions: a) virus free clients are required, b) adequate testing is available

- Testing becomes a requirement. This is done in countries such as China and South Korea. Both have used this approach with great success, but the government provides free tests and they have systems mandated by government to validate that a person is test positive. Thus, the concept is ideal, but it requires significant government intervention and subsidy.
- Where to get a test?: The problem is that most people in the US who are not sick do not know where to get tested, and asymptomatic testing has not been unequivocally sanctioned by the U.S. CDC/FDA. Many/most hospitals today will not test asymptomatic individuals. This has caused some confusion. This approach can work only if a coordinating body works through the logistical, reimbursement, and access issues.
- There remain problems of implementation: How will the businesses know who was tested and not? The sending of reports to an individual from a hospital system requires significant logistical capabilities from a hospital system. There is to date no accepted home testing option. In China, one's test results immediately go into an app that clears the individual electronically. We do not have this system in the U.S.

Hybrid Open and Closed Systems: The Universities. JAX is working with the University of Connecticut, University of Maine, and the Maine Maritime Academy systems in their plans to return students for the fall semester. The basis of their plans is based on universal testing of all students upon return. The remaining question is how frequently should the student body and faculty be tested.

Risk Stratification: The most important information relevant to returning to work safely is that the risk of morbidity and mortality is highly dependent on age, on preexisting illnesses, and potentially socio-economic/ethnic status. Age however is still the predominant risk factor). Thus, unlike the 1918 influenza pandemic, those under the age of 50 have a very low risk of serious illness in COVID-19 whereas those over 65 or

70 have a very high risk of mortality (it has been said that the risk differential of dying between a 15 year old and a 75 year old may be as much as 1000-fold), not to speak of morbidity as assessed by hospitalization rates.

Thus, a return to economic activity must take this into account. This means that instead of complete and comprehensive lockdowns, we should devise approaches to reduce the spread into these vulnerable populations. This means that younger workers (<50 years) and students may be able to return to school or work as long as they do not infect those over 65.

Also, importantly, second waves will always start as mini-outbreaks (initiating clusters) and therefore surveillance by widespread testing and the scrutiny of sentinel at-risk populations followed by isolation of the affected individuals will prevent the spread of the disease into major outbreaks as we first saw in the pandemic. Singapore, China, and South Korea have done this in their response to the second wave outbreak and managed to ease back into economic activity.

When can we truly return to work and recover the economy? The COVID-19 pandemic is here to stay. All actions we have discussed in this document are towards pandemic mitigating until an effective vaccine (as a preventive) is available or if the virus mutates to a less virulent form. The development of effective treatments for SARS-CoV-2 infection will be very beneficial but mainly to significantly reduce serious illness and death from COVID-19. In the best-case scenario, a vaccine may be available in the first two quarters of 2021, whereas useful treatments are being developed now and can be deployed over the next few months. Therefore, we must be prepared to impose social distancing and personal protective equipment guided by viral testing until wide-spread vaccination can be implemented.

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