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June 22nd, 2020

Aileen Fallon
Committee Clerk (Work Programme)
Special Committee on Covid-19 Response
Houses of the Oireachtas Service
Kildare House
Dublin 2

Dear Ms Fallon,

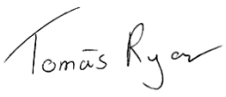
**Submission to Oireachtas Special Committee on Covid-19 Response**

I am writing to return my concise submission on **Testing Strategy** to the Oireachtas Special Committee on Covid-19 Response, following your invitation last week.

A summary of sixteen specific recommendations can be found on pages 11 & 12.

Please let me know if you require anything further. I am always happy to speak on the phone.

Sincerely,



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# Submission to the Oireachtas Special Committee on Covid-19 Response

## 1. INTRODUCTION

This submission has two broad purposes. First, to advocate for the real possibility of SARS-CoV-2 elimination strategy for Ireland. Second, to constructively comment on the SARS-CoV-2 testing situation in Ireland, regardless of whether a suppression or an elimination strategy is adopted by Government.

### 1.1 Context

The cause of COVID-19 is the virus SARS-CoV-2. In the absence of a vaccine or an effective anti-viral treatment, the only method available to manage SARS-CoV-2 is isolation. The virus can be isolated by isolating by isolating the people who carry it. A method of *general isolation* was the basis of the 'lockdown', where everyone was isolated from each other all of the time. Having exited the lockdown, an alternative approach of *particular isolation* where only individuals who carry the SARS-CoV-2, or who are likely to, are isolated from the rest of the population is required in order to maintain suppression SARS-CoV-2 in the population. Isolation of particular individuals requires **real time information** of who those individuals are, and clearly enforceable guidelines for isolation. Therefore, rapid community testing for SARS-CoV-2 must be available to the population at large at all times in order to identify SARS-CoV-2 carriers. Testing must be paired with fast contacting tracing and the quarantine of close contacts.

### 1.2 Testing Background

*Virus Testing:*

Using standard methodology, current testing for the SARS-CoV-2 virus is based on Polymerase Chain Reaction (PCR) testing for detection of the viral RNA from clinical samples in a matter of hours. This method is considered reliable and will tell when a person has the virus, but has a high false negative rate for the first 2 – 3 days post infection. It does not detect immunity or whether as person has been infected with SARS-CoV-2 previously. This is the principle type of testing that has been employed so far, because it detects active SARS-CoV-2 infections and can, if carried out rapidly, be used to prevent the spread of SARS-CoV-2 in the population via the isolation of close contacts.

*Antibody Testing:*

Antibody testing can determine, to a reasonable degree of confidence, whether a person has previously been infected with SARS-CoV-2. Such individuals are likely immune to SARS-CoV-2 for a period of time post infection. This class of testing has not yet been extensively employed in Ireland. It is not useful for containing the spread of SARS-CoV-2 in the population, but it is useful for estimating the

proportion of the population that has been infected with SARS-CoV-2 in the past. It may also be useful for establishing "immunity certificates" in the future.

## 2. STRATEGIC OPTIONS

Realistic management strategies can be classified into three broad domains: *mitigation*, *suppression*, and *elimination*. This submission advocates for the initiation and maintenance of an elimination strategy in Ireland. But the concrete recommendations in this submission equally apply to the effective and sustainable maintenance of Ireland's current ostensible suppression strategy.

While the lockdown has succeeded in suppressing the transmission SARS-CoV-2 in the Irish population, this has only bought us time (Figure 1). Between 1 – 5 % of Irish residents are likely to have been infected, and are presumably immune to the virus at least for a period of months. The vast majority of the population is still susceptible, and all of the same risks from February 2020 persist in June 2020.

The challenge now is to manage the SARS-CoV-2 virus in the Irish population, in a socially and economically stable way and without further lockdowns or heavy restrictions. Starting from here, if no actions are taken there is still the *a priori* risk of unmitigated transmission, leading to the health service being overwhelmed and a case/fatality rate > 10 % as seen in northern Italy. There are three broad strategic options for managing SARS-CoV-2: mitigation, suppression, and elimination (Figure 2).

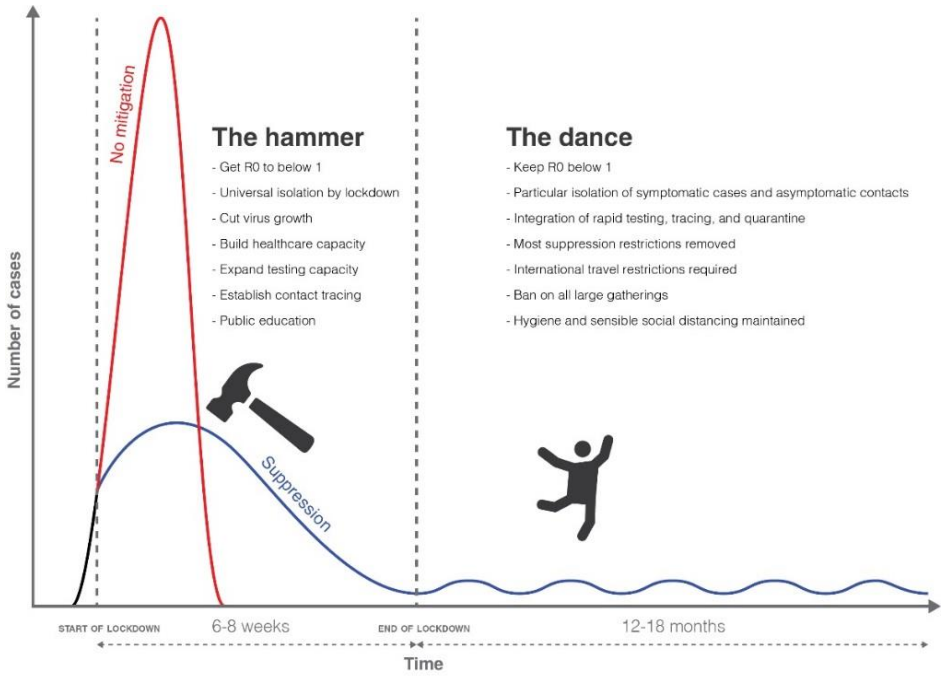



**Figure 1**: "Hammer & Dance" Distinction (adapted from Tomas Pueyo).

Heavy suppression measures (the 'hammer') were necessary to bring the virus under control in the population. Less severe suppression measures (the 'dance') now need to be employed to maintain suppression without disrupting the economy.

### 2.1 Strategy 1: Mitigation

Mitigation strategies slow, but do not prevent, the transmission of SARS-CoV-2 in the population. These measures include mild to moderate social distancing and hygiene. Most of the measures currently employed in Ireland can be classed as mitigation. This approach carries a high risk of spikes of infection that can quickly become surge. It has been estimated that to maintain this strategy, a cycle of successive lockdowns would need to continue up to seven times (Moran et al '20), until we reach a stage of herd immunity, with at least 60 - 65 % of the population infected.

### 2.2 Strategy 2: Suppression

Ireland is currently in a state of SARS-CoV-2 suppression owing to the lockdown. The maintenance of suppression requires mask wearing and a sufficient infrastructure for SARS-CoV-2 TTI infrastructure as well as clear and enforceable guidelines for positive case isolation and contact quarantine. A model approach for a democratic society such as Ireland is South Korea.

### 2.3 Strategy 3: Elimination

The most ideal scenario is elimination (also known as "*crushing the curve*"), which means the effective removal of the virus, with no new cases. Successful elimination has been achieved by New Zealand, Iceland, and Taiwan. Other countries are very close, including Greece, Norway, and Thailand. It is likely that many other countries will pursue this ambition soon, such as Finland, Austria, Denmark, Portugal, and Scotland. Achieving this option would mean no further COVID-19 infections or deaths, an open economy, and a return to a fully normal life without restrictions.

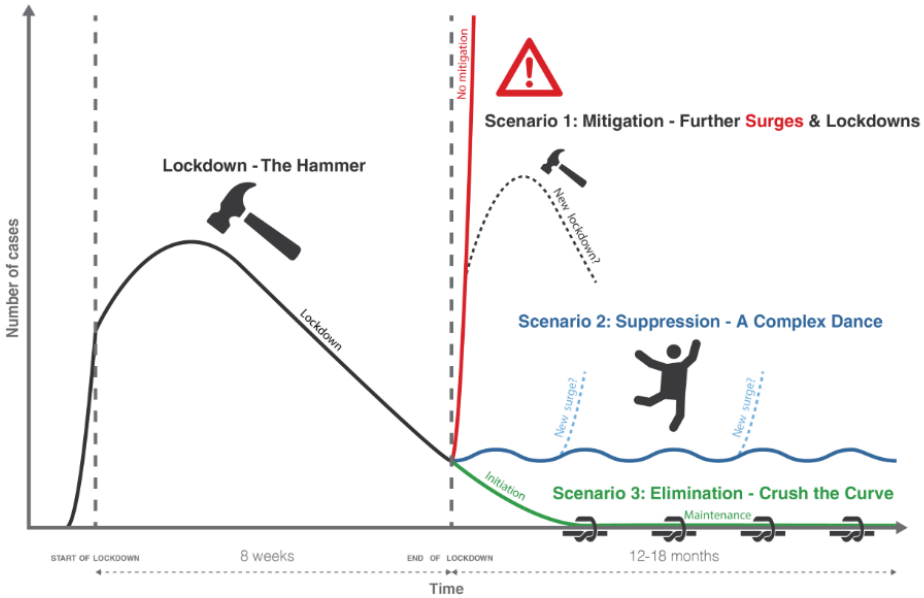


**Figure 2**: Illustrative Graph - A Choice of Three Exit Strategies

In the case of Ireland, ongoing mitigation will require an accumulation of COVID-19 cases and fatalities until we reach potentially 50,000 deaths or an effective vaccine is developed. Suppression (maintaining a flat curve) will involve the gradual accumulation of thousands of deaths, along with a social and economic "new normal" that will be required to maintain suppression and prevent surges. An effective elimination strategy (crushing the curve) would limit cases and fatalities to those already accumulated, and enable a return to a normal social and economic environment.

### 2.4 Elimination Methods

Any elimination strategy is a two stages process: an **initiation** phase, and a **maintenance** phase. There are three main tactical options for the initiation of elimination: a sharp lockdown, an aggressive and targeted test/trace/isolate operation in combination with mask wearing and social distancing, or extensive population testing.

*Method A: Defined Lockdown*

The most direct away way to achieve elimination is with a sharp lockdown, as was achieved in New Zealand. This approach requires a minimum of essential workers, enforced blanket travel quarantine into the country, and the compliance of the population.

*Method B: Hierarchical Test/Trace/Isolate (TTI)*

This method has been most effectively employed in Taiwan. In a country like Ireland, it should be possible to use an aggressive TTI infrastructure; in combination with mask wearing, social distancing, and incoming travel quarantine; to effectively eliminate the virus from the country (Figure 3). A hierarchical TTI approach would not only isolate close contacts, of primary cases, but also test all close contacts of primary cases quickly enough to identify the secondary cases of SARS-CoV-2 infection. The close contacts of the secondary cases would then be quarantined and tested to identify the tertiary cases of infection, and so on for the quaternary cases.

*Method C: Test Everyone*

A seemingly radical approach is to test everyone in the population every two weeks and isolate all positive cases. This would require 350,000 people to be sampled and tested every day. The logistical challenge of sampling could be met by substituting nasopharyngeal swabs with saliva sampling. Saliva (sputnum) has been shown to give equivalent results and would facilitate "at home" sampling that could be combined with a courier system for delivery to test centers. Samples could then be pooled to reduce initial test burden (say 10 samples per pool). In this scenario, a core capacity of only 35,000 tests per day would be required. Most sample pools would be negative, meaning all individuals in the pool would be cleared. When a pool tests positive, then all individual samples from that pool would be re-tested to identify the positive cases(s).

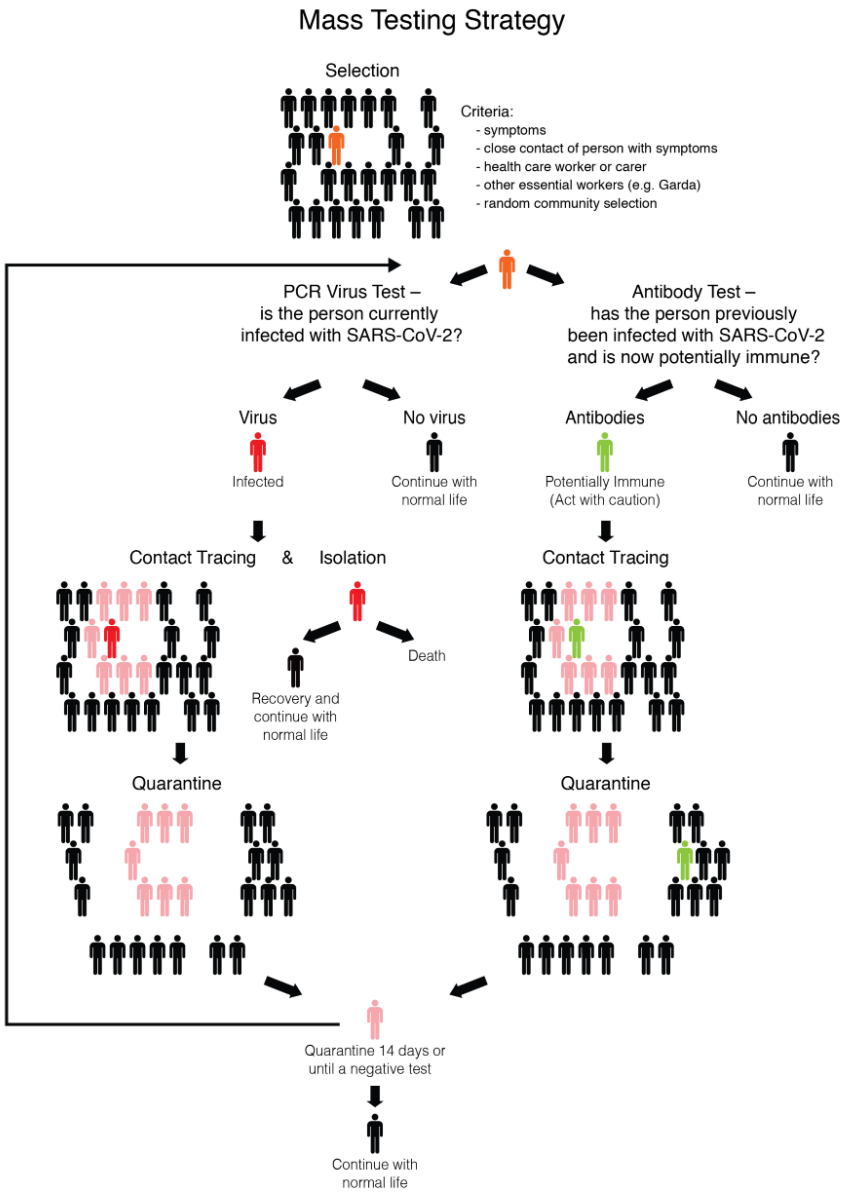



**Figure 3**: Test/Trace/Isolate Procedure (Including Antibody Testing)

## 2.5 Elimination Maintenance & Seeding

It is important to note that while any of the above three methods can achieve the initiation of SARS-CoV-2 elimination, only methods B and C can be used to maintain an elimination or a near elimination state. Presently, method B is far more practical than method C. But in the future, method C may become much more straightforward owing to new technology and/or a substantial scale-up in testing capacity and coordination. A particularly pertinent requirement for the maintenance of elimination, or the effective maintenance of suppression, is the prevention of seeding of new SARS-CoV-2 infections

A common need for the successful maintenance of a suppression or an elimination strategy is the prevention of seeding of new SARS-CoV-2 infections from abroad. This can be achieved by mandatory quarantine of all incoming travelers, regardless of citizenship or residency, for 14 days. More economically practical measures are also possible. The establishment of “air corridors” with other countries that have an equivalent, or lower prevalence of SARS-CoV-2 in their population would facilitate bilateral travel with impediment. More comprehensively, the establishment of SARS-CoV-2 PCR testing at airports and ports, as practiced in Austria, Hong Kong, South Korea, and Japan, would enable the screening of all incoming travelers form high risk zones.

It must be observed that, using current technology, standard PCR testing is not effective at identifying infected SARS-CoV-2 carriers for the first 1 - 3 days post infection. Therefore, a minimum 2 – 3 day period of mandatory self-isolation would still be required for all travelers who test negative at a port or airport (and a record kept of all potential close contacts during that time). They would then be tested at least one or possibly two times, and a repeated negative result would justify an early exit form self-isolation. If they test positive on either the first test or the second test, then naturally they should be isolated for 2 weeks.

## 3. TESTING SUMMARY

### 3.1 Requirements of Testing Throughput

For the purposes of contact identification and quarantine, the role of testing is to inform contacting tracing. The crucial feature is to identify and isolate close contacts ***before*** they spread the SARS-CoV-2 in the population. This is a challenge because while positive cases can display COVID-19 symptoms 5 days post infection, they spread the virus presymptomatically at 3 days post infection (Figure 4). Furthermore, it has been estimated that between 20 and 50 % of all SARS-CoV-2 positive cases are asymptomatic in nature, meaning that even at 5 days post infection they will not experience symptoms and will not know to self-isolate. Therefore there is a 3 day window in which to identify and quarantine the close contacts of primary COVID-19 cases. The 3 days window begins when the primary case experiences symptoms, and from there must be sampled, tested, contacts identified, and contacts quarantined. Missing this window results in effective suppression of the virus in the population as studies have shown (Feretti et al ’20).

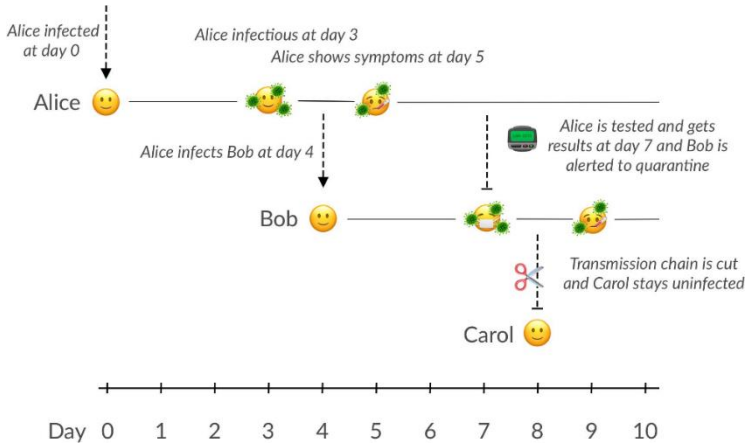


**Figure 4**: Presymptomatic Spread of SARS-CoV-2 (Figure sourced from Bedford Lab at Fred Hutchinson Cancer Research Center, Seattle)

It is crucial that a TTI infrastructure not only has a sufficient capacity, but also is fast enough to capture presymptomatic cases of COVID-19 and asymptomatic SARS-CoV-2 infections. It has been estimated that 20 – 50 % of SARS-CoV-2 infections are asymptomatic, and all symptomatic infections actively spread SARS-CoV-2 infections for 2 days prior to displaying symptoms of COVID-19 at 5 days post infection) (Figure 4). Therefore a successful TTI framework must ideally **identify and quarantine** all close contacts of positive cases (secondary cases), within **72 hours of the primary cases displaying symptoms**.

### 3.2 Testing Capacity in Ireland

Significant progress has been towards developing a SARS-CoV-2 testing operation in Ireland, which is managed by the Health Service Executive (HSE). The operational framework has proven itself effective in broadly estimating the prevalence of COVID-19 in the Irish population throughout the pandemic. It has not, however, been effective so far in preventing the spread of the SARS-CoV-2 virus in the population. It is reported that Ireland's current SARS-CoV-2 of the order of 100,000 tests per week, or about 15,000 tests per day. It is not clear, however, whether this capacity has been achieved consistently over consecutive days in a reliable manner.

### 3.3 Testing Speed in Ireland

According to the HSE COVID-19 dashboard, on June 15th (the last day that testing times were published on the HSE website), the average time taken for community sampling was one day. The average time taken for community test results was 2 days. Then a day or more is reported for tracing of simple contacts to be completed. Based on these data, it is taking **an average of at least four days** for the process to go from appointment booking to contact tracing and isolation to occur. However, the time taken for putative COVID-19 cases to report symptoms is a crucial part of the process. The HSE does not report the time taken for individuals to report symptoms in the first place. Nevertheless on June 2nd, the Deputy Chief Medical Officer noted that it was taking longer than four days for over 50 % of cases simply to be swabbed. Furthermore, it is noteworthy that the average number of contacts is steadily increasing as restrictions are further relaxed.

Based on the above, it is clear that the current infrastructure, while useful, does not operate at a sufficient speed to prevent the presymptomatic and asymptomatic spread of COVID-19 in the population. A reliable and sustainable suppression or elimination strategy will require a test/trace/isolation (TTI) infrastructure that is fast enough and robust enough to clamp down on localized spikes of SARS-CoV-2 infection before they spread further and become surges. At the

Oireachtas Special Committee on May 19th, the Secretary General of the Department of Health noted that the current system was “patched together”, and need to be redesigned form start to finish.

### 3.4 Scope for Augmented Testing

Aside from the prevention of seeding, the spreading of SARS-CoV-2 within the population must be managed. Besides developing a robust TTI infrastructure, a number of other testing measures would have a huge influence on SARS-CoV-2 suppression in the population. There are opportunities for the utilization of Ireland’s testing capacity to prevent spreading beyond the testing of symptomatic individuals.

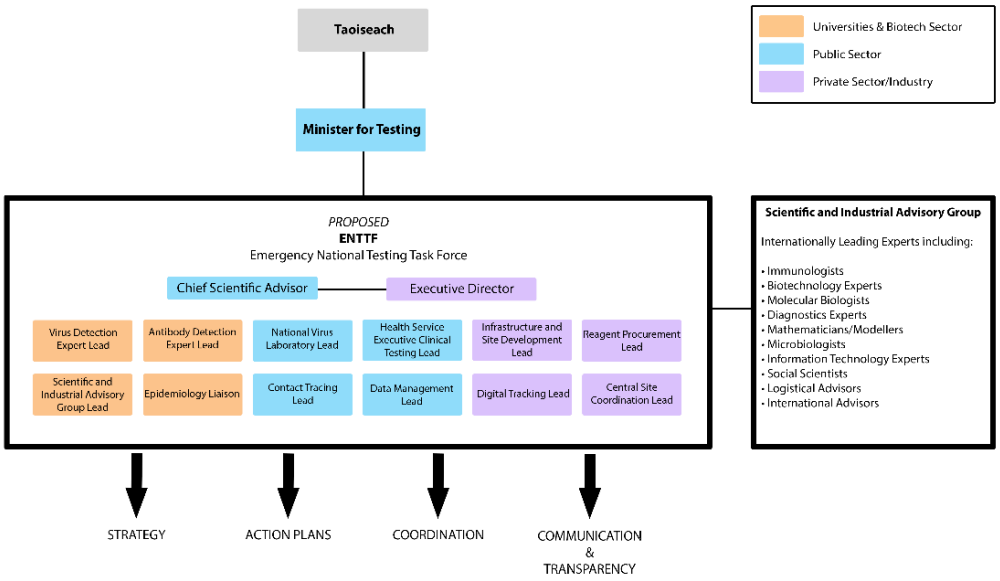
Studies have shown that the regular testing of health care workers (HCWs) can reduce community transmission by 30 %. Furthermore, a study at Cambridge University showed that 3 % of all HCWs screened at Addenbrooke’s Hospital in Cambridge tested positive for active SARS-CoV-2 infection (Rivett et al ’20). This is likely higher in Ireland, where over 30 % of COVID-19 cases are HCWs. Based on this reality, the weekly or biweekly testing of all HCWs would be a wise investment. This approach could be expanded to test all hospital patients, nursing and care home residents and staff, airport and port workers, public transport workers, and teachers.

### 3.5 Antibody Testing & Immunity Certificates

Within the coming months, antibody testing of reliable specificity and sensitivity will become more widely available. This type of testing methodology will likely identify who has had SARS-CoV-2 in the past, and is likely immune and non-infectious. Antibody testing should be employed in the population, and also at travel ports. The possibility of “immunity certificates” is something that should be explored in the future.

## 4. STRUCTURAL CHALLENGES

To implement an effective, and scientifically orientated TTI operation, a new agency should ideally be developed. This agency should be the responsibility of a dedicated Minister, and should encompass




advisors and managers from academia and the private sector (e.g. Figure 5). The scientific knowledge on SARS-CoV-2 is rapidly advanced. Much of this knowledge is outside the domain of public health medicine, and encompasses epidemiology, virology, genetics, immunology, molecular biology, diagnostics, microfluidics, physiology, neuroscience, amongst other fields. It is essential that a broad range of experts, each of the highest caliber in their respective fields, be brought together as an advisory group to orientate a rapidly evolving strategy. For effective implementation side, it would be appropriate to bring in experienced professionals from the private sector including Ireland's biotechnology and pharmaceutical industries.

**Figure 5**: Example Organizational Model

## 5. TRANSPARENCY AND KEY PERFORMANCE INDICATORS

In order to continuously assess the extent and effectiveness of SARS-CoV-2 testing in the Irish population, it is essential that data be openly published in a detailed fashion. The data should be parsed according to type of testing (e.g. community based, hospital or care setting based, travel screening, HCWs, clusters, etc). Furthermore, it is appropriate to keep the public informed for the geographically locality of all cases and clusters. It is also important to record and publish which tests are done on declared symptomatic individuals, and which are done suspected presymptomatic contacts. It would further be valuable to know the proportion of apparently asymptomatic cases in the population (based on self-reporting of lack of symptoms). The publication of daily testing speeds should also be made available, rather than only the seven day averages and medians.

There are a number of useful, basic ways of interpreting the testing data as a heuristic for the efficacy of the testing. One is the % of positive test results, which has been encouragingly low in Ireland for some weeks at the time of this submission. It would also be helpful for the case/mortality rate to be made continuously available. Globally, a 2 - 3 % case/fatality has been observed for COVID-19 in countries where comprehensive community testing has been carried out. In Ireland, the case/mortality rate is about 5 - 6 %, which indicates that many (at least half) of symptomatic COVID-19 cases have not been detected, and most asymptomatic infections have not been detected. Therefore it is appropriate to plot and publish the case/mortality rate in Ireland as estimated for different periods of time. An adequate coverage of community should result in case/fatality rate of about 2 - 3 % and an infection/fatality rate of 0.5 – 1.5 %.

Another useful way of interpreting the testing data is the age distribution of positive SARS-CoV-2 tests. In countries with extensive community testing, it is clear that the middle aged and young adults account for the majority of SARS-CoV-2 infections (many of which as asymptomatic). In contrast, community testing that is not comprehensive results in a bias for the testing of older adults that are much more likely to display severe symptoms. This can result in an apparent but misleading pictures of the population.

## 6. SPECIFIC RECCOMMENDATIONS

1. Initiate cross-party discussion on the the preferred long-term COVID-19 strategy for Ireland; mitigation, suppression, or elimination. Address what the best and worst case scenarios would be for Ireland's society, economy, and education systems under each of these three strategic choices. Consider what is practically required to initiate, and maintain, each option. Provide recommendations to Government on which strategy is in the best interests for the country.

2. Design a stream-lined community testing operation that can identify and isolate **all close contacts** of primary COVID-19 cases **within 72 hours of the first symptoms of each primary case**. Ensure that sample collection happens within 12 hours of symptoms being reported. Consider the possibility of transitioning to "at home" sputum based sampling, with courier collection. Turn over all community based tests within 24 hours from sampling. Complete all contact identification within 24 – 36 hours of positive test result. Ensure that all identified close contacts are isolated for 2 weeks.

3. PCR test all contacts of primary cases during quarantine to identify secondary cases. Then use the information to identify the close contacts of secondary cases, then quarantine and test them, to identify tertiary cases, etc.

4. Expand the existing community testing operation to seek and identify all symptomatic and asymptomatic SARS-CoV-2 infections in the population, until a consistent infection/mortality rate is found to concur with international comparisons and provide confidence that full capture of community cases has been achieved. Consider testing every patient that comes in contact with the health services, regardless of symptoms or contacts.

5. Provide a website and 24 hour helpline for individuals with COVID-19 symptoms to report symptoms and book appointments for sampling.

6. Develop a public education campaign to encourage people to report symptoms and book a sampling appointment immediately after experiencing them.

7. Deliver a workable electronic contact tracing tool that be used by more than 60 % of the adult population, especially in cities and towns.

8. Provide a transparent resource of key performance indicators on testing and tracing. This should clearly separate community testing, and other types of continuous or sentinel testing. Detailed results on contact tracing success should be published, including all criteria for contact identification. Rolling seven day averages should be provided for the percentage of positive tests, the COVID-19 case fatality rate, the SARS-CoV-2 infection fatality rate, and the distribution of SARS-CoV-2 infections according to age bracket in the population.

9. Increase the SARS-CoV-2 PCR testing capacity to enable the sustainable testing of all HCWs on a weekly basis, as well as all nursing or care home staff and any other at risk group. All hospital patients should also be tested before being discharged. This extra capacity should not take away from reserve surge demands in community testing capacity.

10. It will be imperative to plan for a substantially augmented PCR testing capacity by late September 2020, when flu season begins as influenza symptoms overlap with COVID-19 symptoms.

11. Construct detailed plans to rapidly develop a PCR testing infrastructure at airports and ports to allow for the repeated testing of all incoming passengers from outside the island of Ireland.

12. Consider short-term to medium term feasibility of parallel or alterative plans to PCR testing, especially for airports and ports, including RT-LAMP and antigen testing by ELISA.

13. Scaled up antibody testing for SARS-CoV-2 should be carried out at a national level as an adjuvant to PCR virus testing - first in HCWs and residential care centers, and then the general population.

14. Begin exploring the possibility of “immunity certificates” for previously infected people who test positive in antibody or antigen tests. Establish guidelines for commercial antibody and antigen tests. Plan for the use of immunity certification in coordinating frontline HCWs and other at risk groups.

15. Initiate cross border discussions with the Northern Ireland Executive for an all-Ireland COVID-19 strategy.

16. Explore the possible formation of a new, dedicated “Emergency National Testing Taskforce” to rapidly respond to similar future events, ideally on all Ireland basis. “A National Pandemic Laboratory” would be crucial to such an organization, for rapid and centralized testing. This facility would be highly useful for medical laboratory testing in normal time.

## 7. FURTHER RESOURCES

endcoronavirus.org

covidtracking.comu

New England Journal of Medicine – 10 weeks to Crush the Curve

Tony Blair Institute for Global Change

crushthecurve.ie

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