

# An Evidence-Based Approach to Ending the Coronavirus Crisis



Lead author and editor: Julian Morris

Contributing authors: Adrian Moore and Jacob Rich

## EXECUTIVE SUMMARY

Many countries have reacted to the COVID-19 pandemic by locking down whole economies. While this blunt approach has successfully reduced transmission of the virus, it has also starved economies, making the medicine often as bad or worse than the ailment. A more-tailored risk-based approach, as has been used by countries that have successfully controlled their outbreaks, would curtail transmission by the most likely sources, while allowing for more individual movement by the least likely transmitters, providing for the safest reopening of the economy.

We undertook an extensive review of evidence regarding approaches to (a) limiting the spread of SARS-CoV2, the virus that causes COVID-19; (b) reducing mortality from COVID-19; (c) enabling the maintenance of supply chains and essential services; (d) enabling more widespread opening of the economy once effective measures have been put in place to reduce transmission and contain local outbreaks.

Based on this review, we identified several actions that, if taken together, form a coherent and effective approach. Some of these actions are best undertaken by the private sector. Some require government action—though in most cases that action is at a relatively decentralized level: town, county, city, or other local jurisdiction, rather than state or federal. Overall, they can be construed as a public-private partnership.

### A. Measures to identify the scale of the infection, including hotspots, and contain it

The following three steps are intended to discover how widespread COVID-19 is in a jurisdiction, identify emerging virus hotspots or “clusters”, contain those clusters and reduce transmission generally. These steps should be implemented as soon as possible.

1. Undertake population screening for the virus (SARS-CoV2), as well as antibodies to the virus, in order to locate clusters of current and past infection.
2. Simultaneously undertake targeted testing and contact tracing, both manually and through the use of contact tracing apps, in order to identify as far as possible all those who have the virus.
3. Incentivize full isolation for all who test positive for the virus and anyone identified as at risk due to contact with an infected person, until they are able to have a test. Retest individuals for both virus and antibodies after 2 weeks if non-symptomatic at that time.

B. Support the development of risk-based systems that will enable individuals and companies to engage in an increasingly wide range of economic and social activities.

The next four steps are intended to enable individuals and companies to understand better the infection risks associated with particular actions and interactions, and to set rules that appropriately limit those risks.

By taking these steps, it should be possible to implement a phased reopening of businesses and other institutions, and relax stay-at-home requirements, while maintaining appropriate mitigation measures.

The objective is to replace a system that punishes the vast majority of people and businesses with one that requires only those who are infected or likely infected to self-isolate. Those least likely to be infected are able return to work and more normal activities in relative safety.

4. Support the development of an infection-risk based Red-Amber-Green (RAG) CV19 status system for individuals, activities and jurisdictions, which can be used to determine *who* can and cannot do *what, where*.
5. Support the use of privacy- and-autonomy-protecting authenticated CV19 status app(s) for access to activities. The purpose of these apps is to enable individuals voluntarily to share their status with others, in order to ensure both parties are able to take appropriate measures to limit risk. The apps could also be tied to a contact tracing system, thereby improving the effectiveness of that system.
6. For many activities in many places, it will likely be necessary to use masks and other personal protective equipment (PPE). Given the current lack of adequate PPE supply, it is important that any unnecessary barriers to production and distribution be removed. In particular, current federal regulations must be relaxed.
7. Businesses should be encouraged to develop best practices for limiting exposure to CV19, which might be formalized as "CV19 standards". Given concerns about

liability for negligence resulting from exposure of staff and customers, Congress should consider limiting liability for businesses that adopt these standards.

### C. Encourage the development of effective therapies and vaccines

The final steps in the plan relate to the development of therapies and vaccines. It is expected that the former will reduce the severity of COVID-19 and lower the mortality rate. It is hoped that the latter will enable widespread immunity and hence return to normalcy.

8. Incentivize the rapid development of safe and effective treatments and vaccines. New drugs and vaccines usually take months or even years to test in trials involving thousands of people. Since time is of the essence, new, more efficient solutions are needed—and to a considerable degree are being applied. This has required the relaxation of some regulations.
9. Once effective treatments are available at sufficient scale, so that the case fatality rate is substantially reduced, it may be possible to adjust the risk-proportionate restrictions on individuals, activities and jurisdictions. Given that the main justification for the restrictions was the feared high rates of hospitalization and fatality, which threatened to overwhelm healthcare systems, it makes sense that as effective therapies arrive, the curve will automatically be flattened, so the restrictions can be removed.
10. Once an effective and safe vaccine is available and deemed to be “preventative,” it will be made freely available to all. Most restrictions on vaccinated individuals will be removed. Once a sufficient proportion of the population has immunity, either from the vaccine or having COVID-19, the remaining restrictions may be removed.

Actions 1 through 7 can and should be implemented more-or-less simultaneously. This would enable the rapid removal of many restrictions on movement, while simultaneously protecting the most vulnerable and containing the spread of the virus. It is not necessary to test everyone before removing many of these restrictions.

These measures offer an adaptable range of options, and no one approach will work everywhere. Rural areas may not need to use as many tools to reduce risk as urban areas do, and communities with more vulnerable populations, such as more retirees, may need to take different measures from college towns. In all cases, more data-driven approaches based on track and trace are desirable.

For similar reasons, some jurisdictions will be able to open up more rapidly than others, based on the assessment of local risk factors. Other jurisdictions may have to remain subject to more restrictions for a while longer.

## 1. Introduction

SARS-CoV2, the virus that causes COVID-19, is now widespread across much of the world. The failure to contain the virus early on has had tragic consequences. This was nowhere more apparent than in parts of Northern Italy, where the health care system was overwhelmed, forcing medical practitioners to engage in the most awful triage decisions.<sup>1</sup>

To avoid similar tragedies, many jurisdictions, ranging from cities to entire countries, have chosen to implement mandatory lockdowns. These seem to be having the desired effect of slowing transmission in the short term. However, the economic and human consequences of such lockdowns is now becoming evident.

Estimates suggest that in the United States alone, unemployment could reach 30 percent and GDP might decline by 40-50 percent in the second quarter of 2020.<sup>2</sup> Financial stress in general and unemployment in particular are likely to lead to psychological problems, ranging from depression to suicide.<sup>3</sup> In other words, while the lockdowns may be reducing some incidence of disease and death from COVID-19, they are causing increased disease and death from other causes. Underpinning these problems are the following factors:

---

<sup>1</sup> Rosenbaum, Lisa. "Facing Covid-19 in Italy — Ethics, Logistics, and Therapeutics on the Epidemic's Front Line." *New England Journal of Medicine*. March 18, 2020. DOI: 10.1056/NEJMp2005492.

<sup>2</sup> Domm, Patti. "JPMorgan Now Sees Economy Contracting by 40% in Second Quarter, and Unemployment Reaching 20%." *CNBC Markets*. 9 April, 2020, <https://www.cnbc.com/2020/04/09/jpmorgan-now-sees-economy-contracting-by-40percent-and-unemployment-reaching-20percent.html>. Matthews, Steve. "U.S. Jobless Rate May Soar to 30%, Fed's Bullard Says." *Bloomberg Economics*, 22 March, 2020, <https://www.bloomberg.com/news/articles/2020-03-22/fed-s-bullard-says-u-s-jobless-rate-may-soar-to-30-in-2q>.

<sup>3</sup> Yunqiao, Wang, Jitender Sareen, Tracie O. Afifi, Shay-Lee Bolton, Edward A. Johnson and James M. Bolton. "A Population-Based Longitudinal Study of Recent Stressful Life Events as Risk Factors for Suicidal Behavior in Major Depressive Disorder." *Archives of Suicide Research*. Volume 19 (May 2015). 202-217. <https://www.tandfonline.com/doi/abs/10.1080/13811118.2014.957448>; Richardson T., P. Elliott P, R. Roberts. "The relationship between personal unsecured debt and mental and physical health: a systematic review and meta-analysis." *Clinical Psychology Review*. 33(8) (2013).1148-62. <https://www.ncbi.nlm.nih.gov/pubmed/24121465>; Blakely, TA, et. al. "Unemployment and Suicide. Evidence for a Causal Association?" *Journal of Epidemiology & Community Health*, Vol. 57 (2003). 594-600.; In addition to the increased propensity for suicide noted above, anxiety associated with the lockdowns, loss of income, and the fear of COVID-19 may impair immune function, making people more susceptible to COVID-19. Heisz, Jennifer J. "Anxiety about coronavirus can increase the risk of infection — but exercise can help." *The Conversation*. March 22, 2020. <https://theconversation.com/anxiety-about-coronavirus-can-increase-the-risk-of-infection-but-exercise-can-help-133427>

- Many businesses, large and small, are unable to operate, or are only operating at a tiny fraction of the scale necessary to cover costs.
- Few businesses maintain sufficient cash reserves to service fixed costs while suffering a sudden, near-total collapse of revenue over an indefinite time period. So, many businesses have closed or are expected to close permanently if the government-mandated shutdowns continue.<sup>4</sup>
- Business closures have already constrained global supply chains,<sup>5</sup> including for food and agricultural products.<sup>6</sup>
- These dislocations will lead to supply shortages in the short term, as many manufacturers cannot procure needed input materials and farmers struggle to get crops to market.
- The permanent closure of many businesses within those supply chains, however, could mean that shortages continue beyond the short term, and building new businesses to replace them could become challenging since the world will need to consume capital to meet its ongoing consumption needs.
- While many people have been able to continue to work remotely, a large minority of people in a wide range of sectors are unable to work.
- Nations around the globe could be affected similarly, which would mean a sharp decline in global output.

In short, lockdowns cannot be maintained indefinitely. Frustration is already leading some people to call for a complete removal of all restrictions. This would almost certainly be counterproductive, but without a coherent plan, politicians may face no alternative. A realistic plan for unlocking society must be found. Urgently. This brief seeks to offer elements of what such a plan might look like, based on evidence from actions taken in many jurisdictions. Of course, each jurisdiction is unique, and no single plan can take into account all the relevant circumstances of a particular place. Thus, this

---

<sup>4</sup> See, e.g., Peterson, Hayley. "Coronavirus Could Trigger a Second Coming of the Retail Apocalypse, with a New Wave of Bankruptcies and Store Closings Expected to Sweep the Nation." *Business Insider*, 9 April 2020. <https://www.businessinsider.com/coronavirus-could-trigger-retail-bankruptcies-and-mass-store-closings-2020-4>.

<sup>5</sup> Deagon, Brian. "Coronavirus Business Closures Unmask Global Supply Chain Defects." *Investor's Business Daily*, 17 April 2020. <https://www.investors.com/news/technology/supply-chain-management-flaws-ripped-open-coronavirus-business-closures/>.

<sup>6</sup> Jadhav, Rajendra, et al. "Coronavirus Upends Global Food Supply Chains in Latest Economic Shock." *Reuters*, 3 April 2020. <https://www.reuters.com/article/us-health-coronavirus-food-supplies-insi/coronavirus-upends-global-food-supply-chains-in-latest-economic-shock-idUSKBN21L2V7>.

brief outlines a mix of what are likely core elements of any realistic plan along with suggestions for other elements that decision makers can use to inform public policy.<sup>7</sup>

Section 2 reviews the actions taken and outcomes from jurisdictions that have addressed the COVID-19 pandemic in different ways. From this review, we identify lessons that we can incorporate into our advice.

Section 3 discusses actions that can be taken to identify the prevalence of the virus, to contain it, and to enable the establishment of a risk-based system for determining, during the course of this crisis, who can do what, where. Section 4 outlines this risk-based system.

Section 5 explains the role of personal protective equipment (PPE) in reducing transmission of COVID-19 and outlines actions that can be taken to expand access to personal protective equipment, thereby enabling individuals to participate in activities without exposing themselves and others to undue risk of exposure.

Section 6 briefly considers the role of novel therapies for COVID-19 and the potential role that could be played by a vaccine. And it outlines some policy changes that might lead to more rapid development of both therapies and vaccines.

Section 7 reviews actions that can be taken to open the economy based on the preceding sections. And Section 8 offers some conclusions.

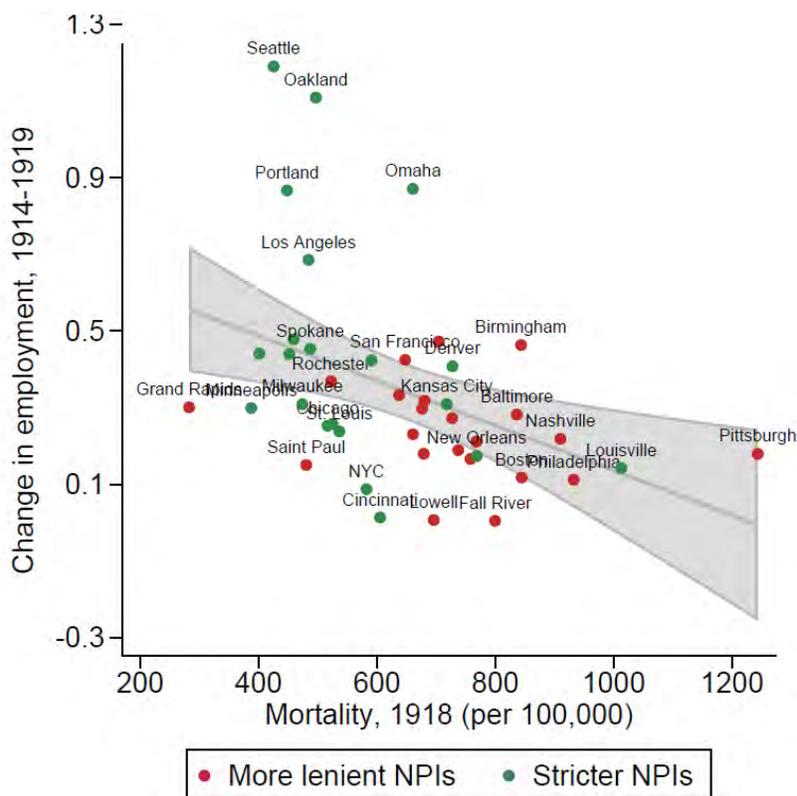
---

<sup>7</sup> Others have offered proposals with some similar elements. See e.g.: Cochrane, John H. "Flatten the Coronavirus Curve at a Lower Cost: A total shutdown could cost the economy \$1 trillion a month. We need more tailored measures." *The Wall Street Journal*, March 24, 2020. <https://www.wsj.com/articles/flatten-the-coronavirus-curve-at-a-lower-cost-11585067354>

## 2. Lessons from the Past and from Other Jurisdictions

A recent analysis of the differential effect of the 1918 flu pandemic in the United States found that cities which took early and aggressive action had a lower mortality rate and a more rapid economic recovery.<sup>8</sup> This can be seen in Figure 1, which contrasts cities that implemented early and aggressive “non-pharmaceutical interventions” (NPIs), such as social distancing, to contain the spread of the Spanish ‘flu (green dots) with those that did not (red dots). Cities that took early and aggressive action had both lower mortality in 1918 and higher rates of employment growth (a measure of economic growth) over the period 1914-1919. It seems likely that the same is true for COVID-19.

**Figure 1: City-level 1918 influenza mortality and manufacturing employment growth 1914-19.**



Source: Correia et al. *Pandemics Depress the Economy* (2020)

<sup>8</sup> Correia, Sergio and Stephan Luck, and Emil Verner. “Pandemics Depress the Economy, Public Health Interventions Do Not: Evidence from the 1918 Flu.” *Social Science Research Network*, (March 30, 2020). <https://ssrn.com/abstract=3561560> or <http://dx.doi.org/10.2139/ssrn.3561560>

Some jurisdictions responded very swiftly to the threat posed by the novel coronavirus that emerged in Wuhan, China in December 2019, introducing travel restrictions, testing, tracing and isolation. As a result, they managed to contain the spread of the virus, keeping infection rates and mortality low. Other places procrastinated, letting the virus spread. This section reviews the actions taken by those jurisdictions that were most effective at containing the spread of the virus—and contrasts these actions with those taken by some other less successful jurisdictions.

## 2.1 Contain the Spread and Crush the Curve

Starting in late December 2019, Singapore, Hong Kong, Taiwan and South Korea, all of which have strong direct ties to China and had experience of the 2003 SARS outbreak, very rapidly put in place measures to limit transmission.

### *Taiwan's approach*

Taiwan's response, arguably the swiftest and most effective, included:

1. Tracing and quarantining travelers with COVID-19 symptoms;
  - I. 2. Stringent restrictions on travel to and from areas with COVID-19 outbreaks;
  - II. 3. The introduction of “health declaration passes,” issued by text message, that enabled faster immigration for people from low-risk areas;
  - III. 4. The purchase and distribution of tens of millions of surgical and N95 masks.<sup>9</sup>

As a result, Taiwan successfully contained the spread of SARS-CoV2 without resorting to a full lockdown. As of April 19<sup>th</sup>, Taiwan reported a total of 420 confirmed cases of COVID-19 and 6 deaths. This is all the more remarkable given Taiwan's proximity to

---

<sup>9</sup> From December 31<sup>st</sup>, individuals with COVID-19 symptoms (coughing, fever) and a travel history to Wuhan, were required to quarantine. From January 20<sup>th</sup>: Limits were imposed on travel to and from affected areas based on risk, with mandatory 14-day quarantine for individuals from high-risk areas. All travelers were required to complete health declaration forms before or on arrival in Taiwan and were issued “health declaration passes” by SMS (text), which enabled more rapid immigration for those presenting minimal risk. Taiwan also instituted increasingly strict prohibitions on non-Taiwanese nationals with travel history from various affected jurisdictions. Meanwhile, by January 30<sup>th</sup>, the government was purchasing and distributing four million masks/day See Wang CJ, CY Ng, and RH Brook. “Response to COVID-19 in Taiwan: Big Data Analytics, New Technology, and Proactive Testing.” *Journal of the American Medical Association*. 2020;323(14).1341–1342. doi:10.1001/jama.2020.3151 <https://jamanetwork.com/journals/jama/fullarticle/2762689#note-JVP200035-1>

China, its relatively large population (23.8 million), and the fact that it had daily direct flights to Wuhan.

## 2.2 Once the Virus Has Spread, Identify and Contain Clusters

There are important lessons to be learned from the approaches to COVID-19 taken by jurisdictions such as South Korea, regions of Italy, Germany (contrasted with the U.K.), Iceland and the San Francisco Bay Area (contrasted with NYC).

### *Some Lessons from South Korea*

Like Taiwan, South Korea managed to contain the spread of SARS-CoV2 relatively quickly through similar measures. In addition, the government:

1. Introduced social distancing measures (including closing schools and restricting large gatherings),
2. Announced that it would rapidly issue emergency authorization for tests that detect the presence of the virus. (The first such authorization came on February 4<sup>th</sup>.<sup>10</sup>)
3. Provided testing to anyone who had COVID-19 symptoms (and increasingly those without symptoms) for the presence of the virus.
4. Undertook tracing and testing of people who had contact with those symptomatic individuals and sent texts to individuals who might have been in contact with those who tested positive.<sup>11</sup>
5. Treated those with severe symptoms.
6. Quarantining those who tested positive but had no or only mild symptoms (the quarantine was monitored using a phone app and strictly enforced).<sup>12</sup>

---

<sup>10</sup> Terhune, Chad, Dan Levine, Hyunjoo Jin, and Jane Lanhee Lee. "Special Report: How Korea trounced U.S. in race to test people for coronavirus." *Reuters*. March 18, 2020 <https://www.reuters.com/article/us-health-coronavirus-testing-specialrep/special-report-how-korea-trounced-u-s-in-race-to-test-people-for-coronavirus-idUSKBN2153BW>

<sup>11</sup> Zastrow, Mark. "South Korea is reporting intimate details of COVID-19 cases: has it helped?" *Nature*. 18 March 2020. <https://www.nature.com/articles/d41586-020-00740-y>

<sup>12</sup> Dudden, Alexis and Andrew Marks. "South Korea took rapid, intrusive measures against Covid-19 – and they worked." *The Guardian*. 20 March 2020. <https://www.theguardian.com/commentisfree/2020/mar/20/south-korea-rapid-intrusive-measures-covid-19>; Braun, Andrés Sánchez, "Commitment, transparency pay off as South Korea limits COVID-19 spread," *EurActiv*, March 16, 2020. <https://www.euractiv.com/section/coronavirus/news/commitment-transparency-pay-off-as-south-korea-limits-covid-19-spread/>

Unfortunately, South Korea experienced a sudden uptick in cases, starting in the city of Daegu on February 18<sup>th</sup>. The outbreak was traced to a single individual, “Patient 31” who is estimated to have infected approximately 1,100 people.<sup>13</sup>

In order to contain the cluster, on February 23<sup>rd</sup> Korea’s Ministry of Health and Welfare (MOHW) requested that all residents of and visitors to Daegu voluntarily self-isolate.<sup>14</sup> It also established mobile testing in Daegu and Gyeongsangbuk-do, the site of another cluster.<sup>15</sup> As a result of these actions, S. Korea was able to slow the spread in the clusters and prevent them from affecting other regions.

### *Vo, Italy*

South Korea’s experience shows that, even after community spread has occurred, it may be possible to stop it relatively quickly. The small town of [Vo](#) in Northern Italy, the site of the first death in the country from COVID-19, appears to have [stopped the disease from spreading in approximately three weeks](#).<sup>16</sup> It did so through a combination of universal testing, two weeks of strict lockdown, and quarantine of cases.

Vo has a population of 3,300, which made universal testing more realistically feasible than it would be in a much larger jurisdiction. But the general approach of widespread testing, tracing the contacts of those who test positive, and isolating all those who test positive has been applied in numerous locations with considerable success.

### *Veneto and Lombardy, Italy*

Indeed, Veneto—the region that contains Vo—has been quite successful in limiting transmission, at least compared to neighboring regions in Italy, through a combination

---

<sup>13</sup> “Patient 31” had a car accident on February 7<sup>th</sup> and had been in hospital. Then, on February 10<sup>th</sup> she developed a fever and a week later was tested for COVID-19; she received a positive test result on the 18<sup>th</sup> and was put in isolation. Unfortunately, before she received her positive test result, Patient 31 had attended a religious service and went for lunch with a friend.

[https://www.cdc.go.kr/board/board.es?mid=a30402000000&bid=0030&tag=&act=view&list\\_no=366232](https://www.cdc.go.kr/board/board.es?mid=a30402000000&bid=0030&tag=&act=view&list_no=366232)

<sup>14</sup> Korean Center for Disease Control. “The Updates of COVID-19 in Republic of Korea.” 02 February, 2020.

[https://www.mohw.go.kr/eng/nw/nw0101vw.jsp?PAR\\_MENU\\_ID=1007&MENU\\_ID=100701&page=1&CNT\\_SEQ=353124](https://www.mohw.go.kr/eng/nw/nw0101vw.jsp?PAR_MENU_ID=1007&MENU_ID=100701&page=1&CNT_SEQ=353124)

<sup>15</sup> Ibid.

<sup>16</sup> Rettner, Rachael. “How one small Italian town cut coronavirus cases to zero in just a few weeks.” *LiveScience*. March 18, 2020. <https://www.livescience.com/small-italian-town-cuts-coronavirus-cases-testing.html>

of widespread testing, including both symptomatic and asymptomatic individuals, and tracing and testing contacts of those who tested positive. It also took great care to ensure those with the infection self-isolated, including by offering tests at home. By comparison, Lombardy, which neighbors Veneto, has undertaken far fewer tests per capita, done a less thorough job of contact tracing, and has done less to encourage self-isolation.<sup>17</sup>

### *Germany and the UK*

Both Germany and the UK have suffered severe outbreaks of COVID-19 but far more people have died in the UK than have died in Germany, in spite of the latter having a considerably larger population (about 83 million compared to about 67 million in the UK). Part of the difference in mortality is likely due to demographic factors: Germany has lower population density and its largest city, Berlin, has a population of only 3.3 million, compared to London's 8.9 million. Culture also likely plays a role: Germans tend to be more rule-bound and so may have more rigorously followed instructions to engage in "social distancing". But a large part of the difference in mortality is likely a result of difference the approach taken to testing, tracing and isolating people.

Since February 28, insurance funds in Germany have covered the costs of testing individuals who were symptomatic, following the advice of the Robert Koch Institute, Germany's equivalent of the Centers for Disease Control (CDC).<sup>18</sup> As the scale of the problem grew during March, provincial governments began widespread testing of non-symptomatic individuals, and initiated an aggressive program of testing, contact tracing and isolation. The aim was to understand the overall incidence of COVID-19, as well as to identify and contain disease clusters.<sup>19</sup> By the week of April 4, 132—mostly private—testing labs were carrying out an average of over 115,000 swab tests per day.<sup>20</sup> Provinces with significant outbreaks also introduced aggressive social distancing measures—and the federal government then introduced "guidelines" for businesses to

---

<sup>17</sup> Pisano, Gary P., Raffaella Sadun and Michele Zanini. "Lessons from Italy's Response to Coronavirus," *Harvard Business Review*, March 27, 2020. <https://hbr.org/2020/03/lessons-from-italys-response-to-coronavirus>.

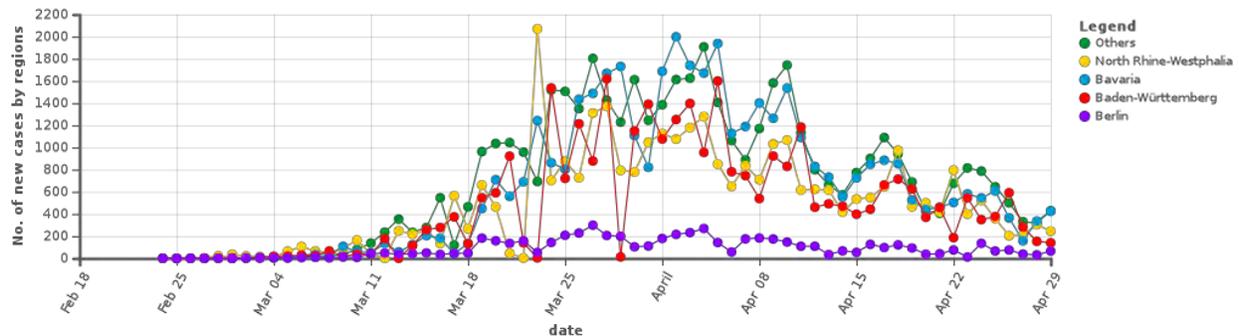
<sup>18</sup> <https://www.zusammengegen corona.de/en/inform/information-on-testing/>; see also: [https://www.rki.de/EN/Content/Institute/institute\\_node.html](https://www.rki.de/EN/Content/Institute/institute_node.html)

<sup>19</sup> Schneider, Paula. "Statistikerin fordert Tests, die endlich das wahre Corona-Ausmaß in Deutschland zeigen." *Focus Online*. 25 March 2020. [https://www.focus.de/gesundheit/news/es-grassiert-ungewissheit-repraesentative-tests-sollen-wahres-ausmass-in-deutschland-zeigen\\_id\\_11813688.html](https://www.focus.de/gesundheit/news/es-grassiert-ungewissheit-repraesentative-tests-sollen-wahres-ausmass-in-deutschland-zeigen_id_11813688.html)

<sup>20</sup> Morris, Chris. "Coronavirus: What can the UK learn from Germany on testing." BBC News. April 11, 2020. <https://www.bbc.com/news/health-52234061>

be implemented by the provinces that included a \$27,000 fine for non-compliance.<sup>21</sup> This strategy seems to have largely been successful; as can be seen in Figure 2.

Figure 2: Number of New Cases of COVID-19 in German Provinces



Source: Data from Robert Koch Institute; graphic from:

[https://en.wikipedia.org/wiki/2020\\_coronavirus\\_pandemic\\_in\\_Germany](https://en.wikipedia.org/wiki/2020_coronavirus_pandemic_in_Germany)

On paper, the U.K.'s approach was almost a mirror image of Germany's. From early February, Public Health England, the country's equivalent of the CDC, recommended testing not only those who were symptomatic but also non-symptomatic contacts.<sup>22</sup> But then on March 13, PHE changed its advice, limiting testing to those who were hospitalized.<sup>23</sup> This apparently sudden change was partly a consequence of PHE's highly centralized approach to analyzing swabs, which were being carried out only in PHE's own labs, rather than relying on the hundreds of private labs around the

<sup>21</sup> "What are Germany's new coronavirus social distancing rules?" *DW*. 22 March 2020. <https://p.dw.com/p/3ZsxK>.

<sup>22</sup> Public Health England. "Guidance: COVID-19: investigation and initial clinical management of possible cases." Updated 6 February (<https://web.archive.org/web/20200206233909/https://www.gov.uk/government/publications/wuhan-novel-coronavirus-initial-investigation-of-possible-cases/investigation-and-initial-clinical-management-of-possible-cases-of-wuhan-novel-coronavirus-wn-cov-infection>) and Updated 12 March 2020 (<https://web.archive.org/web/20200312190449/https://www.gov.uk/government/publications/wuhan-novel-coronavirus-initial-investigation-of-possible-cases/investigation-and-initial-clinical-management-of-possible-cases-of-wuhan-novel-coronavirus-wn-cov-infection>).

<sup>23</sup> Public Health England. "Guidance: COVID-19: investigation and initial clinical management of possible cases." Updated 13 March. <https://web.archive.org/web/20200315110334/https://www.gov.uk/government/publications/wuhan-novel-coronavirus-initial-investigation-of-possible-cases/investigation-and-initial-clinical-management-of-possible-cases-of-wuhan-novel-coronavirus-wn-cov-infection>

country.<sup>24</sup> It was also seemingly driven by an assumption on the part of the government that mass infection was inevitable and containment thus pointless.<sup>25</sup>

On April 1, Mike Fischer, the owner of a private lab, initiated a program of private testing, both at his own lab and by offering 1 million pounds (\$1.25 m) to support testing at other labs around the country.<sup>26</sup> Fischer is reported to have said, “Our aspirational goal ... is that if we can get to 1,000 labs doing 800 tests per day within a few months, that will provide 800,000 tests per day.”<sup>27</sup> Then on April 4, the government announced its own plan to scale up testing, this time involving the private sector in both testing and logistics.<sup>28</sup> Three weeks later, the UK is still running fewer tests per day than Germany was running by the end of March.

Figure 3 contrasts the cumulative of tests (per 1,000 people) in Germany and the UK. As of April 28, the proportion of people tested in Germany was three times that in the UK. Meanwhile, the effectiveness of the differences in approach taken in Germany and the UK can be seen in Figure 4, which shows the number of new confirmed cases and the number of deaths from COVID-19 each day. Germany’s more aggressive testing led to the identification of a much larger number of cases early on, enabling effective isolation, which reduced transmission and lowered mortality.

---

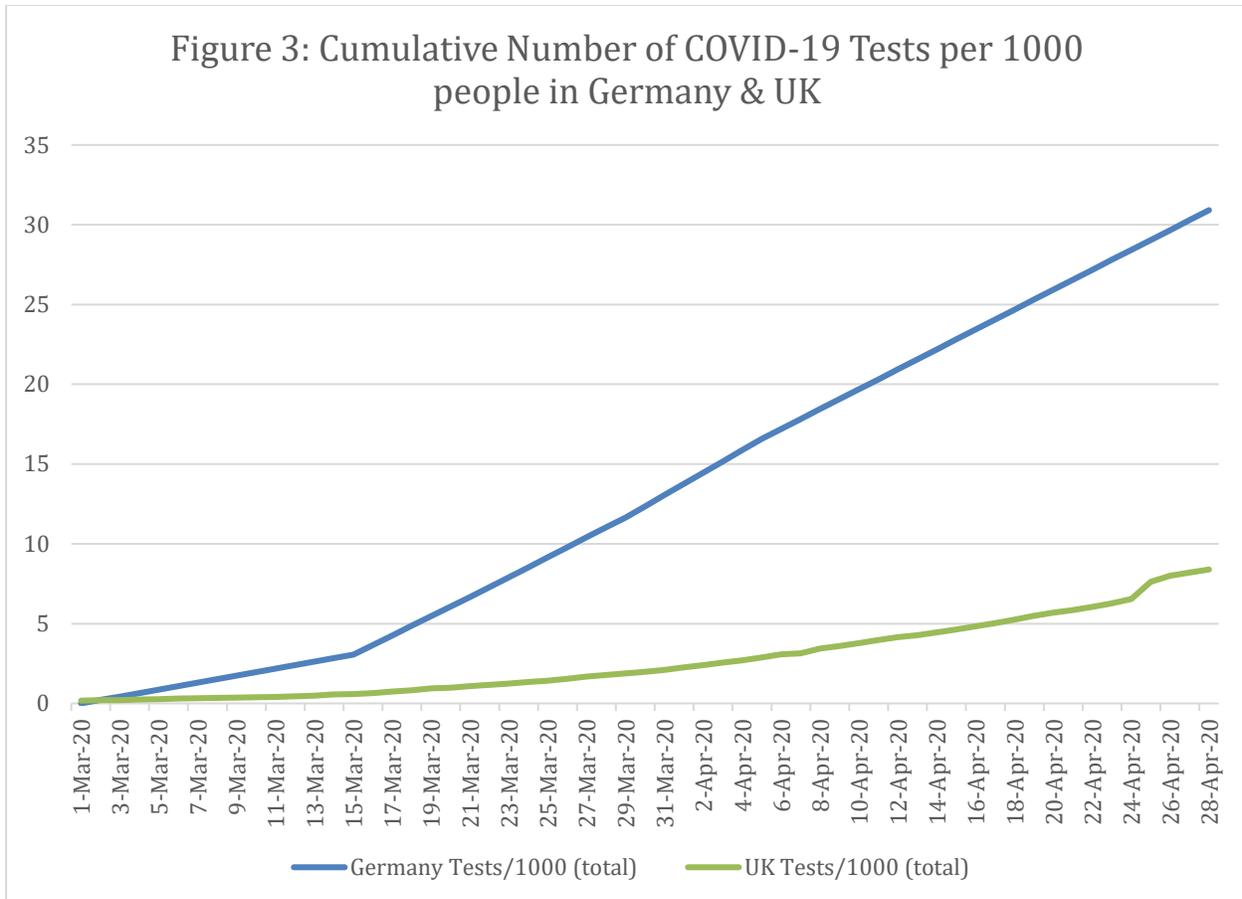
<sup>24</sup> Lesh, Matthew. “Testing Times: The urgent need to decentralise COVID-19 diagnostic testing in the United Kingdom.” London: Adam Smith Institute. April 2, 2020. <https://www.adamsmith.org/research/testing-times>

<sup>25</sup> FT Reporters. “Why the UK is struggling to scale up coronavirus testing.” Financial Times. April 1, 2020. <https://www.ft.com/content/3c9cf7d0-3d11-443e-a156-d111b333fd72>

<sup>26</sup> Rebecca Whittaker. “Abingdon lab owner calls for more Covid-19 tests.” Oxford Mail. April 7, 2020. <https://www.oxfordmail.co.uk/news/18365557.abingdon-lab-owner-calls-covid-19-tests/>

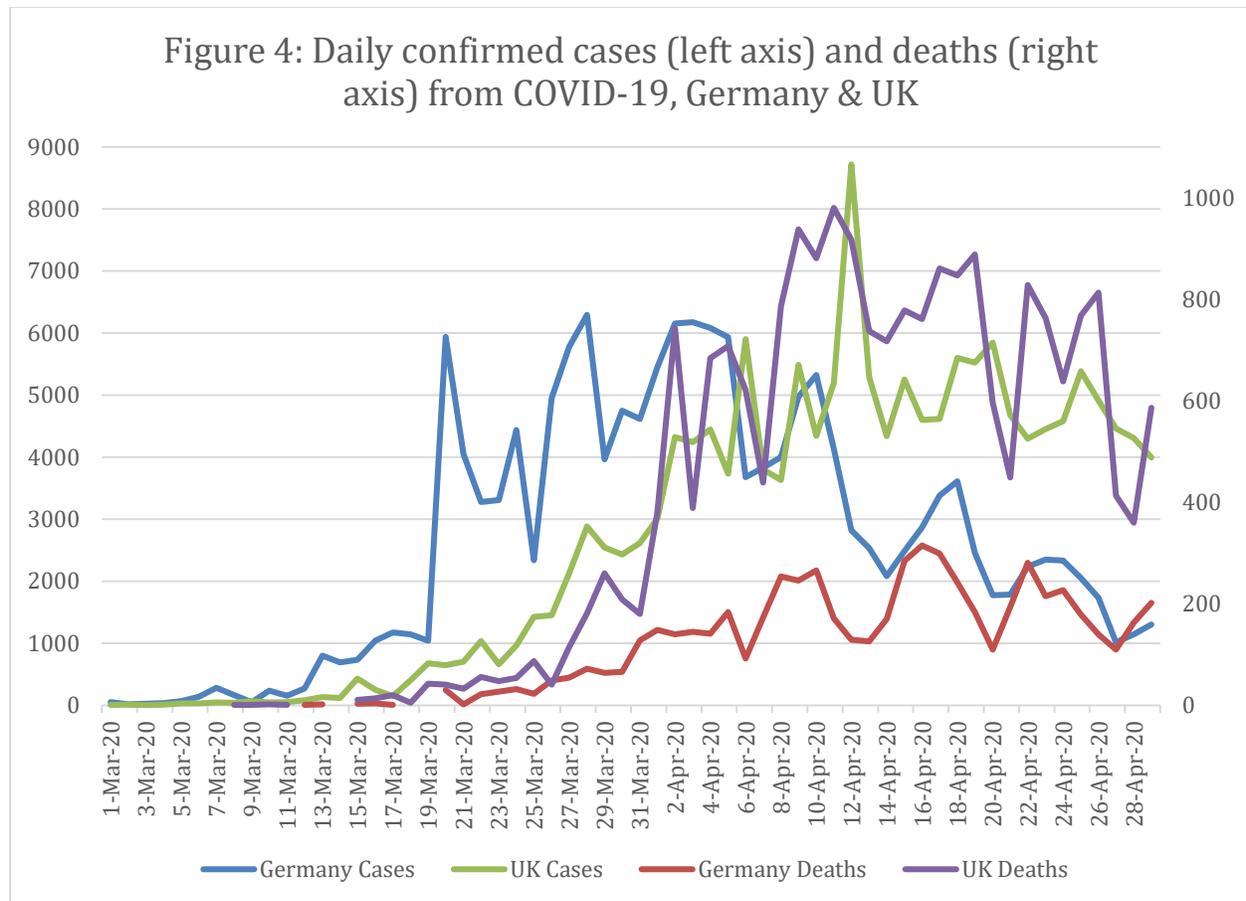
<sup>27</sup> Ibid, citing an interview on Radio 5 live.

<sup>28</sup>



Source: <https://ourworldindata.org/grapher/full-list-cumulative-total-tests-per-thousand>.

(Note the last available datum for tests in Germany was provided on April 19, so we extrapolated based on previous testing rate.)



Source: <https://ourworldindata.org/grapher/daily-covid-cases-deaths>

### Iceland

Iceland has managed to contain the COVID-19 outbreak without ever resorting to the kinds of lockdowns imposed in many other countries. And it has done so while experiencing a mortality rate ten times lower than Sweden—another country that has avoided lockdown.<sup>29</sup> How did Iceland do it?

Iceland's approach has combined widespread testing, quarantine and isolation, and treatment. This has enabled it to contain the spread of the virus, limit mortality, and avoid a lockdown.

<sup>29</sup> As of April 28, Iceland has had 10 deaths from COVID-19 out of a population of 364,000; Sweden has had 2,355 deaths out of a population of 10.23 million. (Source: <https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide>)

Iceland's aggressive testing program combines:

1. A targeted assessment of symptomatic individuals and their contacts, conducted by the government funded and run National University Hospital of Iceland (NUHI),<sup>30</sup> and
2. Population testing (a mix of open invitation and random sampling), conducted and funded by deCODE genetics, a local biotechnology company that is now owned by Amgen.<sup>31</sup>

In addition, a team of 50 individuals, employed by NUHI, has been tracing contacts of all those who test positive.<sup>32</sup>

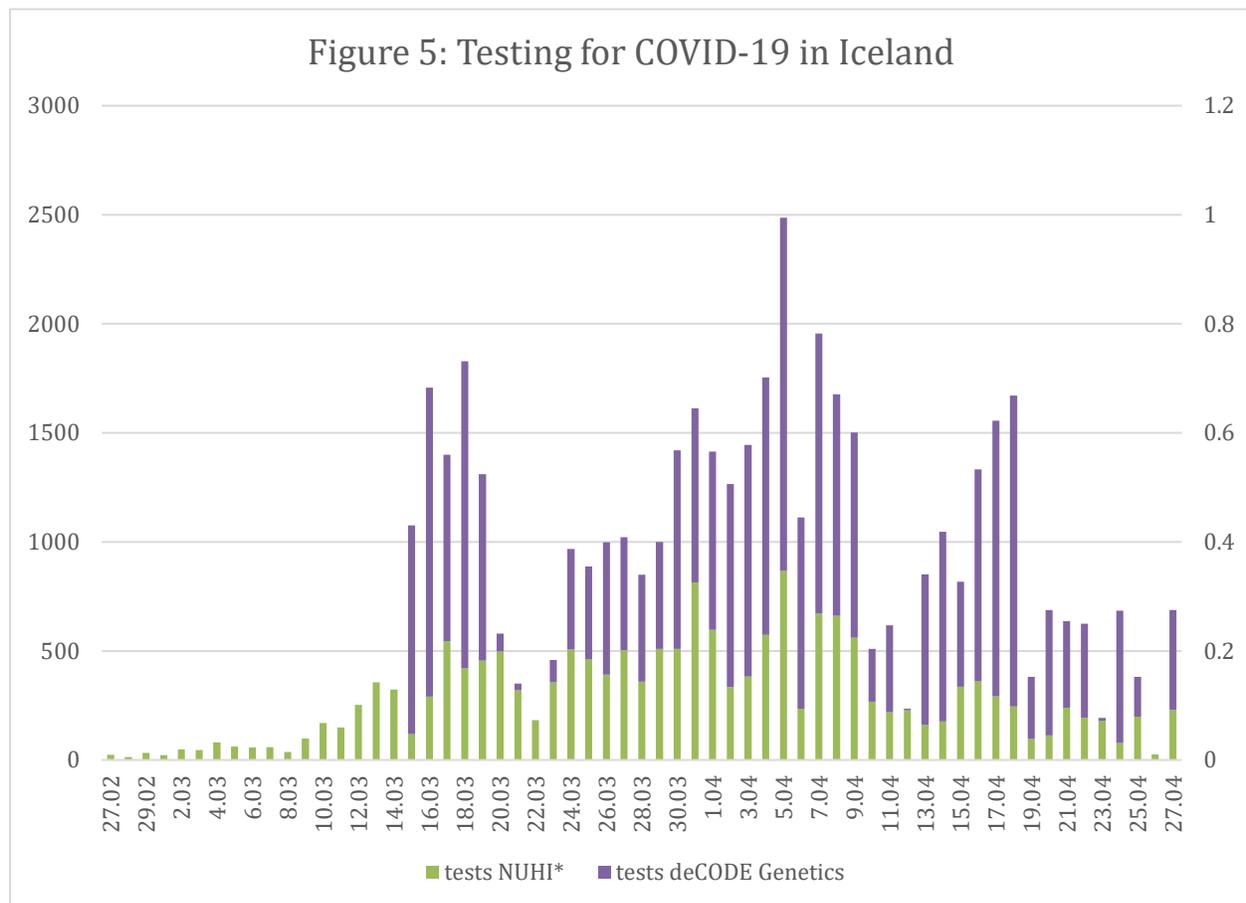
The targeted testing has focused on symptomatic individuals in “high risk” areas and those who had contact with someone who tested positive. Those who test positive, whether or not they are symptomatic, are then required to quarantine for 14 days.

---

<sup>30</sup> “Large scale testing of general population in Iceland underway” Ministry for Foreign Affairs, Prime Minister's Office, and Ministry of Health, Iceland. March 15, 2020. <https://www.government.is/news/article/2020/03/15/Large-scale-testing-of-general-population-in-Iceland-underway/>

<sup>31</sup> Malin Otmani. “COVID-19: First results of the voluntary screening in Iceland.” Nordic Life Science News. March 22, 2020. <https://nordiclifescience.org/covid-19-first-results-of-the-voluntary-screening-in-iceland/>

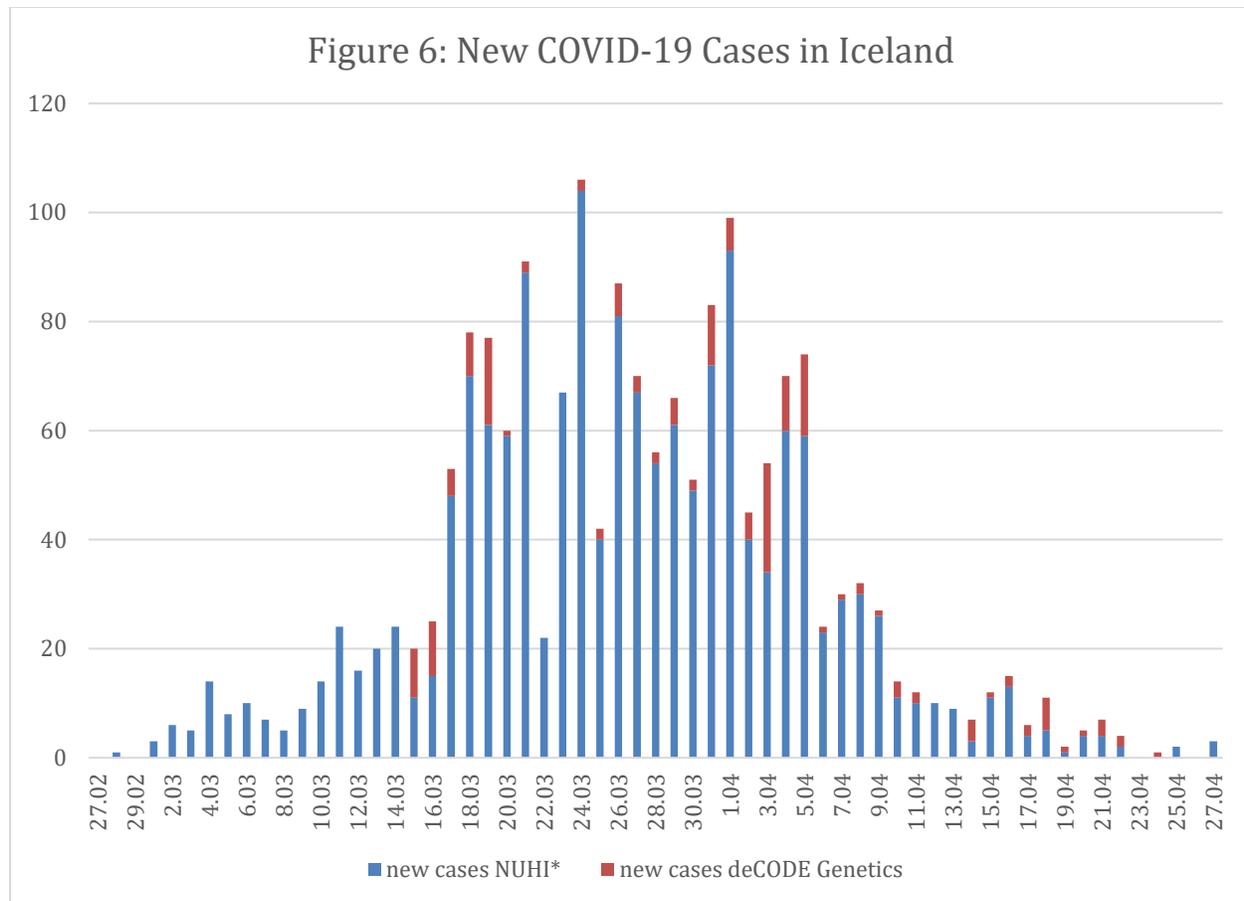
<sup>32</sup> Gudbjartsson, Daniel F. et al. “Spread of SARS-CoV-2 in the Icelandic Population.” *New England Journal of Medicine*. April 14, 2020. <https://www.nejm.org/doi/full/10.1056/NEJMoa2006100>



Source: [www.covid.is/data](http://www.covid.is/data)

The targeted testing program began on February 1<sup>st</sup> and the population testing program began on March 15<sup>th</sup>. Figure 4 shows the number of tests undertaken in the two programs on a daily basis since February 27<sup>th</sup>.<sup>33</sup> Figure 5 shows the number of new cases identified through each. As of April 26<sup>th</sup>, a total of 45,352 samples have been taken (some of these represent re-testing of the same individual); 1,792 confirmed cases have been identified, of which 1,608 have recovered, 174 are in isolation (13 are hospitalized, including 3 in intensive care), and 10 have died.

<sup>33</sup> Between Feb 1<sup>st</sup> and Feb 26<sup>th</sup>, 46 samples were tested (<https://www.covid.is/data>)



Source: [www.covid.is/data](http://www.covid.is/data)

### *San Francisco Bay Area and New York*

In the U.S., the San Francisco Bay Area and New York offer among the starkest contrast in approaches.

COVID-19 infections became a concern in the Bay Area shortly after the initial U.S. outbreak occurred at the Life Care Center in Kirkland, Washington. San Francisco's technology sector was ahead of the curve in terms of raising concerns about and responding to SARS-CoV2. Several days before local governments took any action, company leaders from Bay Area companies were instructing their employees to work

from home.<sup>34</sup> Because the Bay Area has a relatively high proportion of technology workers, it was easier for employers to implement work-from-home policies without a major loss of productivity.

Dr. Sara Cody, head of Santa Clara County's Public Health Department was also proactive; she established an incident room on January 23<sup>rd</sup>,<sup>35</sup> long before any local residents were hospitalized with COVID-19.<sup>36</sup> And on March 14<sup>th</sup>, Cody notified other Bay Area officials of an impending disaster on the scale of Italy's on March 14<sup>th</sup>.<sup>37</sup> Two days later, the Bay Area counties issued the nation's first shelter-in-place order and by the end of the week, all of California was operating under a statewide order issued by

---

<sup>34</sup> Twitter strongly encouraged all its employees globally to work from home on March 2<sup>nd</sup> and mandated it on March 11<sup>th</sup>. [https://blog.twitter.com/en\\_us/topics/company/2020/keeping-our-employees-and-partners-safe-during-coronavirus.html](https://blog.twitter.com/en_us/topics/company/2020/keeping-our-employees-and-partners-safe-during-coronavirus.html); Google asked all its North American employees to begin working from home on March 10<sup>th</sup> and offered payments to temporary staff and vendors impacted by office closures. Fried, Ina. "Google asks all North American employees to work from home." *Axios*. March 11, 2020. <https://www.axios.com/google-asks-all-north-american-employees-to-work-from-home-2fff5a0d-cb7f-4c98-8256-43737f6a68ea.html>; Other companies that implemented work from home policies included Apple, Facebook, Salesforce and Microsoft (whose LinkedIn subsidiary is headquartered in San Francisco). Thomas, Owen. "Salesforce marks its 21st anniversary with a coronavirus work-from-home order." *San Francisco Chronicle*. March 7, 2020. <https://www.sfchronicle.com/business/article/Salesforce-marks-its-21st-anniversary-with-a-15114231.php#>; Fottrell, Quentin. "Facebook, Apple and Twitter ask staff to work from home due to coronavirus — now here's the bad news for the rest of America." *MarketWatch*. March 8, 2020. <https://www.marketwatch.com/story/facebook-apple-google-and-twitter-ask-staff-to-work-remotely-due-to-coronavirus-heres-the-bad-news-for-the-rest-of-america-2020-03-08>

<sup>35</sup> Khanna, Ro. "Why Silicon Valley got coronavirus response right." *San Francisco Chronicle*. April 13, 2020. <https://www.sfchronicle.com/opinion/openforum/article/Why-Silicon-Valley-got-coronavirus-response-right-15195118.php>

<sup>36</sup> Krieger, Lisa, and Nico Savidge. "Coronavirus: Nation's first cluster and death reported in Seattle area; Santa Clara County also adds new case." *The Mercury News*. February 29, 2020. <https://www.mercurynews.com/2020/02/29/coronavirus-nations-first-cluster-of-illnesses-reported-in-seattle-area/>

<sup>37</sup> Ravani, Sarah. "Bay Area coronavirus decision: Behind the scenes of nation's first shelter-in-place order." *San Francisco Chronicle*. March 21, 2020. <https://www.sfchronicle.com/bayarea/article/Bay-Area-coronavirus-decision-Behind-the-scenes-15148425.php>

Governor Gavin Newsom.<sup>38</sup> As a result of these and additional measures, California had flattened the curve by early April.<sup>39</sup>

By contrast, New York's response has been lackadaisical and uncoordinated. On March 17<sup>th</sup>, Governor Andrew Cuomo rebuked New York City Mayor Bill DeBlasio's warnings of an imminent citywide shelter-in-place order stating: "We hear 'New York City is going to quarantine itself.' That is not true. That cannot happen. It cannot happen legally. No city in the state can quarantine itself without state approval. And I have no interest whatsoever and no plan whatsoever to quarantine any city."<sup>40</sup>

DeBlasio nonetheless began closing dine-in restaurants, movie theatres and gyms, but undermined his public health messaging by squeezing in a last-minute workout at the YMCA.<sup>41</sup> Cuomo reversed himself on March 20<sup>th</sup> after seeing a spike in cases the previous day. By then, there were 5,151 confirmed cases in New York City and an additional 1,951 cases elsewhere around the state. Cuomo imposed a set of restrictions similar to those implemented in California effective March 22<sup>nd</sup>.<sup>42</sup> But by then the virus had clearly spread widely, with devastating consequences for the entire tri-state area.

---

<sup>38</sup> Ibid

<sup>39</sup> California COVID-19 Public Dashboard, [https://public.tableau.com/views/COVID-19PublicDashboard/Covid-19Public?%3Aembed=y&%3Adisplay\\_count=no&%3AshowVizHome=no](https://public.tableau.com/views/COVID-19PublicDashboard/Covid-19Public?%3Aembed=y&%3Adisplay_count=no&%3AshowVizHome=no), and Institute for Health Metrics and Evaluation, <https://covid19.healthdata.org/united-states-of-america/california>

<sup>40</sup> Duster, Chandelis and Paul LeBlanc. "New York governor dismisses possibility of shelter in place order after mayor urged New Yorkers to prepare for it." *CNN*. March 17, 2020. <https://www.cnn.com/2020/03/17/politics/bill-de-blasio-andrew-cuomo-new-york-shelter-in-place-coronavirus-cnntv/index.html>

<sup>41</sup> Sheets, Megan. "New York City is considering a 'shelter in place' order and Bill de Blasio says economic fallout could be on par with the Great Depression with the city poised to lose \$3.2BILLION in tax revenue in the next six months." *Daily Mail*. 17 March 2020. <https://www.dailymail.co.uk/news/article-8121307/New-York-City-Mayor-Bill-Blasio-considering-shelter-place-order.html>

<sup>42</sup> Feuer, William and Noah Higgins-Dunn. "Cuomo orders most New Yorkers to stay inside — 'we're all under quarantine now'." *CNBC*. March 20 2020. <https://www.cnn.com/2020/03/20/new-york-gov-cuomo-orders-100percent-of-non-essential-businesses-to-work-from-home.html>

## Discussion

The evidence shows that those jurisdictions that took effective early action to limit the spread of SARS-CoV-2 have managed to reduce the incidence of COVID-19 and limit the effect on the economy. By contrast, jurisdictions that failed to take aggressive early action to contain SARS-CoV2 have generally experienced much more severe outbreaks—and worse economic outcomes. However, as the contrasting experience of Veneto and Lombardy, Germany and the U.K., and San Francisco and New York show, there is very substantial variation in outcomes even between these jurisdictions. The broad contours of the differences in outcomes can be seen in Table 1 (note the stark differences in mortality rates between Taiwan, at one extreme, and Lombardy, at the other). Some of these differences likely relate to the extent of connections to other jurisdictions with significant COVID-19 outbreaks, as well as local population density, and (related to population density) the presence of urban mass transit systems. But there is little doubt that much of the variation in outcomes is due to the effectiveness of their systems to contain clusters.

**Table 1: COVID-19: Cumulative Confirmed Cases, Incidence and Fatality as of April 29, 2020**

| Location | Confirmed cases | Cases per million | Deaths | Case Fatality Rate (%) | Population death rate per million |
|----------|-----------------|-------------------|--------|------------------------|-----------------------------------|
| Taiwan   | 363             | 15                | 5      | 1.4                    | 0.2                               |
| S. Korea | 10,761          | 209               | 246    | 2.3                    | 4.8                               |
| Iceland  | 1,797           | 4,937             | 10     | 0.6                    | 27.5                              |
| Germany  | 160,479         | 1,933             | 6,374  | 4.0                    | 76.8                              |
| UK       | 162,353         | 2,436             | 21,678 | 13.4                   | 325.3                             |
| Veneto   | 17,708          | 3,596             | 1,408  | 8.0                    | 287.3                             |
| Lombardy | 74,348          | 7,370             | 13,575 | 18.3                   | 1,352.1                           |

Source: Author's calculations based on data from Johns Hopkins University (<https://coronavirus.jhu.edu/map.html>).

Effective containment of clusters has been achieved by a combination of:

- Widespread testing for the virus, involving both public and private sector facilities.
- Manual and, in larger jurisdictions, app-based contact tracing systems.
- Isolation of symptomatic individuals and their contacts until tested.
- Isolation of those who test positive for a period of two weeks.

- Isolation of contacts of those who test positive for two weeks or until they are tested (and then continued isolation for those who test positive).
- Restrictions on travel into the jurisdiction, including two weeks' quarantine for those who entered after the outbreak.
- Social distancing measures, such as limits on large social gatherings.
- Voluntary self-isolation in locations with severe clusters.

It is worth reiterating that by implementing systems of testing, tracing and isolation, combined with travel restrictions, both Iceland and Taiwan were able to contain the spread of SARS-CoV-2 without imposing widespread lockdowns. The following section discusses how similar systems of testing, tracing and isolation can be established as part of a process of reopening the economy.

### 3. Test-Trace-Isolate

An effective system for identifying those who have and those who have had COVID-19, along with requirements for self-isolation of those who have COVID-19, as well as those who have a significant likelihood of having COVID-19, is a highly desirable part of any plan to remove lockdowns. Ideally, this would include testing both for the presence of the virus and for the presence of those who have had the virus.<sup>43</sup> Such testing should identify the presence of any clusters, and thereby make it possible to contain those clusters and prevent further contagion. This section describes such an approach, which seeks to integrate insights from the relatively successful strategies adopted in Taiwan, South Korea, Iceland and Germany, along with novel apps that enable contact tracing and sharing of verified COVID-19 status while preserving privacy and autonomy.

#### 3.1 Implement Widespread Population Screening, as Well as Targeted Testing and Contact Tracing

By testing a random sample of the population for the presence of the virus, it should be possible quickly to identify the general location of disease clusters that can be deemed “high risk.” This will then enable more-effective targeted testing and contact tracing.

By simultaneously testing for the presence of antibodies to the virus, it should be possible to assess how widespread the virus has been in the population—and how many people have now recovered and likely have some immunity (based on the proportion of people who test positive for antibodies but negative for the virus). A high prevalence of people with antibodies and a low prevalence of the disease may also indicate that the virus prevalence has peaked, though this can only be fully determined by undertaking repeated testing for the virus.

This testing protocol may be summarized as follows:

1. Undertake population screening and contact tracing:
  - a) Test a random sample of the population for the virus and for antibodies to the virus.
  - b) Trace and test the contacts of those who test positive.
2. Undertake targeted testing and contact tracing:

---

<sup>43</sup> Dewatripont, Mathias, Michel Goldman, Eric Muraille and Jean-Philippe Platteau. “Rapidly identifying workers who are immune to COVID-19 and virus-free is a priority for restarting the economy.” *VoxEU CEPR Policy Portal*, 23 March 2020. <https://voxeu.org/article/rapidly-identifying-workers-who-are-immune-covid-19-and-virus-free-priority-restarting-economy>

- a) Offer testing to anyone who is symptomatic and anyone in a high-risk area. (Mobile testing units, such as those that were established in Daegu, South Korea, and now in several parts of the U.S. are likely an effective way to do this.<sup>44</sup>)
- b) Trace and test the contacts of anyone who tests positive.

In Iceland, deCODE Genetics has been screening an average of 750 people per day, with a peak of 1,619 (on April 5<sup>th</sup>), while NUHI has been performing about 300 targeted tests per day, with a peak of 867 (also on April 5<sup>th</sup>).

Scaling such a program to the U.S., whose population is about 1,000 times the size of Iceland's, would entail running perhaps a million tests of each type per day, with a peak of about 2.5 million. Of course, the number and intensity of testing in any jurisdiction would likely vary considerably depending on the estimated local prevalence, which could likely be established within a few days.

The contact tracing element would likely entail a combination of human tracers and the use of contact tracing apps. In Iceland, 50 contact tracing was undertaken by a team of 50 people. For the U.S., the number of contact tracers would likely be in the tens of thousands. However, this number could be reduced if it were possible to incentivize people to download and use a contact tracing app (see below).

While it may seem odd to suggest that the U.S. adopt a test-and-trace program modeled in part on a program implemented on an island with a population of 364,000, it is not as crazy as it sounds. First, Reykjavik, Iceland's capital and largest city, has a population of approximately 127,000 and population density of 1,200 per square mile.<sup>45</sup> That is similar to many U.S. towns and cities. For example, Abilene, TX, has a population of 122,000 and a density of 1,145 per square mile, while Athens-Clarke County, GA, has a population of 123,000 and a density of 1,060 per square mile.<sup>46</sup> Second, it is also worth reiterating that both Taiwan (population c. 24 million) and South

---

<sup>44</sup> KLTV Digital Media Staff. "Mobile COVID-19 testing sites available in Harrison, Panola, Rusk counties." KLTV.com, April 23, 2020. <https://www.kltv.com/2020/04/23/rusk-county-oem-offers-free-mobile-testing-covid-one-day-only/>; Dobrzyn, Erin. "INTERACTIVE MAP: Here's where to get your drive-thru coronavirus test." clickorlando.com, April 24, 2020. <https://www.clickorlando.com/news/local/2020/03/18/interactive-map-where-to-get-your-drive-through-coronavirus-test/>

<sup>45</sup> Statistics Iceland: [https://px.hagstofa.is/pxen/pxweb/en/lbuar/lbuar\\_mannfjoldi\\_2\\_byggdir\\_Byggdakjarnar/MAN03106.px/table/tableViewLayout1/?rxid=est-ac091780-5f9c-4401-a9d4-ae1bdc5cce02](https://px.hagstofa.is/pxen/pxweb/en/lbuar/lbuar_mannfjoldi_2_byggdir_Byggdakjarnar/MAN03106.px/table/tableViewLayout1/?rxid=est-ac091780-5f9c-4401-a9d4-ae1bdc5cce02)

<sup>46</sup> Maciag, Mike. "Population Density for U.S. Cities Statistics." Governing.com, November 29, 2017. <https://www.governing.com/gov-data/population-density-land-area-cities-map.html>

Korea (population c. 52 million), successfully implemented somewhat similar programs of test-trace-isolate.

But regardless of any similarities or differences in demographics, the fundamental point is that test-trace-isolate demonstrably contains clusters of COVID-19 by imposing restrictions on freedom of movement primarily on those who have or might plausibly have COVID-19. Prima facie that seems far less onerous than the lockdowns that are currently in place throughout much of the U.S. So, it would seem to make sense for towns, cities, counties, and even states to find locally tailored ways effectively to implement test-trace-isolate *instead of lockdown*.

### 3.2 Motivating People to Participate in Test-Trace-Isolate

For test-trace-isolate to work effectively, very high rates of participation will be necessary. At the same time, ideally participation will be voluntary. But how can such high rates of voluntary participation be achieved? Here we discuss some possible mechanisms.

#### A. Incentivize Self-Isolation for Those Who Have or Might Have COVID-19

Ideally, anyone who has COVID-19 symptoms should isolate themselves until they have been tested or until they are no longer symptomatic—and for a minimum of two weeks after the onset of symptoms. This is because a person who is symptomatic may infect others—and infectivity typically lasts for about two weeks following the onset of symptoms.<sup>47</sup> In addition, anyone who tests positive should self-isolate, regardless of whether they have symptoms, for a minimum of two weeks. This is because asymptomatic carriers of COVID-19 can be infectious.<sup>48</sup> Furthermore, individuals who have been in close proximity with someone who has COVID-19 for a significant duration should also self-isolate and obtain a test.

Self-isolation limits the spread of the virus. But it also limits economic and social opportunities for people. As such, individuals might seek to avoid testing in order to avoid the obligation to self-isolate. One way to overcome this perverse incentive—and

---

<sup>47</sup> He, Xi., et al. “Temporal dynamics in viral shedding and transmissibility of COVID-19.” *Nature Medicine*, April 15, 2020. <https://www.nature.com/articles/s41591-020-0869-5>

<sup>48</sup> Ibid.

to encourage individuals to be tested—would be to compensate those who self-isolate, as long as they obtain a test as soon as possible, and to continue to compensate those who test positive for the duration of their self-isolation. Of course, compensation would be paid only to those able to demonstrate that they have remained self-isolated, which might be achieved for example by using an app that tracked their movements and required them to check in periodically using a biometric authentication such as face-ID or fingerprint.

But who would offer this compensation? Plausibly, it would be a mix of companies and governments. Companies are suffering both due to the virus and due to the lockdowns. Many are closed and a continuation of the lockdown might force large numbers into insolvency. Continuing to pay wages to workers who self-isolate is likely a small price to pay compared to losing a business. And if companies are on the hook to pay employees who self-isolate, they will have strong incentives to ensure that those employees are tested quickly.

However, we recognize that it is iniquitous to force companies to pay workers who are essentially idle. In some cases, companies may be able to rely on insurance policies to cover these costs. Those companies who have business interruption insurance, for example, may find that their insurers would be happy to cover the costs of those employees who cannot work if it means that the company can restart. But many companies won't have insurance policies to cover such eventualities, in which case it may make sense for local, state and/or federal government to cover some or all of these costs. (It might be possible to repurpose the federal government's Paycheck Protection Program to do just this.<sup>49</sup>)

## B. Incentivize Widespread Adoption of Contact Tracing Apps

Widespread adoption of contact tracing apps, which enable users to be informed when they have been in close contact with a person who has recently tested positive, can help individuals know whether they should self-isolate and seek testing. One of the big advantages of such apps over manual contact tracing is the speed with which individuals are notified after a contact is identified as having COVID-19.

The Chinese government has been using an app that continuously traces people and notifies them if they have been in close contact with someone who might have COVID-19. Access to transportation systems, as well as any public building requires its use to demonstrate users' COVID-19 status using their Health Status QR Code, which is

---

<sup>49</sup> <https://www.sba.gov/funding-programs/loans/coronavirus-relief-options/paycheck-protection-program>

generated by the app.<sup>50</sup> Hong Kong introduced a mandatory 14-day quarantine for individuals deemed high risk; all those subject to the quarantine are issued a wristband that they are forced to wear; and they are also required to use the *Stayhomesafe* app that connects to the wristband via a QR code—and enables more-effective contact tracing.<sup>51</sup> South Korea also introduced similar smartphone-based contact tracing apps.<sup>52</sup>

The use of these apps has helped contain outbreaks. But such intrusive systems are anathema in most Western democracies. For Americans to be willing to use a contact tracing app, they will likely need to be provided with very clear information about how the data collected will be used, with whom it will be shared and on what terms. To the extent that information from any such app will be shared with any government agency, it will also likely be necessary to ensure that such information is being shared on a limited basis only, that the data will be stored by the agency for a limited time, and that the entire program will be sunsetted once the COVID-19 crisis is over.<sup>53</sup>

### C. Privacy- and Autonomy-Preserving Contact Tracing Apps

In March, a group of scientists at Oxford University developed and published a contact tracing system that would enable individuals to be notified if they have come into contact with an infected person without knowing the identity of that person. The system uses a smartphone app that would share anonymized contact information with nearby smartphones also running the app.<sup>54</sup> Users of the app use a home test to evaluate their status; they then input the result into the app, which then notifies all the phones it has

---

<sup>50</sup> Ankel, Sophia. "As China lifts its coronavirus lockdowns, authorities are using a color-coded health system to dictate where citizens can go. Here's how it works." *Business Insider*. Apr 7, 2020. <https://www.businessinsider.com/coronavirus-china-health-software-color-coded-how-it-works-2020-4>

<sup>51</sup> The Government of Hong Kong Special Administrative Region. "'StayHomeSafe' Mobile App User Guide." <https://www.coronavirus.gov.hk/eng/stay-home-safe.html>

<sup>52</sup> Ghaffary, Shirin. "What the US can learn from other countries using phones to track Covid-19." *Vox Recode*. April 22, 2020. <https://www.vox.com/recode/2020/4/18/21224178/covid-19-tech-tracking-phones-china-singapore-taiwan-korea-google-apple-contact-tracing-digital>

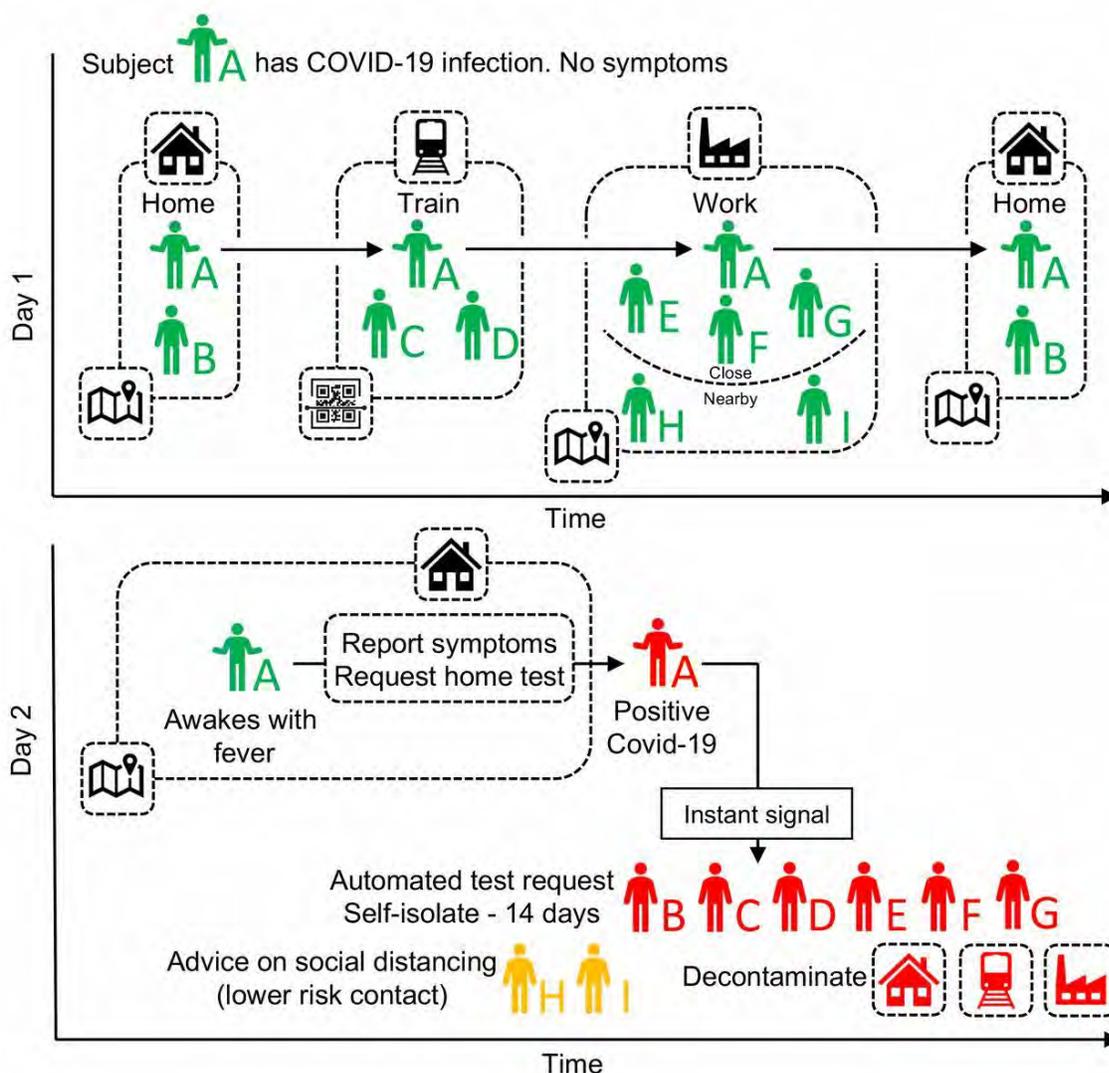
<sup>53</sup> Kazaryan Ashkhen. "How we can embrace technology to fight coronavirus while protecting privacy rights." *Washington Examiner*. April 22, 2020. <https://www.washingtonexaminer.com/opinion/how-we-can-embrace-technology-to-fight-coronavirus-while-protecting-privacy-rights>. And for a deeper dive into the privacy and policy considerations of contact tracing systems see Ada Lovelace Institute. *Exit through the App Store?* April 2020. <https://www.adalovelaceinstitute.org/wp-content/uploads/2020/04/Ada-Lovelace-Institute-Rapid-Evidence-Review-Exit-through-the-App-Store-April-2020-1.pdf>

<sup>54</sup> Ferretti, Luca et al. "Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing." *Science*. 31 March 2020. <https://science.sciencemag.org/content/early/2020/04/09/science.abb6936>

come into contact with. Those potentially infected contacts can then self-isolate for 14 days, during which time they obtain a test, upload the results and, if positive, their contacts will be notified, and so on. The basic schema is shown in Figure 7.

A similar system has now been developed by Google and Apple. The app uses low-energy bluetooth to share anonymized and frequently changing keys with other users of the same app, thereby preventing users from knowing the identity of those who have COVID-19. When it is rolled out, this app will have the significant advantage of being available on practically every single smartphone on the planet. Cross-platform interoperability means that potentially there will be very few dark spots.

Figure 7: Anonymizing Contact Tracing App



Source: Ferretti et al., *Science*, 31 March 2020.

In order to incentivize people to download and use such an app, it might be helpful to tie it to an individual's ability to engage in certain activities. As we discuss in the next section, this could be done entirely (or almost entirely) as a private initiative.

## 4. Establish Risk-Based Restrictions

Until the prevalence of COVID-19 (CV19) is reduced to minimal levels and/or there is herd immunity, which is unlikely to occur until a vaccine is developed (see 4.1), individuals will likely have to continue to take measures to prevent contraction and transmission of SARS-CoV2. One way to guide such measures is to establish a set of traffic light or “red-amber-green” (RAG) systems for individuals, activities and jurisdictions. These would be used in combination to determine appropriate restrictions on *who* can do *what*, *where*.

We emphasize that the purpose of these systems is to enhance trust, so that individuals can move around more freely than would otherwise be the case in a world still filled with grave fear of a deadly disease. Our presumption is that in the absence of systems that help individuals understand the infection risk posed by others, many will demand that government continue with its current restrictions, especially if another wave of disease occurs.

### 4.1 Develop Red, Amber, Green (RAG) CV19 Status System for Individuals

In general, individuals have strong incentives to protect themselves from becoming infected with SARS-CoV2. However, they have less incentive to avoid infecting others. Fortunately, in many cases measures taken to protect oneself from exposure, such as avoiding close proximity or wearing a face mask, also reduce the risk of exposing others if one happens to be infected.

But not all individuals pose the same risk of infection. And not all individuals are at the same risk of exposure. In the U.S. there have been nearly 1 million confirmed cases of CV19 as of April 26. Of those, about 11% are classified as having “recovered.” The available evidence suggests that those recovered individuals are no longer infectious. They also likely have at least some immunity to further infection.

But the number of people who have had COVID-19 may be much larger—because many cases were asymptomatic. Random sampling studies have found that approximately half of those who test positive for SARS-CoV2 have few or no

symptoms.<sup>55</sup> In the U.S. that would mean there are at least 200,000 immune individuals, who logically should not be subject to the same kinds of restrictions as others. In a few weeks, as the vast majority of those currently infected recover, the number of presumptively immune people will rise by hundreds of thousands.

Some recent studies suggest the number of people who have recovered from COVID-19 is even larger than that—because many people with symptoms weren't tested and so have not been included in official tallies. The availability of tests has been very limited across most of the U.S.—and many people with COVID-19 symptoms were not sufficiently ill to warrant hospitalization, so have not been tested. Serological surveys in several U.S. cities suggest the proportion of people who have had COVID could be 20 to 50 times the number of confirmed cases.<sup>56</sup> While some critics have raised methodological concerns with these serological surveys,<sup>57</sup> the results are consistent with serological surveys carried out in Switzerland and Germany.<sup>58</sup> It seems plausible that the actual number of people who have had COVID-19 and recovered could be 5 million or more.

---

<sup>55</sup> Gudbjartsson, Daniel F et al. "Spread of SARS-CoV-2 in the Icelandic Population," *New England Journal of Medicine*. April 14, 2020. <https://www.nejm.org/doi/full/10.1056/NEJMoa2006100>; See also: Day, Michael. "Covid-19: identifying and isolating asymptomatic people helped eliminate virus in Italian village." *British Medical Journal*. March 23, 2020. <https://www.bmj.com/content/368/bmj.m1165>

<sup>56</sup> Bendavid, Eran, et al. "COVID-19 Antibody Seroprevalence in Santa Clara County, California" Preprint, April 17, 2020. <https://www.medrxiv.org/content/10.1101/2020.04.14.20062463v1>; Hopper, Leigh. "USC-LA County Study: Early Results of Antibody Testing Suggest Number of COVID-19 Infections Far Exceeds Number of Confirmed Cases in Los Angeles County." Press Release: University of Southern California. April 20, 2020. <https://news.usc.edu/168987/antibody-testing-results-covid-19-infections-los-angeles-county/>; Abril, Patti & Diana Gonzalez, "Second round of COVID-19 community testing completed; Miami-Dade County and the University of Miami Miller School of Medicine announce initial findings." News Release, Miami Dade County, April 24, 2020. <https://www.miamidade.gov/releases/2020-04-24-sample-testing-results.asp>; Lucking, Liz "Coronavirus antibodies found in 21% of New Yorkers in early testing." *MarketWatch*, April 23, 2020. <https://www.marketwatch.com/story/early-antibody-tests-find-21-of-new-yorkers-have-had-covid-19-2020-04-23>

<sup>57</sup> Vogel, Gretchen. "Antibody surveys suggesting vast undercount of coronavirus infections may be unreliable." *Science*. April 21, 2020. <https://www.sciencemag.org/news/2020/04/antibody-surveys-suggesting-vast-undercount-coronavirus-infections-may-be-unreliable>

<sup>58</sup> Press Release. "Séroprévalence covid-19 : première estimation de la prévalence d'anticorps anti-sars-cov-2 igg dans la population genevoise." Hôpitaux Universitaires Genève. April 22, 2020. <https://www.hug-ge.ch/medias/communiqu%C3%A9-seroprevalence-covid-19-premiere-estimation>; Streeck, Hendrik. "Vorläufiges Ergebnis und Schlussfolgerungen der COVID-19 Case-ClusterStudy (Gemeinde Gangelt)". Preprint. 9 April 2020. [https://www.land.nrw/sites/default/files/asset/document/zwischenergebnis\\_covid19\\_case\\_study\\_gangelt\\_0.pdf](https://www.land.nrw/sites/default/files/asset/document/zwischenergebnis_covid19_case_study_gangelt_0.pdf)

We propose to develop a Red-Amber-Green system for classifying individuals based on their CV19 status. The objective of this system is to limit transmission risk.

### *Criteria for Individual CV19 Status*

The RAG criteria might look something like this:

Red: Has CV19 or status unknown (is or may be infectious)

Amber: Has not had CV19 (is at risk of acquiring CV19, is not infectious)

Green: Has had CV 19 and no longer tests positive for the virus (is not at great risk of acquiring CV19, is not infectious)

Individual status, in combination with activity status and jurisdiction status would determine who can do what, where. This is discussed in more detail below but in general: Reds are isolated; Ambers must avoid reds and be cautious in public, including at work (wear masks, etc.), while Greens are not restricted, but should still take precautions (at least until more is known about the extent of immunity).

But how would status be established? One solution would be to use a combination of virus and antibody tests. Most obviously, anyone who currently tests positive on the virus test is automatically deemed Red.<sup>59</sup> Meanwhile, anyone who was previously diagnosed with CV19, tested positive for the virus, and is now recovered, and tests negative for the virus is presumptively immune and could automatically be deemed Green.<sup>60</sup> Likewise, anyone who tests positive for antibodies but negative for the virus would also be deemed Green. Finally, anyone who tests negative for the virus, negative for antibodies and has never had a positive virus test would be deemed Amber. These criteria are summarized in Table 2.

Unfortunately, concerns remain over the specificity of antibody tests. While some appear to achieve an accuracy of 99.5%, this still leaves the possibility of 0.5% false

---

<sup>59</sup> In some cases, people who have recovered CV19 have tested positive. That might be because they haven't fully recovered, in which case the Red designation is appropriate. But it might also be that the test is perhaps picking up dead virus or virus that has integrated into the person's DNA. To deal with such cases would require an appeal mechanism involving further investigation.

<sup>60</sup> As an extra measure of caution, it may be worth also performing an antibody test to verify that the person has immunity, though such tests tend to have quite a high proportion of false negatives, so it may be better to rely simply on the two virus tests.

positives. Leaving aside the issue of how accurate the measure of specificity is,<sup>61</sup> this implies that for every 1,000 people tested, 5 would be classified as Green when they should in fact be Amber. If a large proportion of the population has been infected, as appears to be the case in New York City and the surrounding area,<sup>62</sup> this false positive rate would likely not pose a problem, but if the prevalence is below 5%, it could cause real problems since 10% or more of those classified as Green might in fact be Amber.

Table 2: Red-Amber-Green Test-Based Criteria

| Status | Virus test | Antibody test |
|--------|------------|---------------|
| Red    | +ve        | N/A           |
| Amber  | -ve        | -ve           |
| Green  | -ve        | +ve           |

To complicate matters further, there remains some uncertainty as to how much, if any, immunity is conferred by having had COVID-19. Some inferences can be made based on SARS, a similar coronavirus; follow-up studies found survivors had strong immunity for two years or more.<sup>63</sup> However, the extent and duration of immunity to SARS-CoV2 remains uncertain. As Henry Greely observes, “The current best guess is that SARS-

---

<sup>61</sup> For the test used in Santa Clara, which was validated against 401 non-covid samples, against which it gave 399 negatives, this implies a binomial 95% confidence interval for false positives of 0.0006 to 0.0179. See Gelman, Andrew. "Concerns with that Stanford study of coronavirus prevalence." *Statistical Modeling, Causal Inference and Social Science*. 19 April 2020 <https://statmodeling.stat.columbia.edu/2020/04/19/fatal-flaws-in-stanford-study-of-coronavirus-prevalence/>)

<sup>62</sup> Lucking, Liz “Coronavirus antibodies found in 21% of New Yorkers in early testing.” *MarketWatch*, April 23, 2020. <https://www.marketwatch.com/story/early-antibody-tests-find-21-of-new-yorkers-have-had-covid-19-2020-04-23>

<sup>63</sup> Liu, W. et al. “Two-year prospective study of the humoral immune response of patients with severe acute respiratory syndrome.” *Journal of Infectious Diseases* Vol. 193, pp. 792-795. 2006.

CoV-2 infection provides some immunity, probably between the few months of some cold-causing coronaviruses and the several years for SARS.”<sup>64</sup>

There are two problems with false Greens: (1) the bearer might engage in behaviors that are disproportionately risky for themselves; (2) having unwittingly acquired CV19, the bearer might engage in behaviors that are disproportionately risky for others.

But that is not the only or perhaps even the main concern. Questions have been raised about the reliability of many of the virus tests—and especially their propensity to give false negatives. If Reds are falsely labeled Amber—and thus not required to self-isolate—the consequences for infection could be dire.

So, at least until more reliable tests become available, there will be a need to supplement them with information from contact tracing. In fact, even if a 100% specific antibody test were to become available, it will still be necessary to ensure, so far as possible, that Ambers were not in fact Reds. That would either require very regular (possibly daily) testing for the virus, or the use of contact tracing.

Given these challenges, it makes sense to base individual CV19 status on a combination of testing (both virus and antibodies) *and* the use of a contact tracing app. This would be integrated through an app that combines information from individual A’s authenticated test with anonymized test data from other individuals with whom A has been in contact, as described below.

#### *Privacy- and Autonomy-Preserving Individual CV19 Status App*

In order for CV19 Status to be functionally useful, it will be necessary for individuals to be able to *demonstrate* their status to others. Conceptually, this simply requires a means of connecting a person’s identity to their CV19 status. In practice, however, this is likely to encounter numerous challenges. One solution would be to embed an individual’s CV19 status into a smartphone app that would then share the status when requested with others via e.g. RFID or a QR code. But this begs several questions:

1. How to guarantee that the user of the smartphone is the same as the person whose CV19 status is being shared? This might be done using biometric identification and a second authentication factor.
2. How to ensure that CV19 status is accurate? This likely entails:

---

<sup>64</sup> Greely, Henry T. “Covid-19 ‘immunity certificates’: practical and ethical conundrums.” Statnews, April 10, 2020. <https://www.statnews.com/2020/04/10/immunity-certificates-covid-19-practical-ethical-conundrums/>

- a. Test data being entered or validated by a trusted authority (e.g. medical professional).
- b. Test data being stored in a manner that cannot be altered by the user or an outside party. This might entail the use of some kind of immutable distributed ledger (e.g a blockchain) that can be accessed only by those authorized to do so (which would be under the control of the individual whose status is being verified) by allocating one-time cryptographic keys.<sup>65</sup>

This CV19 Status App would become the virtual key that enables individuals to participate in activities ranging from work to entering hotels, restaurants, and transportation systems. Potentially the app could be designed to communicate with other apps, such as those for ridesharing or virtual hotel keys, thereby more efficiently facilitating safe use of those services. As such, individuals would be strongly incentivized to use the CV19 Status App.

Consider how this might work for ridesharing. If the ridesharing app knows the user's verified CV19 status, it is able to match riders and drivers with individuals of consistent status or ensure that the driver takes appropriate precautions. For example, if someone with CV19 (i.e. Red status) needs a ride to a clinic, the app will find drivers who are Green or have declared that they are willing to accept the risk and the effect it would have on their own CV19 status (automatically turning them to Amber-Red, so that they are required to go into self-isolation and obtain a test). Meanwhile, an Amber rider can be matched with either an Amber or Green driver.

The CV status app could also be the key to restarting international travel. At present, many jurisdictions that are permitting international travel require 14 days' quarantine on arrival. While such requirements are understandable, they have resulted in an almost total collapse of international business and leisure travel. If passengers were able to demonstrate their current verified CV19 status through use of an app accepted domestically and at their international destination, the doors of international travel could open up once more.

The CV19 Status App could also hold the key to effective contact tracing. By enabling the app to communicate in the background with other app users (e.g. over Bluetooth Low Energy), users could be notified when they have come into contact with others who are subsequently tested and found to be CV19 positive. The app would then automatically change from amber to amber/red, indicating that the user must be tested

---

<sup>65</sup> A consortium in Germany has been developing just such an app. See: [https://ubirch.de/fileadmin/user\\_upload/2020-04-16\\_digital\\_corona\\_health\\_certificate.pdf](https://ubirch.de/fileadmin/user_upload/2020-04-16_digital_corona_health_certificate.pdf)

in order to establish their true status. This would be similar to the system discussed above developed by the group at Oxford University and the app developed by Apple and Google.

One concern with this reliance on COVID-19 status apps is the availability of smartphones. In fact, most adults in the U.S. already have smartphones. A February 2019 survey by Pew found that 81 percent of American adults had smartphones and an additional 15 percent had cellphones.<sup>66</sup> Given the very widespread use of smartphones and the enormous advantages of tying CV status to a smartphone app that can also function as a means of tracing contacts, it makes sense to rely primarily on such an app for the purposes of demonstrating CV status. For those without smartphones, one-time CV status certificates could be issued to cell phones (as was done in Taiwan for those entering the country) or even on paper. Unfortunately, these certificates would only provide a snapshot of status based on a very recently conducted test. A better alternative for those without smartphones might be to establish a program to supply basic smartphones with a basic cell service for those adults without such a service.<sup>67</sup> Assuming such a basic smartphone costs about \$30,<sup>68</sup> and basic cell service (e.g. prepaid) costs about \$50, the total cost of a program that expanded smartphone access to all adults would be approximately \$2 billion (allowing 25% for administration).

*Some Transmission is Inevitable, so At-Risk Individuals Should Continue Voluntarily to Self-Isolate*

It should be noted that even with a highly effective CV19 status app that combines verified test data with information from contacts, the information from contacts who test positive only arrive when that person tests positive, which in nearly all cases will be some time (days or even weeks) after the contact occurred. As such, there will continue to be some transmission (though this can likely be minimized through well designed rules for activities and through widespread use of personal protective equipment, as we discuss below). As such, people who are at most risk of severe forms of COVID-19—particularly the elderly and those with underlying conditions—would be well advised to remain in voluntary self-isolation.

---

<sup>66</sup> Pew Research Center, *Mobile Fact Sheet*, June 12, 2019. <https://www.pewresearch.org/internet/fact-sheet/mobile/>

<sup>67</sup> The app would only require Bluetooth low energy and a cell connection with texting (SMS) to function, so this would not entail adding full internet access.

<sup>68</sup> Numerous inexpensive smartphones are available on prepaid services that meet this criterion.

## 4.2 Develop and Implement a RAG System for Activities

Many jurisdictions have imposed rather arbitrary restrictions on freedom of movement, typically based on what kinds of jobs people do (deemed to be so-called “essential workers”). This has resulted in financial hardship for tens of millions of people, as well as enormous frustration.

Some activities pose minimal risk of harm to others, while providing significant benefits to the individual. An uncontroversial example is outdoor exercise, which, if undertaken with appropriate caution (wearing a mask if in a built-up area, for example) can help build and maintain a healthy immune system, thereby reducing the likelihood of suffering from COVID-19. While outdoor exercise has generally not been prohibited, many forms of outdoor work have been, even forms of work that do not involve close contact with others also would seem a low risk activity. That is not merely iniquitous, it has harmed some of the poorest members of society.

Other activities pose considerable risks of infection both to the individual undertaking them and to others. In many cases, this work also provides sufficient benefits to the worker and others to justify permitting the work to continue, albeit with necessary precautions. Health care work, such as undertaking tests and treating COVID-19 patients, is an obvious example.

Rather than seeking to determine the essentiality of an activity, it makes more sense to determine the risk an activity imposes on the individual undertaking it and others whom they might encounter. And rather than imposing *per se* prohibitions, it makes sense to specify circumstances under which certain restricted activities might be undertaken. These should be as objective, as clear, and as impartial as possible.

### *Criteria for Activities Status RAG*

Logically, the criteria for an Activities status RAG would relate to the likelihood of exposure. Below is a rough RAG with some example activities.

By applying clear, risk-based criteria such as these, it will be possible to define the circumstances under which activities can take place. This will likely include a combination of requiring appropriate PPE and restrictions on proximity (for example by

spacing tables at restaurants and limiting crowding on public transport, which may be a major source of transmission<sup>69</sup>).

Table 3: Red-Amber-Green Sample Activities Criteria

| <b>Status</b> | <b>Criteria</b>                                   | <b>Example Locations</b>                             | <b>Example Activities</b>        |
|---------------|---|--|----------------------------------|
| <b>Red</b>    | confined space with high transmission potential   | Hospital, hotel, restaurant, gym, subway, bus, plane | nurse, waiter, gym rat, commuter |
| <b>Amber</b>  | open indoor space with low transmission potential | Office, taxi/ride-share with open windows, stores    | chef, builder, yoga class        |
| <b>Green</b>  | Outdoor space with no crowds                      | Fields, parks, beaches, personal vehicles            | cyclist, farmer, pool cleaner    |

By combining this activity RAG system with the individual RAG, it will also be possible to define who can participate in what activities, as determined by the organizations setting the rules of participation in those activities, which would mainly be private businesses. Green individuals logically would not be subject to any restrictions. For the most part, Amber individuals will likely be able to participate in most activities if they are wearing appropriate PPE. Red individuals would be prohibited from participating in most activities except some classified as Green (e.g. walking in open spaces, maintaining an appropriate distance and wearing a suitable mask).

Again, it should be stressed that the purpose of these RAG Systems is to enhance trust and enable the gradual removal of restrictions. In general, decisions regarding what activities are permissible and what activities are not permissible for different people should be made by the organizations on whose property those activities take place. For

---

<sup>69</sup> Britschgi, Christian. "Did Subway Riders or Motorists Do More To Spread COVID-19 in New York City?" Reason.com, April 22, 2020. <https://reason.com/2020/04/22/did-subway-riders-or-motorists-do-more-to-spread-covid-19-in-new-york-city/>

the most part, these will be private organizations (the owners of offices, restaurants, movie theatres, and so on), so the decisions are part of a system of private ordering.

Businesses have strong incentives to implement rules that limit the risk of infection to their employees and customers. If an outbreak is traced to a specific facility, it may have to close down temporarily for deep cleaning and may even face liability. A business that adopts best practices for limiting the transmission of COVID-19 is not only less likely to suffer such an outbreak; if one occurs, it is less likely to be found negligent.

Already many of those businesses that remain open have established rules intended to limit transmission. For example, many grocery stores have implemented minimum distances between customers, spray customers hands with disinfectant, and require staff to wear masks or face protectors.

However, governments also have a very significant role to play in determining activities that can take place in government-owned buildings and transportation systems. The rules adopted by the entities operating these facilities should also follow best practices.

#### 4.3 Develop and implement a RAG System for Jurisdictions

The third part of the multidimensional RAG system is for jurisdictions. Such a system would, first and foremost, reflect the current incidence of COVID-19, which would be established through population screening both for the virus and for antibodies. Also of importance, however, would be the availability of treatment facilities, including ICU beds. Criteria might look something like Table 4.:

Table 4: Possible Criteria for Jurisdiction RAG System Status

|       | Possible Criteria |         |               |
|-------|-------------------|---------|---------------|
|       | New Cases         | Deaths  | ICU Use       |
| Red   | Rising            | Rising  | >90% capacity |
| Amber | Falling           | Stable  | <90% capacity |
| Green | Minimal           | Falling | <90% capacity |

The risk-based RAG system for jurisdictions would provide additional guidance to organizations and individuals, so that they can make risk-proportionate choices. The presumption is that in jurisdictions where the incidence of COVID-19 is high and rising, organizations in general and Amber individuals in particular are likely to be more cautious. For that reason, in Red areas, activities would likely be more limited (e.g. some activities with significant transmission potential, such as travel by public transport, dining inside restaurants, and workouts in gyms, would be highly restricted), with more onerous requirements for distancing and use of PPE. In Amber areas, these restrictions would be relaxed somewhat (e.g. dining in restaurants might be permitted with appropriate spacing of tables and use of HEPA air filters to capture potentially contaminated particles, likewise gym workouts, and public transport). Finally, Green areas would remove most restrictions, while maintaining vigilance at points of entry to limit access by individuals with Red status.

A question naturally arises as to who would make the decisions regarding a particular jurisdiction's status and on what basis. To answer the second question first: ideally, decisions would be based on objective criteria, such as those outlined above. To the first question, it is important to keep politics to the minimum, so local governments (municipalities, cities, etc.) might establish a non-partisan committee whose role would be to review the evidence and make decisions.

## 5. Remove Barriers to and Incentivize Production and Distribution of Masks and Other Personal Protective Equipment

Access to and use of appropriate personal protective equipment (PPE) has been an essential component of successful responses to COVID-19 in many countries and is of fundamental importance for the protection of frontline workers everywhere. Countries that have successfully mitigated harms of COVID-19 have secured universal public access to masks, while prioritizing medical-quality respirators for occupations with increased risk of SARS-CoV-2 exposure and individuals at higher risk of COVID-19 mortality.

Unfortunately, Americans currently do not have access to sufficient PPE. The main reason is a lack of domestic supply and restrictions on imports, which we discuss below. As a result, Americans have not been adequately protecting themselves. That must change—and change fast.

### 5.1 What Form of PPE Is Appropriate?

The form of PPE that is most appropriate will depend on the riskiness of the activity being performed. In general, workers who cannot avoid close proximity to others, whether they are co-workers, customers or patients, will likely require more extensive PPE than others. That means: highly effective masks, goggles (or a face plate or other physical barrier), gloves, and, for the most exposed, a full-body suit.

COVID-19 is mostly spread by contaminated droplets that are either picked up from surfaces on hands, which then attach to mucous membranes on the face, or are inhaled while they are still suspended in the air. To prevent infections arising from contaminated hands, individuals are advised to avoid touching their face and to wash or use hand sanitizer regularly. To avoid contamination resulting from inhalation of virus particles attached to droplets in the air, the most important PPE item for most people will be a mask.

## 5.2 What Type of Mask Is Appropriate?

Contaminated aerosols (very tiny droplets) can have diameters of less than 5 micrometers—a thousandth of an inch—and can linger in the air for several hours.<sup>70</sup> These aerosols bypass most masks lacking regulated air-filtering mechanisms. For individuals at highest risk of encountering people infected with COVID-19, whether at work or while travelling, masks with adequate filters are the only products that can provide a reasonable level of protection from SARS-CoV-2. In general, this would mean masks capable of capturing 95% or more of particles of 5 micrometers or more.

By contrast, workers who only have minimal contact with others, typically at a distance of six feet or more, may need little more than a more basic surgical-type mask. The aim of such masks is more to limit transmission to others than to protect the user. In addition, offices and restaurants might install HEPA filters in air conditioners.<sup>71</sup>

Broadly three types of masks might be differentiated:

- SM: surgical type masks that are designed to prevent aerosols and droplets from escaping
- 95: Masks capable of capturing at least 95% of aerosols and droplets during inhalation
- 95+: Masks capable of capturing more than 95% of aerosols and droplets during inhalation, or powered air-purifying respirators.<sup>72</sup>

The decision to wear a mask should in general be left to individuals and businesses, based on the risk of infection associated with the activities being undertaken. However, some general guidance as to what kinds of mask which individuals should use in what jurisdictions when carrying out what kinds of activities can be provided. Table 5 provides

---

<sup>70</sup> Morris, Dylan H. et al. "Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1." *New England Journal of Medicine*. 382 (April 2020).1564-1567.  
<https://www.nejm.org/doi/full/10.1056/NEJMc2004973>

<sup>71</sup> Heffernan, Tim. "Can HEPA Air Purifiers Capture the Coronavirus?" *The Wirecutter*. April 7, 2020.  
<https://thewirecutter.com/blog/can-hepa-air-purifiers-capture-coronavirus/>

<sup>72</sup> N95 masks may not provide sufficient protection for some essential employees against contracting COVID-19. N95 masks do filter at least 95% of air particles, but constant exposure to SARS 2 infected individuals might require additional protection. The CDC needs to confirm the effectiveness N95 masks, the additional acid filtering protections of R and P masks, and the effectiveness of higher-grade masks like N99 and N100 in order to properly prioritize PPE production. Powered, air-purifying respirators are likely the most effective at reducing SARS 2 exposure, but because they are the most time consuming to build, the effectiveness of inferior masks should be determined first.

some broad outlines of the kinds of guidance that would be appropriate for individuals with Amber status.<sup>73</sup>

Table 5: Guidance for use of Masks by Amber individuals

| Jurisdiction Status | Activity Status and Mask Type |       |       |
|---------------------|-------------------------------|-------|-------|
|                     | Red                           | Amber | Green |
| Red                 | 95+                           | 95    | 95    |
| Amber               | 95+                           | 95    | SM    |
| Green               | 95                            | SM    | None  |

### 5.3 Ramping Up the Supply of Masks

Limited availability of masks has hampered the response to COVID-19 across the U.S. A major factor in these supply limitations has been regulation by the Food and Drug Administration (FDA), which requires that masks either be certified by NIOSH (another division of the Department of Health and Human Services) or, under a recent guidance, may be imported and distributed under an Emergency Use Authorization (EUA).

The FDA's regulation of face masks has contributed to supply shortages due to its glacial approach to approvals. Meanwhile, NIOSH has told those developing new masks

---

<sup>73</sup> Individuals with Red status would generally be avoiding other people but ideally would wear a mask when they do expect to encounter people, in order to minimize the chance of spreading their infection. Meanwhile, individuals who are Green and hence presumptively immune would have much less need for masks and other PPE, however, those who are working on the front lines should be advised to wear masks in order to avoid the risk of being infected with a new strain of the virus to which they have less immunity.

that it could take six to eight weeks for it to certify these masks.<sup>74</sup> In an ideal world, all front-line health care workers would be able to access masks that have been approved by the FDA and certified by NIOSH. But we currently live in a world that is far from that ideal. Across the country, many health care workers have had to resort to alternatives that are barely better than a bandana.

In light of the shortages of masks, we recommend that the FDA's monopoly on regulation and NIOSH's monopoly on certification of masks be revoked forthwith. Instead:

1. Individuals and companies should be permitted to import and distribute masks that conform to national regulatory standards for any of the masks of types listed in the shaded cells in Table 5. To achieve this, the FDA should automatically add all masks "eligible for authorization" to its list of authorized respirators.<sup>75</sup>
2. A new category of masks should be established that would enable manufacture or importation of masks conforming to the lower standards as indicated in the non-shaded cells of Table 6, since such masks would be of value to individuals when undertaking Amber activities in Green zones and Green activities in Amber zones—and would offer more protection than a surgical mask.
3. Presumptively authorize private validators of masks who already undertake evaluations of masks and/or other PPE and are recognized as certifiers of PPE for other purposes. This would likely include:
  - a. Hospitals, whose management has a duty of care to medical staff and patients.
  - b. Laboratories that currently validate masks and whose personnel use such masks.
  - c. Certifying bodies such as Underwriters Laboratories, whose marks are well recognized and who thus have a strong incentive to uphold their reputation.
4. Importers and domestic producers of masks who have not yet had their masks certified by NIOSH should be permitted to use private certifiers as an

---

<sup>74</sup> Britschgi, Christian. "U.S. Needs Billions of New Masks to Combat Coronavirus. Feds Say It'll Take Up To 90 Days to Approve New Mask-Making Facilities." *Reason*. March 24, 2020. <https://reason.com/2020/03/24/america-needs-billions-of-new-masks-to-combat-coronavirus-federal-regulators-say-itll-take-months-to-approve-new-mask-making-facilities/>

<sup>75</sup> For FDA guidance on masks eligible for authorization see <https://www.fda.gov/media/136403/download> and for FDA guidance on authorized respirators see <https://www.fda.gov/media/136663/download>

alternative to NIOSH, so long as they clearly indicate the source of certification and mark the masks “Not certified by NIOSH”.

**Table 6: Mask Filtering Efficiency and Regulatory Standards**

| Mask efficiency:<br>Proportion of particles >5 µm filtered | Regulating jurisdiction and mask designation |                     |                  |             |        |                  |
|--|--|---------------------|------------------|-------------|--------|------------------|
|  | United States                                | European Union (EU) | EU and Australia | South Korea | China  | Japan            |
| 80%  |  | FFP1                | P1               | KF80        |        | DS1/RS1/DL1/ RL1 |
| 90%  |  |                     |                  |             | KN-90  |                  |
| 94-95%   | N95/P95/R95                                  | FFP2                | P2               | KF94        | KN-95  | DS2/RS2/DL2/RL2  |
| 99%  | N99/P99/R99                                  | FFP3                |                  | KF99        | KN-99  |                  |
| 99.5-99.7%   | N100/P100/R100                               |                     | P3               |             | KN-100 | DS3/RS3/ DL3/RL3 |

To expedite ending the coronavirus crisis, the U.S. needs to update its PPE guidelines for both health care workers and the general public and remove unnecessary regulations that prevent optimal access to masks. The current model is predicated on the assumption that products may not be imported or sold unless prior approval is provided by federal agencies. The premise of this model was that such authorization would provide additional protection. Instead it is, literally, killing people. While it is true that a poorly designed mask may be worse than no mask at all, the reality is that many people are currently using very poorly designed “masks” (e.g. sewn cotton masks, bandannas). These people—and especially the frontline workers who are among those using such inadequate protection—deserve better! If necessary, these actions should be undertaken as an executive order from the president.

## 6. Remove Barriers to and Incentivize Development of and Access to Treatments and Vaccines

To some extent, jurisdictions will gradually open up as the incidence of COVID-19 declines. However, this process could be sped up if the harm resulting from COVID-19 were reduced, for example through the development of more effective treatments, or if a vaccine were to become available. A high priority must therefore be placed on identifying and providing access to more effective treatments and a vaccine.

Treatments for COVID-19 have the potential substantially to reduce mortality rates and to reduce pressure on the health care system. Several therapies are already undergoing testing, while other therapies are currently in development.<sup>76</sup> There is, obviously, some urgency in ensuring that these therapies are developed, tested, and made available as soon as possible.

Under normal circumstances, the development of novel therapies and vaccines must go through an extremely stringent process overseen by the FDA. However, the FDA also has a much more rapid pathway, called an Emergency Use Approval, that permits use of certain therapies to be made available without going through all the normal clinical trials. These and other approaches to expediting the approval of effective novel therapies must be used wherever possible in order to reduce the burden of COVID-19.

In addition to removing constraints that slow down the process of bringing treatments to market, there are other things that can be done to increase the availability of certain kinds of treatment more quickly. Notably, the production of some antibody-based treatments (notably, convalescent plasma and hyperimmunes<sup>77</sup>), which seek to boost the immune response of patients, are constrained by the availability of plasma from individuals who have had COVID-19 and recovered (since that plasma is the resource

---

<sup>76</sup> For a good summary of the current state of play, see: Ridley, Matt “The contenders – and challenges – in the race to cure Covid.” *The Spectator*. April 25, 2020. <https://www.spectator.co.uk/article/the-contenders-and-challenges-in-the-race-to-cure-covid>

<sup>77</sup> Convalescent plasma is blood plasma derived from individuals who have recovered from COVID-19 and who have antibodies to the disease. (See National COVID-19 Convalescent Plasma Project <https://ccpp19.org/>). Hyperimmunes are based on plasma from multiple individuals, which has then been mixed and concentrated, in order to broaden its effectiveness.

from which the therapies are produced).<sup>78</sup> This is one reason widespread testing for antibodies would be desirable.

Like the development of treatments, the development of a vaccine must go through an onerous approval process. And as with the development of novel therapies, it is incumbent on the FDA to facilitate rapid approval of vaccine candidates as they go through trials. The sooner a vaccine becomes available, the sooner we can all go about our business as normal. Given that demand for a vaccine is unlikely to be a problem, it probably does not make sense for the government to offer a bounty for a vaccine as might be the case for a rare disease or one that primarily affects poor people. In this case, the patent system combined with rivalrous competition is most likely to drive innovation and development of effective candidates.

---

<sup>78</sup> Abbasi, Jennifer. "The Promise and Peril of Antibody Testing for COVID-19." *Journal of the American Medical Association*. April 17, 2020. doi:10.1001/jama.2020.6170

## 7. Reopen the Economy

We have described a series of actions that, if followed, should permit safe and effective, if gradual, reopening of the economy. These actions can be seen as comprising broadly four phases:

### Phase 1: Identify the Scale of the Problem and Take Effective Measures to Contain It, While Simultaneously Building the Means to Defeat CV19

To identify the current scale and rate of infection with SARS-CoV-2 and establish what proportion of the population has had COVID-19 and recovered, governments, working in partnership with business and civil society, should as soon as possible implement the steps described in Sections 2-5 above, namely:

1. Implement population screening and targeted testing for the virus (SARS-CoV2), as well as antibodies to the virus.
2. At the same time, implement contact tracing, both manually and through the use of contact tracing apps, in order to identify disease clusters.
3. Support the development of an infection-risk based Red-Amber-Green CV19 status systems for individuals, activities and jurisdictions, which can be used to determine *who* can and cannot do *what, where*.
4. Support the use of biometric-based, authenticated CV19 status apps for access to activities and contact tracing.
5. Incentivize full isolation for all who test positive, then retest those individuals for both virus and antibodies after 2 weeks if non-symptomatic at that time.
6. Incentivize and remove unnecessary barriers to increased production and distribution of masks and other personal protective equipment.

In contemplating these actions, it is important to remember that the aim is to limit contagion and re-establish trust, so that our lives return, as fast as possible, to normalcy. To that end, the actions taken must be consistent with the re-establishment of an economic and social system that is primarily based on private ordering. As such, wherever possible, actions should be undertaken in a decentralized manner, with priority given to private initiatives. Where government takes a role, whether it be in relation to testing, tracing, establishing a risk rating system, or building a status app, it should primarily be as the coordinator, sponsor, or funder of public-private partnerships.

At the same time, it is important to put in place measures that will, over time, enable better management of CV19 and ultimately a means of defeating the SARS-CoV2. These include incentivizing the rapid development of safe treatments and vaccines.

## Phase 2: Begin to Remove Restrictions Based on RAG Status and Other Local Circumstances

With an effective system in place for identifying the CV19 status of individuals, along with ongoing population screening and containment of emergent clusters, it should be possible to remove some restrictions on movement. As noted above, the extent of continuing restrictions will depend on the current rate of infection with SARS-CoV-2, as well as the capacity of the health care system relative to the expected number of new COVID-19 cases, as connoted by the jurisdictional classification.

As noted in section 4, a key element of opening up the economy will be to define clearly which activities are permissible under which circumstances in which kind of jurisdiction and by which individuals. These decisions are best made at the local level, since there will be particular local circumstances that must be accounted for—such as the modes of transport typically used, what kind of system is used to validate a persons' CV19 status to permit entry to a business, public building, bus, etc., not to mention availability of PPE.

Among the first to return to normalcy will be individuals who are classified Green. Since these individuals are presumably immune, there is no reason to prevent them from resuming work and other normal activities. However, until their immunity can be absolutely guaranteed, their status should remain contingent on continuing to use their CV19 status app and thereby participate in contact tracing. And they should also be encouraged to maintain mitigation measures such as frequent hand washing and cleaning of work surfaces.

At the same time, in Amber and Green jurisdictions, many individuals classified as Amber will be able to resume most of their normal activities. In many cases, especially in Amber jurisdictions, this will mean that, in order to participate, they must use their CV19 status app and follow stringent guidelines for social distancing, use of PPE etc. But that seems a small price to pay to escape lockdown.

In general, current restrictions on businesses and the arbitrary “essential” designations<sup>79</sup> should be removed and replaced with restrictions consistent with the activities undertaken by that business and its employees based on the activities' RAG status and

---

<sup>79</sup> Fernandez, Marisa, and Courtenay Brown. “The randomness of “essential” businesses,” *Axios*, April 20, 2020, <https://www.axios.com/coronavirus-essential-businesses-22e0edfc-d838-4c2a-81eb-9fb81303ee13.html>

the jurisdictions' RAG status. This will allow the vast majority of businesses quickly to resume operation, albeit with additional precautions in place, including the use of CV19 status apps for all individuals entering business premises. They might, as an additional measure, use thermal scans to identify individuals who may have COVID-19.<sup>80</sup>

In addition, in order to limit the risk of virus transmission, businesses might be encouraged to adopt practices that reduce exposure. As noted above, they likely already have strong incentives to do this. But there could be value in the development of standards that embody these best practices, or "CV19 Standards." These might range from the use of PPE to cleaning of surfaces, use of physical barriers to impose separation between individuals, where appropriate, and keeping distance between customers and employees as much as possible. Such standards are likely to evolve over time as understanding of the most effective ways to limit transmission improve.

In practice, such CV19 Standards will vary by activity and might include such things as: specific spacing of tables in restaurants, staggering seating at small gatherings, introducing one-way aisles at grocery stores, and similar measures to curtail physical proximity. Most businesses that remain open are already practicing such measures, and others are putting in place plans for when they reopen.<sup>81</sup> A clearly specified set of standards based on best practices would reassure individuals that these measures have been successfully adopted elsewhere. An illustrative list of measures is given below, based on a study by McKinsey.<sup>82</sup>

---

<sup>80</sup> "Thermal imaging cameras could play "critical role" in keeping people safe from COVID-19." CBS News, April 28, 2020. <https://www.cbsnews.com/news/thermal-imaging-cameras-coronavirus/>

<sup>81</sup> See for example Wynn Las Vegas, <https://www.visitwynn.com/documents/Wynn-Health-Plan.pdf>

<sup>82</sup> Andres Cadena et al, *How to restart national economies during the coronavirus crisis.*, McKinsey and Company. Exhibit 7. April 2020. <https://www.mckinsey.com/~media/McKinsey/Industries/Public%20Sector/Our%20Insights/How%20to%20restart%20national%20economies%20during%20the%20coronavirus%20crisis/How-to-restart-national-economies-during-the-coronavirus-crisis-vF.ashx>

**Illustrative measures****Cross-cutting measures<sup>1</sup>**

- Remote working**
  - Encourage remote work for the next 3–6 months
  - Create remote-work policies that offer employees productivity incentives
- Physical distancing**
  - Ensure a minimum distance of 1.5 meters between two people<sup>1</sup>
  - Define regulation to establish maximum capacity in closed places
  - Suspend any in-person events that congregates more than 25 people
- Temperature and control**
  - Monitor people's temperature in all buildings and shops daily
  - Request employee quarantine when the slightest COVID-19 symptom shows up
- Health and hygiene**
  - Establish daily disinfection procedures
  - Promote mandatory health and hygiene protocols for employees (eg, washing hands, wearing masks and gloves)
- Reporting**
  - Report to relevant health authorities of any case with COVID-19 symptoms
  - Report the chain of contagion to relevant health authorities
- Enforcement**
  - Perform random checks across sectors to ensure compliance
  - Impose fines in cases of noncompliance

**Sector-specific protocols: Retail<sup>1</sup>**

- Implement communication and marketing campaigns to encourage e-commerce
- Implement tax exemptions to e-commerce
- Alternate remote work with face-to-face work as much as possible, especially for administrative staff
- Restrict maximum capacity of stores on per square meter basis
- Ensure that all large meetings are held online
- Set differentiated work shifts (eg, days, nights, weekends, holidays) for administrative staff
- Set differentiated check-in, food, and check-out times
- Create a carpooling scheme for employees in order to prevent them from moving by public transport
- Extend opening times or commercial establishments
- Set specific hours to serve high-risk population

<sup>1</sup> All of these protocols should be clearly defined by local authorities based on their context and

In this process, it is important to remember that a great many individuals will be conservative about taking infection risks, and no one should be required to take risks they don't think worthwhile. For some time, many may choose to continue self-isolation, use of masks and social distancing. Indeed, many people who are at increased risk from COVID-19, such as the elderly, may continue to self-isolate until a vaccine is available if they can afford to do so. Businesses and workers who are able may continue telecommuting or at least avoid meetings and business travel, and parents may continue home or online schooling.

These are the natural reactions of rational individuals to a dangerous contagion and should be encouraged as the emergent, market-based order to combat a serious collective threat. And, in general, the resultant more gradual process of reintroducing physical social interaction will reduce likelihood of new clusters of disease occurring.

At the same time, for people to make good decisions, they need good information. Anonymized data from testing as well as basic information about infection, hospitalization and death rates should be readily available and very up to date, so that it can be incorporated into people's decisions. A good model is the website maintained by Iceland at [www.covid.is](http://www.covid.is) (all of which is conveniently available in English!). Every effort should also be made to provide good information on risks and mitigation measures.

There is a danger that policymakers may try to move too quickly to open up, or fail to communicate effectively the steps that are being taken. If they do so, and especially if they do not offer clear explanations as to the purpose of the steps being taken, and clear data about the current status of a jurisdiction, many people may become more afraid, thereby undermining the process and slowing down a return to normalcy.

All of the above remains contingent on keeping in place an effective system of both population and targeted testing of individuals (based on symptoms), as well as an effective system of contact tracing, including the use of the CV19 status app, and associated testing of Amber-Red individuals. Any individual who tests positive is immediately reclassified to Red and must self-isolate for 14 days, after which time they may be retested if no longer symptomatic.

If ongoing testing and/or contract tracing identifies a cluster of cases, strong additional mitigation measures should be implemented. This may include the temporary closure and cleaning of businesses that are known to have been exposed, as well as the testing of all employees, contacts of those employees, and visitors to the business.

In the above, we have not specified which jurisdictions should have decision-making authority regarding the regulation of business. In the U.S., such decisions are partly a matter for the states and partly a matter for municipalities, counties, and other smaller jurisdictions. In general, we believe that states should delegate most of these matters to more-local jurisdictions. Policymakers should recognize the safety needs are more strenuous in an urban environment, where many individuals are in close, frequent physical proximity and contagion can spread more quickly. Rural areas already benefit from a degree of isolation and may not need regulations as restrictive if there is no sign of infection. This could allow for approaches that vary both across and within states by county, city, or school district, for instance.<sup>83</sup> It is most unlikely that the same policy will

---

<sup>83</sup> For example, a legislative proposal in Michigan would create three tiers of counties with policy measures appropriate to their conditions. The most urban counties would be tier 1 with a continued stay at home order. Less urban counties would be tier 2 with a heightened risk and would be subject to a cap

be appropriate to all jurisdictions, and policymakers should actively avoid such procrustean one-size-fits-all approaches.

### Phase 3: As RAG Status Improves, Remove Additional Restrictions

As the status of each jurisdiction changes, it will be possible to remove additional restrictions. Such decisions will depend very much on the specific progress made in the particular jurisdiction. One factor of general applicability, however, is the availability of effective treatments for CV19. Once these are available at sufficient scale, so that the case fatality rate is substantially reduced, it may be possible to adjust the risk-proportionate restrictions on individuals, activities and jurisdictions.

At the same time, it is important to remain vigilant for a return of the virus either in a cluster or in a second wave. Should that happen, it may be necessary to reintroduce some of the restrictions that have been removed until the virus has once again been tamed.

### Phase 4: Herd Immunity

Once an effective and safe vaccine is available, its use should be incentivized. Then, once a sufficient proportion of the population has immunity, either from the vaccine or having COVID-19, the remaining restrictions may be removed.

Even then, some level of vigilance must be maintained, given the potential for pools of the virus to remain and possibly mutate into a form that the vaccine does not protect against.

---

on gatherings, less travel restrictions, allowing remote and curbside sales but with enhanced safety protocols, allowing more elective, outpatient procedures, and allowing more outdoor recreation with appropriate social distancing. Tier 3 would be the lowest risk category with most restrictions relaxed for less-vulnerable individuals but retaining limits on hotel and vacation accommodations and reduced maximum occupancy for businesses. See LeBlanc, Beth. "House GOP floats regional plan to serve as 'framework' for state's reopening." *The Detroit News*. April 20, 2020. <https://www.detroitnews.com/story/news/local/michigan/2020/04/20/house-gop-floats-regional-reopening-plan/5163181002/>

## 8. Conclusions

In this analysis, we have sought to offer an evidence-based approach to removing the current restrictions on movement, euphemistically called “shelter-in-place” or, perhaps more accurately “lockdown”. It is evidence-based in two senses. First, it is based on evidence of what worked well in several jurisdictions. Second, it requires the use of evidence in an ongoing, iterative process: evidence of the past and present infection status of individuals; evidence of the overall rate of infection in locations; evidence concerning the risk of infection arising from undertaking a specific activity; and evidence concerning the effectiveness of certain strategies and equipment in reducing infection risk.

The proposal outlined herein is ambitious in scope. But it is, we believe, achievable. Moreover, because it entails a significant role for businesses and individuals, we believe that much of it can and should be implemented by those private actors independent of government. Having said that, however, the significant role government plays in activities such as transportation, as well as its role as regulator of PPE, treatments and vaccines, means that the support of government is likely to make implementation more effective. Governments can also play an important role in facilitating the development of jurisdiction-specific risk-based RAG systems.

A fundamental objective of good policymaking is the establishment of clear, straightforward rules that conform to well-established principles of justice. Many of the rules that have been imposed during the current COVID-19 emergency are likely more draconian than necessary and are antithetical to those principles of justice. The often-arbitrary restrictions imposed on businesses that have been deemed “non-essential” is a case in point. A first order of businesses must be to identify more rational and just rules. We hope this proposal is a step in that direction.

## About the Authors

**Julian Morris** is a Senior Fellow at Reason Foundation, Director of Innovation Policy at the International Center for Law and Economics, and a Fellow of the Royal Society of Arts. He has written extensively on the law and economics of innovation, risk regulation, economic growth, human health, and environmental protection. Mr. Morris is the author of over 100 research papers and the editor of several books, including *Rethinking Risk and the Precautionary Principle* and *Sustainable Development: Promoting Progress or Perpetuating Poverty*. Prior to joining Reason, he ran International Policy Network, an international think tank that focused on issues relating to trade, health and the environment. He was also a Visiting Professor in the Department of International Studies at the University of Buckingham and a member of the Council of the School of Pharmacy. Before that Mr. Morris ran the environment and technology program at the Institute of Economic Affairs in London. He is a graduate of the University of Edinburgh and has Masters degrees in economics and related subjects from University College London and Cambridge University. He also has a law degree from the University of Westminster.

**Adrian Moore**, Ph.D., is vice president of policy at Reason Foundation. He leads Reason's policy implementation efforts and conducts his own research on a wide range of economic policy topics. He has published numerous articles and studies on policy issues and change management in the public sector. He is co-author of two books and numerous policy reports and articles. Dr. Moore earned a Ph.D. in economics from the University of California, Irvine. He holds a master's in economics from the University of California, Irvine and a master's in history from California State University, Chico.

**Jacob James Rich** is a policy analyst at Reason Foundation. His work primarily focuses on health care policy, specializing in prescription and illegal drug regulations. Prior to joining Reason, he conducted research for the Cato Institute focused on economics and opioid policy. Rich holds master's degrees in mathematics and economics from Eastern Michigan University.