COVID-19: Social Disease and Public Prudence

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Abstract

The article profiles the social aspects of the COVID-19 pandemic including the social component of virus transmission, the parallels between national and regional social distancing habits, and the impact of COVID-19 on populations. The interaction of low-contact and high-contact cultures with the COVID-19 virus is analyzed. The public policy response is examined with particular reference to proportionality in decision-making. The article explores the role of mid-range, balanced policies and temperate, moderate actions in dealing with a serious public health issue.

Keywords: *anxiety, balance, community immunity, coronavirus, COVID-19, crowds, death, economic lockdown, explanation, families, fear of death, haptics, high-contact cultures, low-contact cultures, modeling, pathogen, panic, predictions, proportionality, proxemics, public policy, quarantines, reproduction number, social disease, social distancing, virus*

A Preliminary Analysis

This is a preliminary analysis of the COVID-19 pandemic. The analysis was completed on April 30, 2020. At that point, the course of the virus had a good distance to go. Events will necessarily outrun the evidence compiled below—by how much and in what way is unpredictable. That said, COVID-19 is the most important global public policy issue since the Global Financial Crisis and the following 2008 recession. Before that was 9/11—and before that was the collapse of the Soviet Union. Even mid-stream, the COVID-19 episode requires comment. It is the defining moment of our time—and its effects will reverberate through the next decade. It will have all kinds of implications, large and small, that we cannot anticipate. Yet like previous pivotal events, we will experience the coming decade in its shadow.

Background

The degree of virulence of a virus can be measured. The standard measure—the R_0 [R-zero] or basic reproduction number of a virus—is the average number of persons that an average infected person can potentially infect. The effective reproduction number (R_E) tells us how many persons an average infected person actually infects at a given point (or points) in time. The R_0 number assumes that there are otherwise no measures or conditions that limit the virus's communicability. The profile of the susceptible population, the environment, and the behavior of the transmitting agents can all affect the infection rate of a virus in action. An R_0 below 1 means that an infected person infects on average less than one person—in this case, the virus struggles to reproduce itself and spread.

The basic reproduction number varies depending on the virus. For instance, the R_0 of mumps is high (4–12) though not as high as measles (12–18) or chicken pox (10–12). The 2019 H1N1 influenza R_0 was 1.4. Seasonal influenza ranges from 0.9 to 2.1.[1] The early estimates of COVID-19's R_0 varied widely. Oxford University's Centre for Evidence Based Medicine on April 14, 2020 cited a median figure of 2.63 and an R_0 ranging from 0.4 to 4.6.[2] This was based on nine early studies from Wuhan, Shenzhen, and South Korea. In comparison, the 1918 pandemic flu had an R_0 of 2 to 3. The R_0 number is important. From this, epidemiologists can calculate the level of immunity potentially needed across society before a virus is unable to effectively reproduce itself.

Assuming the median R_0 figure of 2.63 for a given population, it is calculable that 62% of that population would

[1] Joseph Eisenberg. "R0: How Scientists Quantify the Intensity of an Outbreak like Coronavirus and Predict the Pandemic's Spread," *The Conversation*, February 5, 2020, https://theconversation.com/r0-how-scientists-quantify-the-intensity-of-an-outbreak-like-coronavirus-and-predict-the-pandemics-spread-130777.

[2] Jeffrey K. Aronson, Jon Brassey, and Kamal R. Mahtani. "'When Will It Be Over?': An Introduction to Viral Reproduction Numbers, R0 and Re," Centre for Evidence Based Medicine, Oxford University, April 14, 2020, https://www.cebm.net/wp-content/uploads/2020/04/%E2%80%9CWhen-will-it-be-over_%E2%80%9D_-An-introduction-to-viral-reproduction-numbers-1.pdf.

need (in one way or another) to be immune for COVID-19 to die out.[3] The level of community immunity varies from virus to virus. In the case of mumps, given its high R_0 number, 75 to 86% of a population potentially needs to have immunity—either by virtue of a vaccine, or antibodies, or behavioral conditions—for the reproduction of the virus to fall low enough (below an R_0 of 1) for the transmission of the virus to slow and eventually stop. The level of community immunity is an 'if-then' figure derived from the R_0 number. Specialists may disagree on this figure.

The R_0 figure has limits. It indicates the potential virulence of a virus. But this potential exists in the absence of government control measures, human agency, or environmental (e.g., hygiene, ventilation) factors that work to reduce the R_0 to an R_E—the latter being a measure of the virus's actual rather than its potential capacity to transmit from one or more persons. Models of R_0 extrapolated from periods and places of the uninhibited (maximum) spread of a virus do not necessarily reflect its communicability over its entire infectious history.

[3] Aronson, Brassey, and Mahtani, "'When Will It Be Over?'." Early serological (anti-body) testing in New York City in April 2020 suggested that 20% of the city had been exposed to the virus. Brooklyn with a population of 2.53 million had a death toll of 3,540 (April 23) or 1,399 per million. During the same period, Stockholm had an exposure rate that appeared to be broadly similar (though increasing) and a fatality rate of 1,098 per million population. In both cases the serological data remained limited. Bonn University research in Gangelt, Germany—a COVID-19 hotspot—found that 15% of the population had been exposed to the virus.

Immunity to a virus is achieved in several ways. The first is pharmaceutical: a vaccine against the virus. The second is exposure. Individuals who have not been vaccinated (or those for whom the vaccine is ineffective) are exposed to the virus. They then get sick, and their own immune system responds. If their immune system successfully fights off the virus, they recover. The "memory" of their successful immune response is stored in their body in the form of anti-bodies. Should the recovered person get exposed to the virus again, antibodies immediately tell their immune system how to repel the virus. Vaccines take molecules (antigens) from the pathogen and introduce them into the body. This teaches the immune system to produce antibodies that will "remember" the viral pathogen in the future and act swiftly to repel it before the pathogen spreads and causes an illness.

When a person is exposed to a virus, one of four things happens: (a) they fall ill—in a small percentage of cases seriously or critically ill—and in a very small percentage of cases they will die; (b) they get exposed, have mild symptoms, and recover; (c) they are asymptotic and never know that they were exposed and carried the virus; (d) they had a vaccine shot, and the vaccine has trained their immune system to successfully fight off the virus.

COVID-19-related deaths are concentrated among persons over 70 years of age (and especially among those over 80) who have multiple co-morbidities (underlying chronic conditions, notably high blood pressure, cardiovascular disease, and diabetes).[4] As of late April 2020, variously high and very high percentages of national deaths from COVID-19 had occurred in nursing homes.[5] Principally old and especially very old persons had a high risk of dying if they were infected with the virus. This however raises the question of causality. For while many persons who die will die with the virus recorded on their death certificate, they will not necessarily have died because of the virus.

The British Imperial College epidemiologist Neil Ferguson speculated that possibly anywhere between a half and two-thirds of the high-risk cohort (i.e., aged persons with multiple underlying conditions) who die after being infected with the

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[4] See *Statistik över antal avlidna i* Covid-19 [Statistical number of COVID-19 deceased], April 27, 2020, from Sweden's National Board of Health. A Chinese study of 168 patients who died in 21 hospitals in Wuhan in January 2020 concluded that "(75.0%) were men. The median (IQR) age was 70 (64–78) years, and 161 patients (95.8%) were older than 50 years . . . Hypertension was the most common comorbidity (84 patients [50.0%]), followed by diabetes (42 patients [25.0%]), and ischemic heart disease (31 patients [18.5%])." Jianfeng Xie et al., "Clinical Characteristics of Patients Who Died of Coronavirus Disease 2019 in China," *JAMA Network Open* 3, no. 4 (April 10, 2020), https://jamanetwork.com/ journals/jamanetworkopen/fullarticle/2764293.

[5] "In the countries for which we have official data (Australia, Belgium, Canada, France, Hungary, Ireland, Israel, Norway, Portugal, Singapore and some regions of Spain), the percent of COVID-related deaths in care homes ranges from 19% to 72%)." Comas-Herrera et al., "Mortality Associated with COVID-19 Outbreaks in Care Homes: Early International Evidence," International Long Term Care Policy Network, April 16, 2020, https://ltccovid.org/wp-content/uploads/2020/05/Mortality-associated-with-COVID-21-May-6.pdf.

As of late April in the United States, 64% of Colorado's COVID-related deaths were in nursing homes and more than 50% in Connecticut (Wingerter 2020; Phaneuf 2020).

virus would have died in 2020 in any event.[6] Such deaths should not show-up in statistical reporting as excess deaths over and above the expected national median for a given week. Thus, it is statistically possible to filter such persons out of the picture of mortality by looking at excess deaths that occur above the weekly national norm. In March and April 2020, many countries confronting COVID-19 did not register significant or even any increases in excess deaths—deaths above the norm. Yet other countries did (see table 1). This is puzzling. Why did some COVID-affected countries experience much higher than normal mortality rates while many others did not? This is a question we will return to.

In the case of COVID-19, a vaccine in 2020 is unlikely. This does not mean that it will not happen; just that the probability of it happening is low. Vaccines are slow to develop and test—twelve to eighteen months from March 2020 is the most optimistic timeline generally given for a COVID-19 vaccine. In truth a vaccine may never eventuate, or it may be many years away, or it may only protect some

[6] On March 25 2020, giving evidence to the UK House of Commons Science and Technology Committee Neil Ferguson, the Imperial College London epidemiologist, put it this way: "We don't know what the level of excess deaths will be in this epidemic . . . By the end of the year, what proportion of those people who died from COVID-19 would have died anyhow? . . . It might be as much as half to two thirds of the deaths we're seeing from COVID-19, because it is affecting people who are either at the end of their lives or in poor health conditions." Jacob Sullum, "No, British Epidemiologist Neil Ferguson Has Not 'Drastically Downgrade' His Worst-Case Projection of COVID-19 Deaths," *Reason*, March 27, 2020, https://reason.com/2020/03/27/no-british-epidemiologist-neil-ferguson-has-not-drastically-downgraded-his-worst-case-projection-of-covid-19-deaths/.

people. For all its resources, pharmaceutical science has not had much success over decades in creating antiviral vaccines. One in ninety antiviral vaccine projects fail. At the time of writing there were eighty COVID-19 vaccine projects under way around the world.[7] With that degree of investment of resources and time, it is plausible to think that a vaccine will be produced. Yet that is not guaranteed because of the very high failure rate of such projects. Hope is not a scientific methodology.

In any event, vaccines do not always provide comprehensive immunity. The efficacy of seasonal flu vaccines varies from year to year. The elderly—the principal COVID risk group—often respond less well to vaccines. If not a vaccine, then what? Effectively, the answer is three-fold. One is community immunity ("herd immunity")—when enough healthy members of the population are exposed to the virus without getting seriously ill or dying or even knowing they have been exposed. The alternative to herd immunity is social distancing—creating sufficient physical distance between people (limiting close contact) and fine-tuning environmental (including sanitation and ventilation) conditions to reduce the communicability of the disease. A third option is the combination of the two: those at low risk (the young) carry the burden of herd immunity while those at

[7] Ian Frazer, "Will We have a Vaccine?: Interview with Professor Ian Frazer" byy Norma Swan, *Health Report*, Australian Broadcasting Corporation, April 13, 2020, https://www.abc.net.au/radionational/programs/healthreport/coronavirus-vaccine-ian-frazer/12144260.

high risk, the elderly, are physically distanced.[8] On the whole, public policy through March and April 2020 proved incapable of such nuance.

Fatalities

Human populations naturally wish to acquire immunity—however it is obtained—for a very simple reason. A small percentage of persons who fall sick from exposure to a viral pathogen will fall critically ill from the virus and some will die from it. As in the case of COVID-19, a critical illness can mean not only death but long-term damage to the body.[9] COVID-19, like other viral pathogens, has an infection fatality rate (IFR). This is the percentage of those die after infection. In the case of COVID-19 like the R_0 and R_E, it is better to think of the IFR of the virus not as a single number but rather as a range of numbers. From random-sample research conducted in Germany and Iceland, the IFR was estimated in April 2020 to range between 0.01% and 0.36% (see table 2). Undoubtedly as further research is published, the range of IFR numbers will change or be refined.

[8] In effect, this is what Streeck et al. (2020) recommended after their study of Gangelt in Germany: "[The already-infected] 15 percent of the population reduces the speed (net number of reproductions R in epidemiological models) of a further spread of SARS-CoV-2. By adhering to stringent hygiene measures, it can be expected that the virus concentration in the event of an infection in a person can be reduced to such an extent that the severity of the disease is reduced, while at the same time developing immunity."

[9] The innate immune response of the body causes bodily "inflammation." When the immune response is uncontrolled, this can result in substantial damage to uninfected body tissue.

However, given the pattern of deaths per capita that occurred during the months of January through April 2020, it is also plausible that the COVID-19 phenomenon manifests in a considerable range of different infection fatality rates in different countries and regions. In short, a single IFR for COVID-19 does not apply uniformly across the world.

It is impossible to predict the future course of the virus. But at the time of writing, part way through its dissemination, table 3 clearly shows a wide span of rates of fatality between countries. Later on we will also see that the same thing applies between regions in the United States and Canada. In addition to the biochemical characteristics and behavior of the virus, this suggests that there are social reasons or social contexts that explain—or rather partly explain—the significant variations in the number of fatalities per capita between nations and regions. It is possible that lower and higher national rates of death reflect a range of R_E and IFR numbers. It is also possible that over time this range will decrease and that rates of death per nation and region will eventually converge on a median percentage over one, two, or three years. The latter cannot be precluded. Nonetheless at the time of writing, the variation of rates of fatality between and within nations is striking.

In April 2020, a modest amount of solid research was done on infection fatality rates—the percentage of infected persons who have died from the virus. While the IFR number is crucial to understanding the relative virulence of the disease, IFR data collection in March and April 2020 was severely hampered by the limited amount of random-sample testing for infected populations that was conducted by researchers and governments. However, the two serious cases of random-sample testing that were carried out—one in the German viral hotspot of Gangelt; the second in Iceland—offered evidence of a range of fatality rates stretching from 0.01% to 0.36% of infected persons as shown in table 2.

In one important respect, virus behavior is predictable. As William Farr discovered in the nineteenth century, viral infections expand and decline at a bell-curved rate: slowly at first, followed by a quick-paced rise upwards, then a cap, then a quick-paced decline, and finally (slowly again) a taper until the virus fades out. The curve upwards and downwards can be relatively steep or comparatively gentle—though the common expression "flat" exaggerates the nature of a moderate incline. Nations or regions that are successful (for whatever reason) in moderating the bell curve reduce the R_E number (the number of persons an infected person will infect in practice) as well as the fatality rate among infected people. Given the history of viruses there is no guarantee that the bell curve pattern of infection will not recur in the form of a series of bell curves or "waves" of infection. At the time of writing, it is impossible to forecast whether this will happen with COVID-19 or if the R_E number and the infection fatality rate within and between nations and regions will broadly converge on a median figure. That proviso stated, it is equally plausible that the significant variation between countries and within countries, evident through March and

April 2020, will persist. If so, what explains the variation? What kind of social force or bio-social pattern causes it?

There have been several suggestions made to explain the large range in the incidence of deaths per capita between (say) Italy and Taiwan (see table 3). Why does one society have over four hundred deaths per million population while another society has a handful of deaths per million population? There are possible political explanations of this phenomenon, which I will consider later on. Other explanations include climate (warm temperature), ICUs (intensive care units) per capita, the percentage of the population who smoke, the percentage of persons in single households, the percentage of persons in multi-generational households, air quality by country, the death rate per capita from influenza and pneumonia, and the rate of smoking per country.[10] The explanations go like this: COVID-19 survives a shorter period of time in sunlight; single persons are more socially isolated; multi-generational families are more likely to transmit the virus from the young to the most-at-risk elderly populations.[11] In addition because COVID-19 attacks the

[10] A study by the Intensive Care National Audit and Research Centre, London looked at 6,720 critical care COVID-19 patients. The median age of admission was 62 years-old, 72% were males. Of 4,078 admissions with outcomes, 2,067 died [50.7 percent] and 2,011 were discharged. Of those receiving advanced respiratory support (mechanical breathing etc.), 65% died. See Table 1 and Table 9 of Intensive Care National Audit and Research Centre, *ICNARC Report on COVID-19 in Critical Care* (Napier House, London: ICNARC, 2020).

[11] There is a strong positive correlation between sunshine duration and temperature.

respiratory system, there are a number of possibly respiratory-related causes: air pollution and smoking. The incidence of influenza is a proxy for the state of the respiratory health of a susceptible population. As is evident from tables 4, 5, and 6, there is no correlation between COVID-19 deaths per capita and any of these factors—except for the case of intergenerational contact.[12]

A Social Disease

A lot of extant explanatory models about COVID-19 ignore the most elementary fact about the virus. It is passed on by close contact between persons. The virus is transmitted via droplets. A droplet containing the virus passes from one person to another person (or persons) who are in close physical contact with the first person.[13] The second person draws in a droplet through the mouth, nose, or eyes. As we'll see in a moment, close contact—the proximity of one person to another—is not only a physical or bio-medical phenomenon but also a social one.

Researchers from Bonn University undertook a preliminary virological study of Gangelt in Germany, a town

[12] "Other households" was used as a proxy for inter-generational households as the category "other households" excludes couple, single parent, and sole-person households.

[13] Liu et al. (2020) undertook a study of COVID-19 aerosol (airborne) transmission in the enclosed spaces of a Wuhan hospital and found little evidence of it except in crowded spaces and unventilated spaces including toilet cubicles.

hit hard by COVID-19.[14] They could find no evidence of the transmission of the virus in supermarkets, restaurants, or hairdressing salons. Rather, major outbreaks of the virus were the result of closely packed get-togethers that took place over prolonged periods of time.[15] Outbreaks stemmed from tightly packed events such as after-ski parties with people pressed together in close quarters for a sustained period of time. Football crowds and carnival celebrants were also directly connected to outbreaks.[16] But whether the relevant transmissions occurred outdoors or in related celebrations in bars or in packed transport going home—crowded enclosed spaces—was not clearly established in the Gangelt study. Although, Chinese research (below) suggests that transmission occurs mostly in enclosed spaces.[17] The Bonn researchers could detect the virus when they swabbed tactile surfaces such as remote controls, washbasins, mobile phones, toilets, and door handles. However, they only detected RNA, the ribonucleic acid (genetic information) of "dead" viruses.

[14] Streeck et al. 2020; "How German Scientists Hope to Find Coronavirus Answers in Country's Worst-Hit Spot," *The Local,* April 2, 2020. As of April 2, the Heinsberg area—where Gangelt is located—had a population of 250,000 and a death rate from COVID-19 of 156 per million, a significant figure.

[15] The reference is to after-ski-parties held in Ischgl, Austria, a scene of high-energy revelling in bars, pubs, clubs, and discos.

[16] The references are to a Champions League football match played in Milan on February 19, 2020 attended by 40,000 fans from nearby Bergamo and to carnival celebrations in Gangelt on February 15, 2020.

[17] Presumably then, any enclosed spaces with a crush of people—be it churches, conferences, theatres, lecture theatres, or peak-hour public transport—all pose potential elevated risks of transmission. Lack of ventilation adds to the risk.

As the lead virologist observed in reported remarks: a door handle can only be infectious if someone has actually coughed in their hand and then reached for it. "After that, you have to reach for the door handle yourself and touch your face."[18]

In China, researchers studying the transmission of the virus also raised doubts that supermarkets, restaurants, and hairdressers were significant locations of transmission.[19] The Chinese researchers looked at outbreaks involving three or more secondary cases in 320 municipalities in China. The study excluded Hubei province where the virus pandemic began as well as Beijing, Shanghai, and Guangzhou. From a total of 7,324 cases and 318 clusters tabulated for the study, the researchers found that 254 (79.9%) of the outbreak clusters occurred in a home (one in a villa; all others in apartments), 108 (34.0%) occurred in a transport location, 14 (4.4%) at a restaurant or other food venues, 7 (2.2%) at an entertainment venue, 7 (2.2%) at a shopping location (shopping mall and supermarket), and 26 (8.1%) at a miscellaneous location (e.g., hospital, hotel room, unspecified community venue, power plant). All of the cluster outbreaks identified from municipal data occurred in indoor locations.

The research drew on municipal data from January 4 to February 11, 2020 (Wuhan, the center of China's mass

[18] "How German Scientists Hope to Find Coronavirus Answers in Country's Worst-Hit Spot," *The Local,* April 2, 2020.

[19] Qian et al., "Indoor Transmission of SARS-COV-2," medRxiv preprint, April 7, 2020, https://doi.org/10.1101/2020.04.04.20053058.

outbreak, was locked down on January 23). Chinese New Year 2020 extended from January 25 to February 8. Thus, the data is necessarily skewed against workplace locations for virus transmission and skewed in favor of family travel for Chinese New Year. After the January 23 shutdown of Wuhan, Chinese across the country began voluntarily staying home. Nonetheless, it is notable that during the busiest time of the year—marked by mass shopping, dining-out, and public entertainment—virus transmission mostly occurred between family members, relatives, and socially-connected individuals and generally not with socially-unconnected individuals (strangers). Among the 318 cluster outbreaks, 129 (40%) involved only family members, 133 (41.8%) involved family relatives, and 29 (9%) involved socially-connected individuals. In contrast, only 24 (7.5%) involved socially-unconnected individuals (strangers).

What these figures underline is the degree to which COVID-19 is a disease of social proximity or close contact. Families and homes (including nursing homes and families traveling together) figure prominently in the transmission of the virus because they are relationships and locations of close contact. The crowding of persons in enclosed social spaces has a similar effect. Early large outbreaks of the virus were associated with close contact in crowded charismatic church assemblies and cruise ships.[20]

[20] The references are to the *Diamond Princess* cruise-ship and the messianic Shincheonji Church of Jesus in Daegu, South Korea; the Pentacostal Bethany

What if the pattern that applies at a micro-social level also applies at the macro-social level? The virus's relative (non)transmission is subject to how intensely physically-close individuals touch each other, breathe-on each other, or in some way communicate microscopic sprays of droplets to each other. How does this operate on a large social scale at the level of nations or regions? Is relative physical distance not only something that functions between dyads and triads and small groups of human beings in close or crowded contact but is also manifest in a large social scale involving millions of people?

The anthropologist Edward T. Hall introduced the idea of proxemics to the social sciences in the 1960s.[21] Proxemics, which is related to haptics (touch), is the study of personal space. This is the space that persons normally allow for in their interactions with others—families, friends, acquaintances, and strangers. What this research over the years has shown is that personal space considerably varies by nation and region. Several serious studies have measured habitual physical distance between nationalities and denizens of regions within nations. The discipline of inter-cultural business communication studies has also produced a large literature based on accumulated observations and reports of national personal spatial habits—a subject of some

Slavic Missionary church in Sacramento, California; and the evangelical church of Bourtzwiller in Mulhouse, France; among others.

[21] Edward Hall, *The Hidden Dimension* (Garden City, NY: Doubleday, 1966).

importance when Americans and Japanese or Swedes and Italians do business together.

Table 7 compares death rates per capita related to COVID-19 and national interpersonal spatial habits. Interpersonal distances vary between nations. This is true of interactions with strangers, acquaintances, and families. Table 8 illustrates the difference between France and Germany. Those relative distances mirror the rates of COVID-related deaths per capita to a significant degree as does the propensity of national subjects to touch each other, as do meeting-and-greeting conventions—notably when the causal effects of all these propensities and conventions combine. The kiss-on-the-cheek versus the handshake versus the bow-nod greeting all imply relative degrees of social distance that mirror the relative spread and impact of COVID-19 between nations.

What applies on a national level is replicated in a fractal manner on a regional level, as Tables 9 and 10 illustrate. A high-contact culture is a culture in which habitual everyday physical interactions between people are close by comparison to low-contact cultures where physical distance (as a matter of habit) is greater. The degree of distancing is culturally specific, the product of the long history of cultural ancestry. The habit of distancing is formed early in childhood. Three cases are examined in detail here: the United States, Canada, and Italy. French and Italian cultural ancestry is used as the proxy for high-contact culture in North America. In the case of the United States, the incidence by region of the “un-inhibited” personality type is also used as a proxy for close contact. In the case of Italy (table 10), American political scientist Robert Putnam made famous a measure of the proxy for a high-contact culture: degrees of "civic" behavior by region, that is, membership of clubs, societies, choirs, and the like. To a significant degree, the higher the rate of "civic" behavior, the higher the rate of deaths per capita in Italy's regions.

What applies at a national and regional level almost certainly applies at a sub-regional level. The fractal pattern of the spread of COVID-19 goes all the way down. For example, New York State had high levels of COVID-related deaths in some countries but not in others.[22] I would caution against the prognosis that urban density explains this. As tables 4, 9, and 10 illustrate, there is no correlation between urban density and per capita death rates.

Public Policy

March and April 2020 saw a dramatic development in public policy across most of the world. In March, governments began to sponsor social distancing policies—first by advising populations to physically distance and then implementing regimes to test persons who might be infected, track their contacts, and quarantine confirmed carriers of the virus at home (table 11). A range of prohibitions short of

[22] Very high in the southern counties in and around New York City (such as Suffolk, Bronx, West-Chester) but very low in the northern parts of the state.

comprehensive social shutdown were also progressively introduced (table 12). This was followed in April 2020 by governments shutting down their economies (to varying degrees) to further reduce physical interaction between people. Tables 13 and 14 indicate the relative intensity of these shutdowns by nation.

In the absence of government prohibitions, three things can be used to reduce the reproduction number of COVID-19: a vaccine, community immunity, and social distancing. In addition, re-purposing an existing drug might provide an effective therapy for persons in critical care. There was little chance of a vaccine being developed early enough to combat the virus spread in 2020. Drug therapy was also uncertain. A public policy argument that was common in the latter part of March 2020 boiled down to the following: Community immunity will reduce the R_0 number in due course. In the interim where the R_0 number is high or very high, the resulting influx of serious and critical cases could put undue pressure on a nation's hospital system. In lieu of a vaccine or effective therapy as well as an R_0 number between 2 and 3, this left governments with a third mitigating factor: human agency, the ability to distance oneself from others.

A series of public health measures were introduced in March 2020: social distancing advisories, travel advisories, travel restrictions, flight screening, testing and tracing infected persons, home quarantining of infected persons, flight bans, nursing home restrictions, temporary school closures, border closures, sports cancellations, bans on gatherings, and the hotel quarantining of infected persons. These were largely—though not entirely—proportionate to a serious health issue. The best of these measures addressed key characteristics of the virus spread. Social distancing targeted the specific nature of the transmission of the disease that occurs through close physical contact—especially within families and between relatives and friends. Tracking and tracing targeted persons who were ill from the virus or who had contracted it (table 11). Nursing home advisories and restrictions targeted persons in nursing homes who were at particular risk of dying from the disease or with the disease present in their autopsies.

Other aspects of the March public policy phalanx appeared excessive. Closing schools to prevent the spread of the virus among the very low-risk population of children and their young adult parents was an example.[23] This was in contrast with efforts to restrict close physical contact with older and elderly relatives at much higher risk of dying from the virus. A lack of proportionate, targeted, fine-tuned, and mid-range responses dogged COVID-19 public policy through March and April 2020. It is as though no public language or civic rhetoric existed anymore to deal with mid-range public matters that fall between the extremes of unimportance and catastrophe. The medium, middle, and

[23] The reason for this falls into two categories. One was a prejudice of public health officials against the idea of community immunity, even if the community carriers were low-risk young persons. The second was the fear that education employees—not so much teachers who skew young but ancillary staff who skew older—might be at risk.

intermediate fell out of focus while the rhetoric of emergency, crisis, and disaster heated up.

This is typified on a national scale by the United States, which swung from doing little in March to shutdowns in April (table 11 and 12). Within a few weeks the country careened from the president calling the virus a hoax to shutdowns in most American states with much of the population directed to stay at home. In numerous countries, March restrictions on gatherings addressed the propensity of the virus to propagate in crowded enclosed spaces. But like many of the later April lockdown measures the bans on gatherings lacked finesse. These did not distinguish between enclosed and unclosed spaces, outdoor or indoor spaces, ventilated or unventilated spaces, packed or dispersed bodies; or take into account the length of time (prolonged or short) that a person might spend in an enclosed space; or specify the difference between a crowded indoor space and one that was not crowded. The lockdown measures in late March and April exhibited even less proportion and finesse. They were of a wholesale and largely undifferentiated nature. They required the closure of arbitrarily defined "non-essential" businesses, the quarantining of whole nations and their healthy populations in their own homes, and the extended closure of schools.

In one way or another all the measures in March and April 2020 were (or tried to be) an artificial amplification of the habits of social distancing and inter-personal spacing that nations and regions already practiced. Governments in effect attempted to augment, magnify, and intensify habitual social spacing. Did it work? The answer is yes and no. The March 2020 government advisories; tracking, tracing, and quarantining regimes; and targeted prohibitions (such as travel bans) had a measurable influence on the spread of the virus. German epidemiologists reported a drop in Germany's reproduction number from a high of 3.1 on March 9, 2020 to an admirable low of 1 by March 21. After that, through to April 9, the reproduction number fluctuated between 0.9 and 1—a success reflected in Germany's modest death rate per capita (table 15).

The results of the April 2020 measures—the lockdowns—by governments are less impressive. Germany reached the propitious reproduction number of 1 before their lockdown began. Death rates per capita in countries with severe lockdowns, like the United Kingdom, commonly peaked in April and then dropped—outwardly a success of the lockdown policy. But deaths per capita is a lagging indicator of infections that begin (conservatively) three weeks prior to death on average.[24] In many countries including the United Kingdom, the rate of infections (as indicated by the subsequent rate of daily deaths) had peaked and had been

[24] The incubation period—the time between exposure to the virus (becoming infected) and the onset of symptoms—is on average 5 to 6 days (WHO 2020). There are 17.8 days on average from the onset of symptoms to death or discharge from the hospital (Verity et al. 2020).

falling before the imposition of a lockdown[25] (table 16). Any effect of a lockdown would only show itself three weeks after the lockdown had begun given the stages of incubation followed by infection through to death or hospital discharge in serious COVID cases.

Conversely if COVID-19 followed the characteristic symmetrical bell-curve trajectory of viruses that William Farr observed in 1840, then a country whose first infection occurred on January 20 and whose day of peak deaths occurred on April 8 (11 weeks apart) could expect to see the bell curve taper through June (and social optimism return by mid-to-late May). What the bell curve pattern should remind us is that nature has its own regularities—and human intervention is limited in the degree to which it can alter or reverse these. Human beings can adapt to nature's constancies (social distancing being an example), and it can re-purpose natural phenomena for its own ends (vaccines being an example). But "the government must do something to fix this now" styles of intervention rarely work effectively. They lack the modesty of successful human adaptation. Humility is a virtue too often absent from public policy.

[25] Japan's Ministry of Health on March 9, 2020 ("Hospitals Told to Prepare for Bed Shortage at Peak of Virus Outbreak," *Asahi Shimbun*) predicted that the Coronavirus peak of each Japanese prefecture would occur "roughly three months" after their first reported case of local transmission. On March 24, 2020, I observed on Twitter (https://twitter.com/PMcomment/status/1242286719568732160) that China's peak of active cases occurred at the three-month point; South Korea's at 2 months. As it turned out, Australia, Hong Kong, and South Korea peaked at two months. For data on active cases, see Worldometer, Coronavirus by nation.

Proportionality

Public and government attitudes in March 2020 and early April 2020 were strongly influenced by predictions made by researchers modeling the reproduction number of COVID-19, the resulting anticipated rate of death per capita, and the projected demand for hospital beds. Given different assumptions, the projections of deaths differed widely, even within the same model (table 17). Modelers often made no clear distinction between the effective reproduction number, $R_{E,}$ and the basic reproduction number, $R_{0,}$ of the virus. Insistent claims were made during March of 2020 that comprehensive lockdowns of the economy and society were needed to save hospital systems. The lockdown strategy was developed by Communist China. Yet democratic nations embraced it in late March.

As March progressed, COVID hawkishness rose. It was increasingly argued that severe measures had to be imposed—particularly, the quarantining of a large portion of the healthy populations of nations. Without this, hospital systems would collapse under the weight of an overwhelming demand for beds to treat serious and critical COVID-related cases. In some cases, there were apocalyptic-scale predictions of the need for hospital beds. In the end, actual demand fell markedly short of the predictions (tables 18 and 19). This is a stark reminder that modeling is not an observation of what has happened; it is a prediction of future events based on the assumptions of the modelers. Those assumptions in themselves can be more or less realistic. But even then, they rarely effectively model countervailing forces—be they natural or social—that can reverse a predicted course of events. This is especially true in the cases of natural or social causation that are dependent on the interaction of multiple causal factors.

Modeling commonly provides a range of possible outcomes based on a range of assumptions. Some of these assumptions are more probable or realistic than others. The difficulty is that figures at the upper end of the range—the least probable ones—tend to get widely quoted because of their melodramatic character. The most exaggerated figures—all of them based on assumptions and not empirical realities—enter the public imagination. In late March and early April 2020, this kind of histrionic translation occurred on a mass scale—initially via journalists, academics, health officials, and government ministers. What followed was a torrent of apocalyptic imagining—a social contagion—cascading through many national populations and reinforced by obsessive daily death counts. But was it an apocalypse? Or was it a serious public health matter that then was blown out of all proportion? In Europe, as death tolls associated with COVID-19 grew through March and April and reached a peak in April 2020, measures of excess deaths—rate of deaths greater than what would normally be expected—indicated that the matter was serious but variable in its seriousness and far from apocalyptic (table 1). Yet forebodings of immanent disaster circulated widely even while the worst death rates per capita were confined to specific nationsand their regional hotspots (tables 9 and 10).

The report for the government produced in March 2020 by Imperial College London researchers was the single most influential document produced during the COVID-19 episode. [26] Its influence was enormous. It galvanized governments (not just in the United Kingdom but more generally) to impose increasingly severe shutdown policies. The paper gave different estimates of total deaths over a five month or longer period depending on different reproduction numbers and different "suppression strategies" (table 20). Among an enormous range of predictions of total deaths in the UK—ranging from 500,000 to 5,600—the report had to make some more or less correct predictions almost by definition. In a way, the model couldn't be wrong. The modeling of the mean projected number of deaths by the Institute for Health Metrics and Evaluation at the University of Washington proved much more reliable not least because these numbers concentrated on the mean number, which was conducive to moderation in prediction (table 21).

Among the enormous range of forecasts made by Imperial College researchers, the soundest predictions of total deaths from COVID-19 all assumed the necessity of a severe shutdown of the society and the economy—"workplace contact rates reduced by 25%"; "households reduce contact

[26] Ferguson et. al., "Impact of Non-Pharmaceutical Interventions."

outside household, school or workplace by 75%."[27] This anticipated and defined what was subsequently applied (even more severely) by the British government in April. The shutdown of society and the economy became commonplace throughout the world in April 2020. The intensity of the shutdowns varied between nations (tables 13 and 14). But the economic impact across the board was severe (tables 22 and 23). The outcome of these government-engineered recessions is not an easy thing to predict. There is no precedent for them. In April 2020 the International Monetary Fund (IMF) forecast a -6.6% real GDP decline among the economically advanced European nations and a 9.2% unemployment rate in 2020.[28] In the major economies of Asia, the projected figures were -4.5% GDP growth and 4.1% unemployment. Advanced economies that were predicted to have 10% or more unemployment in 2020 included Germany, France, Italy, Spain, Ireland, Portugal, Greece, Sweden, Norway, and the United States.

Social life is multi-dimensional. It requires the balancing of multiple private and public goods. A sense of proportionate behavior is necessary to accompany this. One cannot with justification elevate one good without taking into consideration other competing goods. Proportionality is crucial. In a given time period we might treat an issue like the spread of a pathogen as "serious." Thus, a certain proportion

[27] Ibid., Table 2.

[28] IMF, *World Economic Outlook: The Great Lockdown* (April 2020).

of time and resources is devoted to it; 60:40 might be an appropriate weighting. Let us call this an Aristotelian approach to public policy. It assumes that there is a "middle way" in public policy—a balancing of competing considerations. Good judgment—or prudence—is the intellectual virtue that reflects this. Good judgment is different from the notion of the need to act out of "an abundance of caution," which is common in government statements during late March and April 2020. This supposes that governments can eliminate risk from a society caught-up in a state of uncertainty. This is impossible. Attempting to entirely eliminate one risk creates other, even greater, risks as a result.

Take the case of deaths—specifically the number of excess deaths per week by country in March and April 2020 (table 1). Excess death tallies allow us to calculate the number of deaths attributable to COVID-19 separate from COVID-related deaths due principally to co-morbidities. Although, the question is: attributable to COVID-19 in what way? For at this point, the matter gets more complicated. A percentage of persons exposed to the virus will die directly as a result of that exposure. But among excess deaths there are also deaths of persons with no infection that were caused by anti-COVID public policy measures. It has long been observed that public policy routinely leads to (negative) unintended consequences. Researchers examining population-based health records in England and Northern Ireland found that during the public health emergency period there was a 44–

66% drop in admissions for chemotherapy and a 70–89% reduction in urgent referrals for early cancer diagnosis compared to pre-emergency levels.[29] In its effects on mortality, they calculated that this represented 6,270 excess deaths at 1 year in England and 33,890 excess deaths in the US.

Another research study found an increase in observed, compared with expected, mortality in Scotland (+73%), England and Wales (+49%), the Netherlands (+65%), and New York state (+34%).[30] But of these deaths, only 65% in Scotland, 68% in England and Wales, 49% in the Netherlands, and 73% in New York State were attributable to COVID-19 infections. How to explain the number of excess deaths that were not attributable to COVID-19 infections? COVID public policy measures and associated rhetoric disrupted normal clinical patterns. Populations avoided emergency, medical, and hospital waiting rooms because of stay-at-home pressures and fears of infection. The effect was a pronounced fall in the diagnosis and treatment of life-threatening non-COVID conditions.

The unintended consequences of public policy span not only the short term but also the long term. Governments paid close attention to the projected loss of life-span due to

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[29] Alvina Lai et al., "Estimating Excess Mortality in People with Cancer and Multimorbidity in the COVID-19 Emergency," medRxiv preprint, April 2020, https://doi.org/10.1101/2020.05.27.20083287.

[30] Kieran F. Docherty et al., "Deaths from Covid-19: Who are the Forgotten Victims?" medRxiv preprint, April 28, 2020, https://doi.org/10.1101/2020.04.21.20073114. The researchers examined data through to April 22, 2020.

COVID-19 but did not give proportionate attention to the significantly larger number of life-span years lost when societies are plunged (or in this case plunge themselves) into periods of mass unemployment. Prudent social distancing to reduce the R_E number of the virus would have led to a global recession in any event by slowing and curbing social interaction but not to the same degree as government stay-at-home orders. The greater the degree of shutdown, the larger the unintended negative effects on physical and mental health.

Economies are robust. They bounce back after recessions. But as probable in the case of COVID-19, a major recession in economic activity means a period of time with as much as 10% unemployment. This is not just an economic phenomenon. It is also a health phenomenon. What follows eventually from periods of high unemployment are deaths of despair—or, in a more technical sense, shorter life-spans for those who were out of work for significant periods of time. [31] The psychological and mental dynamics that lead to this are well-known and set out in table 24. A prudent balanced approach to public policy would consider deaths in the long-term as well as the short-term. Not least, as in the case of COVID-19, when the long-term loss of life-span

[31] Of concern is also the number of deaths from undiagnosed serious illnesses due to (1) the health industry's focus on COVID-19 and (2) patients avoiding medical and hospital waiting rooms for fear of being exposed to the virus.

years (assuming a mass 10% unemployment peak) far outweighs any but the most extreme COVID-19 mortality scenarios (table 20).

The remarkable thing about the public policy decisions to shutter economies in late March and April 2020 is how little cost-benefit analysis was applied to the process. There was almost a complete absence of balance in public policy making during this period. Public policy routinely deals with competing goods. Any major government action involves trade-offs. The opportunity to do X always comes with Y cost. Resources devoted to A cannot be allocated to Z. Yet in late March and April, there was no concentrated public discussion of the costs and benefits of an Imperial College-style shutdown approach. There was no discussion of whether the projected decrease (a speculative outcome at best) in the virus's reproduction number could justify a 6% drop in annual economic growth in 2020 (even offset by a 4% rebound in growth in 2021). Nor was there clear and compelling evidence that presented extreme artificial social distancing (lockdown) would do substantially better in achieving such a decrease than the more moderate forms of social distancing that prevailed for most of March.

As it turns out, the more moderate social distancing techniques in key cases appeared to work sufficiently well to see death rates peak and begin to decline before lockdowns were instituted (table 16). Daily deaths in many countries peaked around the first or second week of April and began to decline. Deaths are a lagging indicator. This means that three weeks before the peak of deaths in April—in the second and third week of March, infections peaked and began to decline. Lockdowns predominately began in the last week of March—well after the decline in the effective reproduction number had kicked in in these countries. Speaking on April 25, Australia's chief medical officer estimated that the effective reproduction number in the country had reached 1 (the level at which the virus will start to peter out) before the country's stern "level three" restrictions began.[32]

Conclusion

What happened in April 2020 was a form of collective hysteria about a serious but not catastrophic public health matter. Governments and publics both panicked. Hysteria was a kind of mental contagion. Once it is set running, it overwhelms all other considerations for a time; then as swiftly it recedes. At its height, it tolerates no opposition. It cannot be questioned. It is as infectious as a viral pathogen. But like viruses its effective reproduction number at some point begins to decline. The social body forms anti-bodies to the mental virus. Calm is restored.

How do we explain April's collective hysteria? There are a number of factors.

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[32] Based on a rolling five-day average of new cases reported, the virus's effective reproduction rate reached a peak of 1.39 in Australia on March 12. Between March 29 and April 24—through Australia's shutdown—the effective reproduction rate varied between 0.99 and 1.11. Cases (unlike deaths) are an imprecise measure of reality—many cases are undetected. Nonetheless, the data indicated a clear trend and approximated what happened (Hayne 2020).

First, for decades various apocalyptic scenarios have gripped the world, predictions of environmental apocalypses common among them. End-of-the world scenarios have become common in public policy arguments.

Second, there is the legacy of 2008. The world economy recovered in three years after 2008 but the legacy of cognitive and emotional despair from the shock of that event, the most serious downturn since the Great Depression, left a mental outlook dominated by pessimistic, hyperbolic, and anxious thoughts. Stress reaction was impaired. Social contagions (exemplified by social media) increased.

Third, as the philosopher Thomas Hobbes observed in the seventeenth century, the fear of death is a building block for the modern state. Panicking nations look to the state for reassurance and action. April 2020 saw a brief moment of "epidemiarchy." Public health officials, who the public usually ignore, became celebrities in the public spotlight. Democratic states followed the model of authoritarian China and locked down their societies and economies.

Fourth, contemporaries are uncomfortable with death. Belief in an after-life has diminished. Yet reconciliation with the fact of mortal finitude and the limits of a this-worldly existence has not replaced it. If we neither believe that "death is not the end" nor fully accept that "life is finite" and that death in old-age is a natural limit that gives shape, form, and meaning to each life, then anxieties about death are apt to become overheated and eventually hysterical.

Climbing back down from April 2020 will be difficult. The government-engineered recessions will leave deep economic and psychological scars worldwide. The enthusiastic emotional investment of publics and governments in lockdowns will leave a legacy of deep ambivalence: guilt for over-reacting combined with denial that an over-reaction occurred. We will see a defiant insistence that lockdowns were "necessary," an uneasy conscience that they were not "necessary," a sense of culpability and contrition at the damaging consequences of lockdowns, and a feeling of being haunted by 2020 as earlier decades were haunted by 2008, 2001, and 1989.

Table 1. European mortality, excess deaths, z-scores for March–April 2020

Z-scores: NE = no excess less than 2; LE = low excess 2–4; ME = moderate excess 4–7; HE = high excess 7–10; VH = very high excess 10–15; EH = extremely high >15

Week	Dates	England	Wales	Scotland	France	Germany*	Belgium	Spain	Norway	Sweden	Italy	Switzerland
Week 11	March 9–15	NE	NE	NE	NE	NE	NE	LE	NE	NE	ME	NE
Week 12	March 16–22	ME	NE	NE	ME	NE	ME	VH	NE	NE	VH	ME
Week 13	March 23–29	EH	ME	ME	VH	NE	EH	EH	NE	ME	EH	ME
Week 14	March 30–April 5	EH	VH	VH	EH	NE	EH	EH	NE	VH	EH	VH
Week 15	April 6–12	EH	EH	EH	EH	NE	EH	EH	NE	VH	EH	HE
Week 16	April 13–20	EH	ME	VH	LE	NE	ME	ME	NE	LE	ME	ME
Week	**Dates**	**Denmark**	**Austria**	**Hungary**	**Greece**	**Portugal**	**Netherlands**	**Ireland**	**N Ireland**	**Finland**	**Estonia**	
Week 11	March 9–15	NE	NE	NE	NE	NE	LE	NE	NE	NE	NE	
Week 12	March 16–22	NE	LE	NE	NE	LE	ME	NE	NE	NE	NE	
Week 13	March 23–29	NE	NE	NE	NE	LE	EH	NE	NE	NE	NE	
Week 14	March 30–April 5	NE	LE	NE	NE	ME	EH	NE	ME	NE	NE	
Week 15	April 6–12	LE	NE	NE	NE	ME	EH	NE	ME	NE	NE	
Week 16	April 13–20	NE	NE	NE	NE	LE	HE	NE	NE	NE	NE	

Source: Euro Mono, "Graphs and Maps: Z-Scores by Country," https://www.euromomo.eu/graphs-and-maps#z-scores-by-country.

Note: A z-score indicates the distenace of a data point from a mean.

This table was prepared by Peter Murphy.

* Data for Germany refers to Berlin and Hesse only

Table 2. Coronavirus infection fatality rates (IFR) and projected resulting deaths among infected national populations

<table>
<tr><th colspan="3"></th><th colspan="4">If: the IFR assumption</th><th colspan="2"></th></tr>
<tr><td colspan="3"></td><td>Baseline: University of Bonn April 17 estimated IFR for Gangelt, German</td><td>Baseline: Simon (2020) April 10 estimated IFR for Iceland</td><td colspan="2">Baseline: Oxford Centre for Evidence Based Medicine April 9 estimated IFR range for Iceland</td><td colspan="2"></td></tr>
<tr><td>Country</td><td>Population, 2019</td><td>60% of population infected ["herd immunity" threshold]</td><td>COVID-19 IFR 0.36%</td><td>COVID-19 IFR 0.04%</td><td>COVID-19 IFR 0.19%</td><td>COVID-19 IFR 0.01%</td><td>Total annual deaths, 2015</td><td>Deaths, coronary heart disease, 2017</td></tr>
<tr><td colspan="3"></td><td colspan="4">Then: projected deaths per nation</td><td colspan="2"></td></tr>
<tr><td>Australia</td><td>25,203,000</td><td>15,121,800</td><td>54,438</td><td>6,049</td><td>28,731</td><td>1,512</td><td>159,052</td><td>23,153</td></tr>
<tr><td>United Kingdom</td><td>65,650,000</td><td>39,390,000</td><td>141,804</td><td>15,756</td><td>74,841</td><td>3,939</td><td>602,781</td><td>75,426</td></tr>
<tr><td>United States</td><td>328,200,000</td><td>196,920,000</td><td>708,912</td><td>78,768</td><td>374,148</td><td>19,692</td><td>2,712,630</td><td>479,223</td></tr>
<tr><td>Sweden</td><td>10,230,000</td><td>6,138,000</td><td>22,097</td><td>2,455</td><td>11,662</td><td>614</td><td>91,071</td><td>17,223</td></tr>
<tr><td>Italy</td><td>60,360,000</td><td>36,216,000</td><td>130,378</td><td>14,486</td><td>68,810</td><td>3,622</td><td>646,048</td><td>108,924</td></tr>
</table>

Sources: World Health Organization, "WHO Mortality Database," https://www.who.int/healthinfo/mortality_data/en/; WorldLifeExpectancy data based on WHO age-adjusted death rate estimates, 2017, https://www.worldlifeexpectancy.com/; Streeck et al. (April 2020) as cited in Streeck et al. (June 2020); Oke and Heneghan (Centre for Evidence-Based Medicine, March 17, 2020); Gudbjartsson et al. (2020); Simon (2010).

Notes: The IFR of seasonal flu strains, which kills tens of thousands of Americans each year, is around 0.1% (see https://www.cdc.gov/flu/about/ burden/index.html). The Gangelt study was a random sample of 1,000 residents. As of March 29, deCode Genetics in Iceland had tested 5,571 Icelanders on a quasi-random basis. The Gudbjartsson et al. (2020) Icelandic study included a targeted testing population [9,199 persons with symptoms, or who had traveled to high-risk countries, or who had been in contact with infected persons; testing was conducted by the National University Iceland Hospital; and this was 2.9% of Iceland's population], 10,979 persons who were issued with an open invitation to test, and a random sampling of 2,283 persons [3.7% of Iceland's population; testing was carried out by deCode Genetics]. As of April 4, 2020, 0.8% in the open-invitation group and 0.6% in the random population group tested positive for the virus. Of the targeted population of high-risk individuals, 13.3% tested positive for the virus. The Oxford Centre for Evidence-Based Medicine estimated from this data an IFR for Iceland in the range of 0.01% to 0.19%. From the epidemiological data, Simon (2020) estimated an IFR of 0.040% compared to his mathematically-derived estimate of 0.05%–0.13% with a median estimate of 0.10%.

This table was prepared by Peter Murphy.

Table 3. COVID-19: selected countries, deaths per million population, and contextual factors as of April 26, 2020

Country	First confirmed case 2020	Days from first confirmed case to April 26	Total COVID-19 deaths	Population	COVID-19-related deaths (per million pop.)	Median age of the population	Total annual deaths (latest availabe*)	Annual deaths (per million pop.)	Influenza and pneumonia deaths (per million pop., 2017)
Spain	February 1	86	23,190	46,754,778	496	42.7	422,568	9,038	102
Italy	January 31	87	26,644	60,461,826	441	45.5	646,048	10,685	82
France	January 24	94	22,856	65,273,511	350	41.4	544,618	8,344	141
United Kingdom	January 31	87	20,732	67,886,011	305	40.5	602,781	8,879	230
Netherlands	February 27	59	4,475	17,134,872	261	42.6	148,997	8,696	146
Sweden	January 31	87	2,194	10,099,265	217	41.2	91,071	9,018	156
Switzerland	February 25	61	1,610	8,654,622	186	42.4	67,606	7,812	102
United States	January 24	94	55,413	331,002,651	167	38.1	2,712,630	8,195	149
Denmark	February 27	60	422	5,792,202	73	42.2	52,224	9,016	171
Germany	January 27	91	5,976	83,783,942	71	47.1	925,200	11,043	109
Canada	January 25	93	2,560	37,742,154	68	42.4	252,338	6,686	93
Norway	February 27	60	201	5,421,241	37	39.2	40,686	7,505	196
Hungary	March 4	53	272	9,660,351	28	42.3	127,053	13,152	61
South Korea	January 20	97	243	51,269,185	4.7	41.8	275,895	5,381	198
Australia	January 25	93	83	25,499,884	3.3	38.7	159,052	6,237	97
China	*November 17, 2019*	162	4,633	1,439,323,776	3.2	37.4	9,980,000	6,934	147
Japan	January 16	101	372	126,476,461	2.9	47.3	1,290,444	10,203	345
Singapore	January 23	95	12	5,850,342	2.1	34.6	18,640	3,186	701
Hong Kong	January 23	95	4	7,496,981	0.5	43.5	46,757	6,237	—
Taiwan	January 21	97	6	23,816,775	0.3	40.7	172,418	7,239	—

Sources: Worldometer, "COVID-19 Coronavirus Pandemis: Reported Cases and Deaths by Country, Territory, or Conveyance," https://www.worldometers.info/coronavirus/?utm_campaign=homeAdvegas1?#countries; Worldometer, "Countries in the World by Population (2020)," https://www.worldometers.info/world-population/population-by-country/; Central Intelligence Agency, "The World Factbook: Median Age," https://www.cia.gov/library/publications/the-world-factbook/rankorder/2177rank.html; World Health Organization, "WHO Morality Database," https://www.who.int/healthinfo/mortality_data/en/; WorldLifeExpectancy, "Influenza and Pneumonia: Death Rate per 100,000," https://www.worldlifeexpectancy.com/cause-of-death/influenza-pneumonia/by-country/; National Bureau of Statistics of China, 2019, http://www.stats.gov.cn/english/; Taiwan Ministry of Health and Welfare, 2016, https://www.mohw.gov.tw/lp-137-2.html.

Note: This table was prepared by Peter Murphy.

* Latest available figures from World Health Organization Mortality Database

Table 4. COVID-19 conjectured contextual factors: Which, if any, factors correlate with country deaths per million?

Country	COVID-19-related deaths (per million pop. As of April 26 2020)	ICUs (per 100,000 population*)	Average annual temperature (C°)	Population (per square km. of largest city)	CV tests (per million performed by March 13–20)	% of single person households^	% of 'other' households^ [not couple, single parent or single person]	Inter-generational close contact, care for parents during the last 12 months (% per country)	Air quality by largest city, unless noted otherwise (Air Quality Index, 0=best quality)	Influenza and pneumonia death rate (per million in 2017)	International visitors [business, tourism, personal] to number one destination city (per millions in 2016)	Median age of the population	Rate of smoking (per population)
Spain	496	8.2–9.7	13.3	5,200	642	23.19	10.62	10%	24	102	8.2	42.7	20%
Italy	441	—	13.45	2,950	3,422	31.08	8.61	10%	132#	82	7.65	45.5	24%
France	350	—	10.7	3,550	563	33.79	4.81	4%	41	141	8	41.4	28%
United Kingdom	305	3.5–7.4	8.45	5,100	952	30.58	10.12	—	29	230	19.88	40.5	19%
Netherlands	261	—	9.25	4,908	350	36.38	1.71	6%	27	146	8	42.6	25%
Sweden	217	—	2.1	2,700	1,416	36.22	5.02	4%	—	156	2.08	41.2	21%
Switzerland	186	—	5.5	4,700	4,62	36.98	3.04	5%	55▫	102	2.24	42.2	23%
United States	167	20–31.7	8.55	2,050	314	26.74	15.29	—	4	149	12.75	38.1	17%
Denmark	73	6.7–8.9	7.5	1,850	1,852	37.48	6.16	4%	—	171	1.63	42.2	17%
Germany	71	—	8.5	3,750	1,993	37.27	5.52	6%	30	109	4.94	47.1	30%
Canada	68	13.5	−5.35	2,650	3,000	27.58	6.09	—	33	93	4.52	42.4	15%
Norway	37	—	1.5	3,300	8,067	39.58	4.68	—	8	196	—	39.2	22%
Hungary	28	—	9.75	2,550	311	32.08	8.88	—	78	61	3.36	42.3	28%
South Korea	5	—	11.5	16,700	6,176	23.90	14.50	—	122	198	10.2	41.8	27%
Australia	3.3	8.0–8.9	21.65	2,100	4,456	23.90	8.70	—	13	97	3.7	38.7	15%
China	3.2	2.8–4.6	6.95	11,500	—	—	—	—	128•	147	6.12	37.4	25%
Japan	2.9	7.9	11.15	4,750	276	34.45	16.16	—	33	345	11.7	47.3	22%
Singapore	2.1	—	26.45	8,350	6,495	—	—	—	53	701	12.11	34.6	17%
Hong Kong	0.5	—	22.6	6,659	703	—	—	—	—	—	8.37	43.5	—
Taiwan	0.3	—	22	15,200	898	—	—	—	62	—	7.35	40.7	—

Sources: Prin and Wunsch (2012, table 1); CityMayors Statistics, "The Largest Cities in the World by Land Area, Population and Density," http://www.citymayors.com/statistics/largest-cities-area-125.html; World Population Review, "2020 World Population by Country," https://worldpopulationreview.com/; OurWorldinData, "Coronavirus (COVID-19) Testing," https://ourworldindata.org/coronavirus-testing; ; Palma (*Financial Times*, March 22, 2020); OECD, "OECD Family Database," SF1.1: Family size and household composition, Table SF1.1.A. Types of household, 2011, Distribution (%) of households by household type, http://www.oecd.org/els/family/database.htm; Brandt, Haberkern, and Szydlik (2009, fig. 2 Care for parents during the last 12 months from); IQAir, "Air quality and pollution city ranking," April 2020, https://www.iqair.com/world-air-quality-ranking; WorldLifeExpectancy, "Influenza and Pneumonia: Death Rate per 100, 000,"https://www.worldlifeexpectancy.com/cause-of-death/influenza-pneumonia/by-country/; Wong and Choong (2016); World Population Review, "Smoking Rates by Country 2020," https://worldpopulationreview.com/countries/smoking-rates-by-country.

Note: Treating COVID deaths per capita as the dependent variable, the correlation coefficients of urban density (largest city), tests performed, solo households, other households, air quality, flu deaths per capita, international visitors, median age, and smoking rate all indicated only a weak positive relationship. For inter-generational contact, there is a moderate positive relationship.

This table was prepared by Peter Murphy

* ICUs are defined by countries in many different ways. These estimates from Prin and Wunsch (2012) involve different definitions of ICU beds.

^OECD-32 average: 30.56% for single person households; 9.81% for 'other' households.

#Milan ▫Bern •Wuhan

Table 5. Air pollution by major COVID-19 affected cities

City	PM2.5* Annual mean, ug/m3, 2016
Wuhan	57
Daegu, S Korea	42
Madrid	10
New York	7
Detroit	8
Denver	8
Milan	27
London	12
New Orleans	8

Sources: WHO air quality database, https://www.who.int/airpollution/data/cities-2016/en/ (2016 data unless otherwise stated); IQAir, "Top 50 World's Most Polluted Cities 2019 (PM2.5)," https://www.iqair.com/world-most-polluted-cities; New Orleans air pollution data 2014.

Notes: Number one most polluted: Ghaziabad, India, 110.2 PM2.5
Number fifty most polluted: Bhiwani, India 61.6 PM2.5

This table was prepared by Peter Murphy.

*Atmospheric particulate matter (PM) that have a diameter of less than 2.5 micro-meters

Table 6. Air passengers by major COVID-19 affected cities

City	Airline passengers, 2018	City population, 2019	Annual passengers per city resident
COVID-19 Hotspot Cities			
Daegu, S. Korea	2,530,000	2,460,000	1.0
Madrid	57,891,340	5,567,000	10.4
New York	141,964,323	19,354,922	7.3
Detroit	35,236,676	3,522,206	10.0
Denver	64,494,613	2,787,266	23.1
Milan	24,600,000	2,945,000	8.4
London	177,276,807	8,567,000	20.7
New Orleans	13,100,000	1,029,123	12.7
Comparator Cities			
Sydney	44,400,000	4,630,000	9.6
Singapore	65,628,000	5,183,700	12.7
Hong Kong	74,517,402	7,206,000	10.3
Los Angeles	109,825,171	12,815,475	8.6
Stockholm	26,800,000	1,264,000	21.2

Sources: Airports Council International, "World Airport Traffic Report," 2018, https://aci.aero/; Simple Maps, "World Cities Database," 2019, https://simplemaps.com/data/world-cities.

Notes: Supplementary air traffic data: Daegu 2016, New Orleans 2018, Sydney 2018, Detroit 2018, Milan 2018, Stockholm 2018.

This table was prepared by Peter Murphy.

Table 7. COVID-19 deaths and preferred interpersonal social distancing for selected countries

Countries	COVID-19 deaths (per million pop. as of April 26)	Social Distance: Stranger (cm)	Personal Distance: Acquaintance (cm)	Intimate Distance: Close Person (cm)	Median distance (cm)	Median distance (arm-length)	Intimate distance (arm-length)	Mean number of body parts touched in public personal interaction	Conventional greeting: cheek kissing (CK), hand shaking (HS), bowing/ nodding (BW)	Social Distance: Stranger (seated, mean head-to-head proximity in cm)	Social Distance: Stranger (mean torso-to-torso proximity in busy public spaces in cm)
Spain	496	91	74	57	74	1.61	1.24	—	CK	—	—
Italy	441	95	68	45	68	1.48	0.98	—	CK	—	36
France	350	—	—	—	—	—	—	4.75	CK	60	36
United Kingdom	305	—	—	—	—	—	—	—	HS	—	—
English	—	100	83	57	83	1.80	1.24	5.67	—	45	39
Scottish	—	—	—	—	—	—	—	—	—	—	27
Irish	—	—	—	—	—	—	—	—	—	—	26
Netherlands	261	—	—	—	—	—	—	—	CK	66	35
Switzerland	186	110	93	73	93	2.02	1.59	4	CK	—	—
United States	167	95	68	50	68	1.48	1.09	6.72	HS	—	—
Denmark	73	—	—	—	—	—	—	8	HS	—	—
Germany	71	95	64	42	64	1.39	0.91	6	HS	—	—
Canada	68	100	88	73	88	1.91	1.59	—	HS	—	—
Norway	37	102	72	37	72	1.57	0.80	—	HS	—	—
Hungary	28	130	108	95	108	2.35	2.07	6	CK	—	—
South Korea	5	108	84	65	84	1.83	1.41	0.91	BW	—	—
Australia	3.3	—	—	—	*83**	*1.80**	—	—	HS	—	—
China	3.2	115	83	58	83	1.80	1.26	1.33^	BW/HS	—	—
Japan	2.9	—	—	—	—	—	—	2	BW	—	—
Hong Kong	0.5	112	87	69	87	1.89	1.50	1.33^	HS	—	—
Taiwan	0.3	—	—	—	—	—	—	1.33^	BW	—	—

Sources: Sorokowska et al. (2017); McDaniel and Andersen (1998); T. Moss (*Conde Nast Traveler*, October 18, 2017); eDiplomat, "Cultural Etiquette," http://www.ediplomat.com/np/cultural_etiquette/ce_cn.htm; Remland, Jones, and Brinkman (1991): 215–232, table 1; Remland, Jones, and Brinkman (1995).

Notes: Taken separately, the coefficient correlates of the various proxemic and haptic variables indicate moderate positive relationships with the outcome variable (COVID mortality per capita). When median distance, body touching, and greeting styles are analyzed together, the relationship is a very strong one.

Average distance of arm from shoulder to fingertip is 46 cm.

This table was prepared by Peter Murphy.

* Median distance estimated based on Noesjirwan (1997)

^ Combines China, Hong Kong, and Taiwan

Table 8. Comparative locations and preferred interpersonal social distancing in Europe (as of 2014; measured in centimeters)

	Leipzig, Germany					Lyon, France				
Relationship	**Formal Public**	**Casual Public**	**Party**	**Formal Private**	**Formal Casual**	**Formal Public**	**Casual Public**	**Party**	**Formal Private**	**Formal Casual**
Spouse/ Significant Other	40–60	20–60	40–60	40–60	0–40	20–30	0–20	0–25	25–30	0–20
Family Member	20–60	20–60	20–60	20–60	20–60	20–30	0–20	0–25	25–35	0–25
Very Close Friend	40–60	20–60	20–60	40–60	20–60	0–15	0–10	0–10	0–15	0–10
Friend	~60	~50	~50	~60	~50	15-30	10–20	10–20	20–40	10–20
Group of Friends	~50	~50	~50	~50	~50	5–10	5–10	5–10	5–10	5–10
Acquaintance	60–90	60–90	60–90	60–90	60–90	20-40	10–20	10–20	20–40	10–20
Stranger	60–90	60–90	60–90	60–90	60–90	100+	100+	100+	100+	100+
Facility Staff	60–90	60–90	60–90	60–90	60–90	SH	SH	SH	SH	SH

Source: Joel Vervoort, Paige Arding, Mark Lasia, Chukwunonso Bernard-Oti, Proxemics Across Europe, 2014, https://prezi.com/ulqcwyickq5n/proxemics-across-europe/. Data based on interviews with subjects, with a bias toward younger adult subjects.

Notes: The study was undertaken as many proxemic studies are conducted by marketing and business communication professionals.

This table was prepared by Peter Murphy.

SH = depends on status hierarchy

Table 9. High-contact culture: US states and Canadian provinces by COVID-19 death rate per million and cultural ancestry compared with the degree of personality (temperamental) inhibition and degree of urbanization by state and province (as of April 16, 2020)

* Proxy for high-contact culture						
State	**COVID-19 death rate (per million pop. as of April 26)**	**% of population with Italian cultural ancestry [highest: 6% and over]*^**	**% of population who report Italian cultural ancestry first or second in the American Community Survey [highest states: 16–19%, lowest states: 0–4%]***	**% of population who report French cultural ancestry first or second in the American Community Survey [highest states: 8–16%; lowest states: 0–2%]***	**Uninhibited personality type by state [high incidence: 5 low incidence: −5]***	**Urban population (% of total population, 2010)**
New York	1,135	6% and over	12–16%	2–4%	5	87.9%
New Jersey	669	6% and over	16–19%	0–2%	3	94.7%
Connecticut	537	6% and over	16–19%	4–6%	3	88.0%
Massachusetts	424	6% and over	12–16%	6–8%	5	92.0%
Louisiana	371	5–5.9%	4–8%	8–16%	1	73.2%
Michigan	333	4–4.9%	8–12%	4–6%	−2	74.6%
District of Columbia	260	4–4.9%	4–8%	0–2%	0	100.0%
Rhode Island	214	6% and over	16–19%	8–16%	3	90.7%
Maryland	152	6% and over	4–8%	0–2%	4	87.2%
Illinois	151	6% and over	4–8%	2–4%	−2	88.5%
Pennsylvania	143	6% and over	12–16%	0–2%	4	78.7%
Delaware	126	4–4.9%	8–12%	0–2%	4	83.8%
Colorado	123	5–5.9%	4–8%	2–4%	3	86.2%
Indiana	122	2–2.9%	0–4%	2–4%	1	72.4%
Washington	103	3–3.9%	4–8%	2–4%	−2	84.1%
Georgia	89	2–2.9%	0–4%	0–2%	−5	75.1%
Mississippi	76	Under 2%	0–4%	2–4%	0	49.4%

Vermont	74	6% and over	8–12%	8–16%	4	38.9%
Nevada	70	6% and over	4–8%	2–4%	−3	94.2%
Comparator States						
Kentucky	47	2–2.9%	0–4%	2–4%	0	58.4%
California	44	5–5.9%	4–8%	0–2%	−2	95.0%
Oregon	22	3–3.9%	4–8%	2–4%	−1	81.0%
Texas	23	Under 2%	0–4%	2–4%	2	84.7%
Arkansas	17	Under 2%	0–4%	2–4%	−2	56.2%
Utah	13	2–2.9%	0–4%	2–4%	−3	90.6%
Canada comparator provinces	**COVID-19 death rate (per million population, April 25)**		**% of population of French descent [French colonial ancestry]***	**Francophone Canadians % of population***		**Urban population (% of total population, 2011)**
Quebec	171		31.3%	79.95%		79.0%
Ontario	56		10.7%	2.23%		85.0%
British Columbia	20		8.5%	0.38%		85.0%
Alberta	17		11.0%	0.68%		82.0%

Sources: Kiersz (*Business Insider Australia*, September 10, 2018) based on Minnesota Population Center's Integrated Public Use Microdata Series for the 2017 American Community Survey; Jones (*Gallup News*, June 22, 2004); Garoogian (2012) based on US Census Bureau, American Community Survey, 2006-2010 Five-Year Estimates; Iowa State University, "Iowa Community Indicators Program: Urban Percentage of the Population for States, Historical," https://www.icip.iastate.edu/ tables/population/urban-pct-states; Statistics Canada, https://www.statcan.gc.ca/eng/start; Canada 2011 National Household Survey, https://www12.statcan.gc.ca/ nhs-enm/ 2011/dp-pd/prof/index.cfm?Lang=E; Canadian Census 2011; Albas and Albas (1989); Statista, "Number of coronavirus (COVID-19) deaths in Canada as of April 25, 2020, by province or territory," https://www.statista.com/statistics/1107079/covid19-deaths-by-province-territory-canada/; Worldometer, "Canada: Coronavirus Cases (as of April 17, 2020)," https://www.worldometers.info/coronavirus/country/ canada/?fbclid=IwAR0Dq24eL83mbPb8qltMM38xRmRKt0AleT1t0yfMYpJM6Vk8EQY9_gUWsyE; Rentfrow et al. (2013, fig. 2. Maps of multistate personality clusters); Kagan (1994).

Notes: High contact cultures exhibit lower measures of everyday physical distance [higher proximity] between strangers, acquaintances, and intimates as well as higher rates of physical body touching. The trait of being uninhibited means not engaging in social withdrawal and avoidance or wariness in relation to persons. Uninhibited personalities are affectively spontaneous and excitable, and display a readiness to approach unfamiliar people and objects. This is not the same as sociable personalities or the gregarious temperament of the extroverted personality. The uninhibited person is not inhibited from or fearful of touching unfamiliar objects or approaching strangers. This lack of inhibition though is asssociated in Rentfrow et al.'s (2013) American regional geo-psychological study with anxiety and other kinds of fear states (see Kagan 1994, 95).

Treating US COVID-19 deaths as the outcome variable, the correlation cofficient of deaths per capita and cultural ancestry indicated a moderate positive relationship. Likewise, the independent variables of cultural ancestry and un-inhibition have a moderate positive relationship with deaths per capita. The correlation coefficient of mortality per capita with the two variables of Italian cultural ancestry and un-inhibitation indicates a very strong positive relationship. In Canada, Francophone language has a strong positive relationship to per capita mortality. The relationship of Francophone language and cultural ancesty combined with mortality per capita is very strong.

This table was prepared by Peter Murphy.

^ Ten US states have the highest percentage [6% or over] of Italian cultural ancestry, a proxy indicator of high-contact culture; all ten of those states are represented in the table above

Table 10. Total COVID-19 deaths per capita by region in Italy (as of April 24, 2020) compared with population density and civic intensity

Region	Population (January 2019)	Total COVID-19 deaths by region (as of April 16)	Deaths (per million pop.)	Population density (persons per km2)	Most civic (1) to least civic regions (9)*
Lombardy	10,060,574	13,106	1303	436	2
Aosta Valley	125,666	129	1027	38	4
Emilia-Romagna	4,459,477	3,303	741	201	1
Liguria	1,550,640	1,076	694	287	2
Marche	1,525,271	865	567	162	3
Piedmont	4,356,406	2,699	620	173	3
Trentino-South Tyrol	1,072,276	389	363	87	1
Veneto	4,905,854	1,244	254	282	3
Abruzzo	1,311,580	286	218	121	6
Friuli-Venezia Giulia	1,215,220	258	212	160	2
Tuscany	3,729,641	742	199	163	1
Apulia	4,029,053	383	95	209	8
Umbria	882,015	62	70	106	3
Lazio	5,879,082	384	65	347	5
Molise	305,617	20	65	69	8
Sardinia	1,639,591	102	62	69	6
Campania	5,801,692	336	58	426	9
Sicily	4,999,891	218	44	195	7
Basilicata	562,869	24	43	56	7
Calabria	1,947,131	80	41	128	9
Italy	60,359,546	25,706	426		

Sources: Statista, "Coronavirus (COVID-19) deaths in Italy as of April 24, 2020, by region," https://www.statista.com/statistics/1099389/coronavirus-deaths-by-region-in-italy/; Eurostat, "Population density by NUTS 2 region, 2018," https://data.europa.eu/euodp/en/data/dataset/QEgn3fJF0SQo7qpAN8T9g; Putnam (1993, 97, fig. 4.4).

Notes: Treating COVID deaths by region as the dependent variable, the correlation coefficients of civic behavior indicated a moderate positive relationship.

This table was prepared by Peter Murphy.

* "Civic" refers to membership of associations, clubs, choirs, music groups, literary circles, and the like.

Table 11. Number of COVID-19 tests per million by country and date

Country	COVID-19-related deaths (per million pop. as of April 26, 2020)	January 21	February 1	February 15	March 1	March 15	April 1
Spain	496	—	—	—	—	—	175
Italy	441	—	—	—	0	357	9,156
France	350	—	—	—	37	559	3,412
United Kingdom	305	—	3	44	175	598	2,272
Netherlands	261	—	—	—	—	939	4,533
Sweden	217	—	—	—	109	1,423	3,656
Switzerland	186	—	—	—	—	—	15,074
United States	167	—	—	—	0	79	3,473
Denmark	73	—	—	—	—	1,851	4,677
Germany	71	—	—	—	1,064	2,609	11,205
Canada	68	—	—	—	—	1,435	6,833
Norway	37	—	—	—	—	3,314	17,297
Hungary	28	—	—	—	—	955	—
South Korea	5	0	7	146	1,883	5,207	8,184
Australia	3.3	—	—	—	—	5,633	10,276
Japan	2.9	—	—	8	20	103	273
Singapore	2.1	—	—	—	—	—	11,111
Hong Kong	0.5	—	—	—	—	—	12,911
Taiwan	0.3	—	—	—	—	723	1,416

Sources: OurWorldinData, "Per Capita: COVID-19 tests vs. confirmed deaths," https://ourworldindata.org/grapher/ covid-19-tests-deaths-scatter-with-comparisons; Hong Kong Department of Health, "Data in Coronavirus Disease (COVID-19)," https://data.gov.hk/en-data/dataset/hk-dh-chpsebcddr-novel-infectious-agent; Singapore Ministry of Health, "Number of COVID-19 Tests Performed and Daily Updates on National Health Statistics for Comparison," April 6, 2020, https://www.moh.gov.sg/news-highlights/details/number-of-covid-19-tests-performed-and-daily-updates-on-national-health-statistics-for-comparison.

Notes: If data for nominated date is not available, data for the closest date is used. The Sweden April 1 figure is from March 29; the Denmark March 15 figure is from March 20; the Germany March 1 figure is from March 8; the Germany April 1 figure is from March 29; the Norway March 15 figure is from March 16; the Canada March 15 figure is from March 18; the Australia March 15 figure is from March 22; the Australia April 1 figure is from April 2; the Japan February 15 figure is from February 14; the Taiwan March 15 figure is from March 21; the Singapore April 1 figure is from April 6.

This table was prepared by Peter Murphy.

Table 12. Early COVID-19 mitigation actions taken from December 2019–March 2020

AQ=Airport Quarantine Centers; BC=Border Closure; CSQ=Cruise Ship Quarantine; EX=Extraction of Citizens; FB=Flight Ban; FS=Flight Screening; GB=Gatherings Banned; GEP=Government Economic Package; HBI=Hospital Beds Increased; HOQ=Hotel Quarantine; HQ=Home Quarantine; IZ=Isolation Zones Mandated; LGB=Large Gatherings Banned; MDL=Moderate Lockdown; ME=Medical Equipment Masks; MLD=Mild Lockdown; NEH=Non-Essential Hospital Operations Restricted; NHR=Nursing Home Restrictions; SC=Schools Closed; SCI=School Closure Incidental; SCP=School Closure Partial; SD=Formal Social Distancing Rules; SE=State of Emergency Declared; SLD=Severe Lockdown; StLD=State Lockdowns; SPC=Sports Cancelled; TA=Travel Advisory; TR=Traveler Restrictions; TSO=Table Service Only [restaurants]

Date of actions undertaken	**Australia**	**Canada**	**Denmark**	**France**	**Germany**	**Hong Kong**	**Italy**	**Japan**	**Netherlands**	**Norway**	**Singapore**	**South Korea**	**Spain**	**Sweden**	**Switzerland**	**Taiwan**	**UK**	**USA**
Last week Dec						FS										FS		
First week Jan											FS							TA
Second week Jan																		TA
Third week Jan																ME		
Fourth+ week Jan		TA FB EX				SE SC TB SPC	SE TB				TB FS HQ NHR BC						TA	
First week Feb	TA HQ BC	EX			EX			TB CSQ EX			HQ	TB TA				TB HQ SC	HQ	AQ
Second week Feb																TA	HQ	
Third week Feb											TR GEP			TA				EX
Fourth+ week Feb			HQ	LGB	HQ FS		MDL	SC SPC HQ	TA		TA	IZ	TA		LGB	TB GEP TR	TA	SCI TA TB
First week March	TC SPC	TA	TR HQ NHR	SCP SPC	ME	EX	SC SPC		TA		TB HQ	SD SC HBI GEP		TA TB	NHR SC BC LGB			SCI
Second week March	LGB GEP	GEP TB SE^ SC MDLD	NEH SD MLD LGB BC TA TR	LGB	SC MLD SPC GB GEP NHR		SLD		LGB FB BC	SC SPC SD TR TA NHR FB GEP	NHR	IZ	SE MDL GEP FB BC LGB	LGB	SLD GEP LGB	HQ TA		TB
Third week March	HQ BC SD MDL	SE^ SC MDL	SD BC SC GB	SD	SE MDL GB TB	TB HQ HOQ MLD			SD SC SPC MDL GEP NHR				SLD GEP	SD SPC		TB TR	ME SC LGB SPC	StLDs
Fourth+ week March	GB MDLD SCP GEP	GEP TB	SLD	SLD	MDL GEP MD									LGB TSO			SLD	StLDs

^States

Table 13. Workplace location visits and length of stay against a baseline of January 3–February 6, 2020 activity

Country	March 29	April 5	April 16
Italy	−63%	−62%	−62%
Spain	−64%	−68%	−63%
Switzerland	−46%	−42%	−41%
France	−56%	−53%	−55%
Netherlands	−35%	−54%	−24%
South Korea	−12%	−13%	−7%
United Kingdom	−55%	−54%	−57%
Sweden	−18%	−25%	−24%
Denmark	−28%	−22%	−23%
Norway	−34%	−32%	−36%
Hong Kong	−24%	−27%	−31%
United States	−38%	−40%	−38%
Germany	−39%	−30%	−29%
Japan	−9%	−13%	−22%
Canada	−44%	−46%	−47%
Australia	−33%	−36%	−41%
Hungary	−66%	−29%	−38%
Taiwan	−1%	−22%	4%
Singapore	−15%	−10%	−55%

Source: Google, "COVID-19 Community Mobility Reports," https://www.google.com/covid19/mobility/.

Note: This table was prepared by Peter Murphy.

Table 14. Retail and recreation location visits and length of stay against a baseline of January 3–February 6, 2020 activity

Country	March 29	April 5	April 16
Italy	−94%	−95%	−86%
Spain	−94%	−94%	−92%
Switzerland	−81%	−76%	−77%
France	−88%	−85%	−86%
Netherlands	−65%	−29%	−46%
South Korea	−19%	−17%	−16%
United Kingdom	−85%	−82%	−81%
Sweden	−24%	−18%	−41%
Denmark	−37%	−23%	−31%
Norway	−65%	−60%	−43%
Hong Kong	−35%	−37%	−38%
United States	−47%	−49%	−45%
Germany	−77%	−58%	−56%
Japan	−26%	−25%	−30%
Canada	−59%	−63%	−54%
Australia	−45%	−44%	−40%
Hungary	−32%	−54%	−51%
Taiwan	−9%	−9%	−18%
Singapore	−28%	−23%	−61%

Source: Google, "COVID-19 Community Mobility Reports," https://www.google.com/covid19/mobility/.

Note: This table was prepared by Peter Murphy.

Table 15. Effective reproduction number of COVID-19 compared with government actions taken in Germany

Date	Reproduction number	Government action in corresponding week
Last week of February		Home quarantines, flight monitoring
March 6	2.3	—
March 9	3.1	—
March 11 peak	3.3	Sports cancelled, school closures, mild lockdown measures, gatherings ban, nursing home restrictions
March 16	2.7	Moderate lockdown measures, gatherings banned, travel ban, home quarantine, hotel quarantines
March 21	1	Formal social distancing rules
March 23	0.9	Severe lockdown measures
March 26	1	—
March 30	0.9	—
April 1	1	—
April 6	0.9	—
April 9	0.9	—

Source: "Schätzung der aktuellen Entwicklung der SARS-CoV-2-Epidemie in Deutschland – Nowcasting," *Epidemiologisches Bulletin 17*, April 22, 2020, fig. 4.

Note: This table was prepared by Peter Murphy.

Table 16. COVID-19 infection peak compared to lockdown timing

Nation	Date lockdown began	Daily deaths peak	Infection peak*	Infection peak before (B), after (A), or same (S) as lockdown start	Days that infection peak occurred after lockdown
Australia	March 29	April 6	March 16	B	0
Italy	March 7<>9	March 27	March 6	S	0
Spain	March 28	April 2	March 12	B	0
United Kingdom	March 23	April 21	March 31	B^	0
Austria	March 16	April 8	March 18	A	2
Germany	March 23	April 8	March 18	B	0
Denmark	March 13	April 4	March 14	S	0
France	March 16	April 15	March 25	A	9
United States	March 19<>April 7	April 21	March 31	B/A	0–12
Thailand	March 26	April 3	March 13	B	0
Switzerland	March 16	March 20	February 26	B	0
Netherlands	March 15	April 7	March 17	A	2
Israel	March 19	April 2	March 12	B	0
Ireland	March 28	April 24	April 3	A	6
Finland	March 18	April 21	March 31	A	13
Croatia	March 22	April 19	March 29	A	7
New Zealand	March 26	March 28	March 7	B	0
Slovenia	March 20	April 7	March 17	B	0
Philippines	March 15	April 12	March 22	A	7
Malaysia	March 18	March 26	March 5	B	0
Lithuania	March 12	April 10	March 20	A	8

Source: Worldometer, "COVID-19 CORONAVIRUS PANDEMIC: Daily deaths by nation," https://www.worldometers.info/coronavirus/; UK NHS, "COVID-19 daily announced deaths 3 May 2020," https://www.england.nhs.uk/statistics/statistical-work-areas/covid-19-daily-deaths/.

* The infection peak is imputed. It back-dates infections three weeks prior to deaths.

^ On UK National Health Service (NHS) figures the peak occurred on April 8. According to the UK, April 21 is the peak.

Table 17. Models of the coronavirus infection fatality rate (IFR) and projected resulting deaths among infected population

Nations, Population, Herd Immunity Threshold Population Number			Number of deaths if 60% of the population ["herd immunity" threshold] has been infected by the infection fatality rate (IFR) of different epidemiological models, 2020							
			CEBM estimated IFR range: 0.1%–0.36%							
	Population as of 2019	60% of population infected ["herd immunity" threshold]	COVID-19 IFR 0.36% [highest] (CEBM, April 17, 2020)	COVID-19 IFR 0.1% [low] (CEBM, April 17, 2020)	COVID-19 IFR 0.5% (Timothy Russell LSHTM estimate, March 9, 2020)	COVID-19 IFR 0.9% (Imperial College estimate, March 16, 2020)	COVID-19, Wuhan IFR 0.66%, (Imperial College estimate, March 13, 2020)	COVID-19, Diamond Princess IFR 2.9% (Imperial College estimate, March 13, 2020)	COVID-19 IFR 1.2%, (Diamond Princess actual Nature, March 26, 2020)	COVID-19 various IFR by country [0.042%-0.232%] (P. Simon (2020), April 10, 2020*)
Australia	25,203,000	15,121,800	54,438	15,122	75,609	136,096	99,804	438,532	181,462	6,351
Canada	37,590,000	22,554,000	81,194	22,554	112,770	202,986	148,856	654,066	270,648	20,524
Denmark	5,806,000	3,483,600	12,541	3,484	17,418	31,352	22,992	101,024	41,803	4,877
Germany	83,020,000	49,812,000	179,323	49,812	249,060	448,308	328,759	1,444,548	597,744	50,310
Japan	126,860,000	76,116,000	274,018	76,116	380,580	685,044	502,366	2,207,364	913,392	46,431
Norway	5,515,000	3,309,000	11,912	3,309	16,545	29,781	21,839	95,961	39,708	2,250
South Korea	51,25,000	30,735,000	110,646	30,735	153,675	276,615	202,851	891,315	368,820	20,592
Switzerland	8,570,000	5,142,000	18,511	5,142	25,710	46,278	33,937	149,118	61,704	11,929

Sources: Lourenço et al. (2020); Simon (2020); Ferguson et al. (2020); Russell et al. (2020); Verity et al. (2020). *3*

Notes: The IFR of seasonal flu strains is around 0.1% (see https://www.cdc.gov/flu/about/burden/index.html).

This table was prepared by Peter Murphy.

* Simon (2020) predicted IFR by country: Australia 0.042%, Canada 0.091%, Denmark 0.14%, Germany 0.101%, Japan 0.061%, Norway 0.068%, South Korea 0.067%, and Switzerland 0.232%.

Table 18. Australia: ICU and Ward Beds for COVID-19 peak, predicted, and actual

Number of serious + critical [hospitalization] COVID-19 cases, Australia		**February 15 (0) March 1 (0) April 1 (50) April 15 (76) April 20 (49)**
Total [baseline] hospital beds, 2017–2018		**97,500**
Predicted need for hospital ICU and ward beds for admissions [Doherty Institute, University of Melbourne]		
Scenarios assume cancellation of non-urgent surgery and reduction in admissions for conditions such as respiratory infections and traffic accidents		
Worst-Case Scenario A [5 x baseline ICU bed capacity]	Total ICU and ward beds for admissions during COVID-19 pandemic	26,870
	COVID ICU and ward beds for admissions [50% of total]	13,435
Scenario B [3 x baseline ICU bed capacity]	Total ICU and ward beds for admissions during COVID-19 pandemic	16,122
	COVID ICU and ward beds for admissions [50% of total]	8,061
Scenario C [2 x baseline ICU bed capacity]	Total ICU and ward beds for admissions during COVID-19 pandemic	10,748
	COVID ICU and ward beds for admissions [50% of total]	5,374

Sources: Australian Institute of Health and Welfare, "Hospital resources 2017–18: Australian hospital statistics," https://www.aihw.gov.au/reports/hospitals/hospital-resources-2017-18-ahs/contents/introduction; Worldometer, "COVID-19 CORONAVIRUS PANDEMIC," https://www.worldometers.info/coronavirus/?zarsrc=130 (data archived by date at the Internet Archive); R. Moss et al. (2020).

Note: This table was prepared by Peter Murphy.

Table 19. IHME projected mean for COVID-19 hospital beds needed vs. actual COVID-19 serious and critical care hospitalisations in the United States

IHME COVID-19 estimates, mean COVID-19 Beds Needed			***Actual Serious and Critical Care Hospitalizations***
March 25 release	*April 1 release*	*April 8 release*	
March 15 Projected: 3,503	March 15 Projected: 3,922	March 15 Projected: 1,338	March 15 Actual: 10
March 30 Projected: 96,733	March 30 Projected: 93,743	March 30 Projected: 36,646	March 30 Actual: 1,411
April 11 Projected: 226,620	April 11 Projected: 246,346	April 11 Projected: 94,248	April 11 Actual: 11,320
April 26 Projected: 166,643	April 26 Projected: 204,571	April 28 Projected: 55,754	April 26 Actual: 15,143

Sources: IHME (Institute for Health Metrics and Evaluation), "COVID-19 estimate downloads," http://www.healthdata.org/covid/ data-downloads; Worldometer, "COVID-19 CORONAVIRUS PANDEMIC: Daily reports by country: USA," https://www.worldometers.info/coronavirus/?zarsrc=130 (see the Internet Archive).

Note: This table was prepared by Peter Murphy.

Table 20. Comparison of the loss of life-span years from COVID-19 (CV) deaths [Imperial College model] with the loss of life-span years from unemployment in a major recession in the United Kingdom

Abbreviations [Imperial College Model in Ferguson et al. (2020)]:

R_0=basic reproduction number or the number of persons a single person will infect with the virus; Triggers=public policy interventions trigged by numbers of critical care [ICU] cases; CI=case isolation in the home (symptomatic cases stay at home for 7 days, reducing non-household contacts by 75% for this period. Household contacts remain unchanged. Assume 70% of household comply with the policy.); *HQ*=voluntary home quarantine (Following identification of a symptomatic case in the household, all household members remain at home for 14 days. Household contact rates double during this quarantine period. Contacts in the community reduce by 75%. Assume 50% of household comply with the policy.); *SDO*=social distancing of those over 70 years of age (Reduce contacts by 50% in workplaces, increase household contacts by 25%, and reduce other contacts by 75%. Assume 75% compliance with policy.); *SD*=social distancing of entire population (All households reduce contact outside the household, school, or workplace by 75%. School contact rates are unchanged. Workplace contact rates are reduced by 25%. Household contact rates assumed to increase by 25%); *PC*=closure of schools and universities (Closure of all schools; 25% of universities remain open. Household contact rates for student families increase by 50% during closure. Contacts in the community increase by 25% during closure).

R_0	On Trigger	*Do Nothing Total Deaths*	Projected total life span years lost from CV deaths	Total life span years lost from recession with 10% unemployment peak	CV life span years lost + or −recession life span years lost	*CI_HQ_SD Total Deaths*	Projected total life span years lost from CV deaths	Total life span years lost from recession with 10% unemployment peak	CV life span years lost + or − recession life span years lost
2	60	410,000	2,788,000	3,275,000	−487,000	47,000	319,600	3,275,000	−2,955,400
2.2	100	460,000	3,128,000	3,275,000	−147,000	61,000	414,800	3,275,000	−2,860,200
2.4	300	510,000	3,468,000	3,275,000	193,000	94,000	639,200	3,275,000	−2,635,800
2.6	400	550,000	3,740,000	3,275,000	465,000	120,000	816,000	3,275,000	−2,459,000
R_0	**On Trigger**	***PC_CI_SD Total Deaths***				***PC_CI_HQ_SD Total Deaths***			
2	60	6,400	43,520	3,275,000	−3,231,480	5,600	38,080	3,275,000	−3,236,920
2.2	100	13,000	88,400	3,275,000	−3,186,600	10,000	68,000	3,275,000	−3,207,000
2.4	300	43,000	292,400	3,275,000	−2,982,600	34,000	231,200	3,275,000	−3,043,800
2.6	400	48,000	326,400	3,275,000	−2,948,600	48,000	326,400	3,275,000	−2,948,600

Source: Ferguson et al. (2020).

Notes: UK workforce: 32.75 million (ONS, July 2019)

UK projected Second Quarter 2020 unemployment rate: "Unemployment rises by more than 2 million to 10 per cent in the second quarter, but then declines more slowly than GDP recovers." (UK Office of Budget Responsibility, April 14, 2020)

Projected UK GDP growth contraction in 2020: −6.5 % (IMF, World Economic Outlook, April 2020, Table 1.1)

The estimate of the loss of life span years through the experience of mass unemployment (1 year per displaced employee) is derived from (a) Table V in Sullivan and von Wachter (2009, 1289) is a study based on "administrative data on the quarterly employment and earnings of Pennsylvanian workers in the 1970s and 1980s matched to Social Security Administration death records covering 1980–2006." Sullivan and Wachter concluded that the bust-era cohort of unemployed workers with three or five years in a job and aged 30 to 55 at the time of displacement lost an average of 1.5 life span years compared with employees who were not displaced; (b) Schwandt and von Wachter (2020) is an analysis of new entrants into the US 1982 labor market "facing a 3.9 percentage point increase in the entry unemployment rate." It concludes that new labor market entrants in a mass layoff era results in a loss between 5.9 and 8.9 months of life expectancy per capita.

The table assumes the average age of those who die are 79 years old (Italian National Institute of Health, March 17, 2020) and that they have on average three chronic health conditions (UK Office of National Statistics, Deaths involving COVID-19, England and Wales: deaths occurring in March 2020). It is further assumed that the life expectancy of a person aged 79 years with three pre-existing chronic conditions is 6.8 years, an estimate based on the American study by DuGoff et al. (2014). Life expectancy in practice is shorter for persons with multiple chronic health conditions.

Table 21. IHME projected mean for cumulative COVID-19 deaths vs. actual COVID-19 deaths in the United States

IHME COVID-19 estimates, deaths, mean projected			***Actual Deaths***
March 25 release	*April 1 release*	*April 8 release*	
March 15 Projected: 79	March 15 Projected: 79	March 15 Projected: 79	March 15 Actual: 68
March 30 Projected: 3,182	March 30 Projected: 2,997	March 30 Projected: 2,997	March 30 Actual: 931
April 11 Projected: 22,297	April 11 Projected: 22,253	April 11 Projected: 20,899	April 11 Actual: 20,562
April 26 Projected: 53,865	April 26 Projected: 59,119	April 26 Projected: 47,997	April 26 Actual: 55,415

Sources: IHME (Institute for Health Metrics and Evaluation), "COVID-19 estimate downloads," http://www.healthdata.org/covid/ data-downloads; Worldometer, "COVID-19 CORONAVIRUS PANDEMIC: Daily reports by country, USA," https://www.worldometers.info/coronavirus/, (see Internet Archive).

Note: This table was prepared by Peter Murphy.

Table 22. Purchasing Managers Index (PMI): Manufacturing by country, expansion, and contraction

Country	**April 2020**	**March 2020**	**February 2020**	**November 2019**	**February 2019**
Spain	—	45.7	50.4	47.5	49.9
Italy	—	40.3	48.7	47.6	47.7
France	15.0	43.2	49.7	51.7	51.5
Netherlands	—	50.5	52.9	49.6	52.7
Switzerland	—	43.7	49.5	48.5	54.3
United Kingdom	32.9	47.8	51.7	48.9	52.1
Sweden	—	43.2	53.2	46.4	52
Denmark	—	46.8	49.1	53.6	61.5
United States	36.9	48.5	50.7	52.6	53
Germany	34.4	45.5	48	44.1	47.6
Canada	—	46.1	51.8	51.4	52.6
South Korea	—	44.2	44.4	49.4	47.2
China	—	50.1	40.3	51.8	49.9
Australia	45.6	49.7	50.1	49.9	53.1
Singapore	—	45.4	48.7	49.8	50.4
Japan	43.7	44.8	47.8	48.9	48.9
Hong Kong	—	34.9	33.1	38.5	48.4
Taiwan	—	50.4	49.9	49.8	46.3

Source: The Global Economy, "Purchasing Managers Index (PMI), manufacturing by country," April 30, 2020, https://www.theglobaleconomy.com/rankings/pmi_manufacturing/.

Notes: >50 = expansion
<50 = contraction

This is based on a survey of businesses as to whether their supplier deliveries, inventory levels, production, employment, and new orders are expending, contracting, or staying the same. Each factor is equally weighted.

This table was prepared by Peter Murphy.

Table 23. Purchasing Managers Index (PMI): Services by country, expansion, and contraction

Country	April 2020	March 2020	February 2020	November 2019	February 2019
Spain	—	23.0	52.1	53.2	54.5
Italy	—	17.4	52.1	50.4	50.4
France	10.4	27.4	52.6	52.5	50.2
Switzerland	—	44.7	51.9	52.6	56.2
United Kingdom	12.3	35.7	53.2	49.3	51.3
Sweden	—	46.9	56.7	48.2	55.3
United States	27.0	39.8	49.4	51.6	56.0
Germany	15.9	31.7	52.5	51.7	55.3
China	—	40.3	26.5	53.5	51.1
Australia	19.6	38.5	49.0	49.7	48.7
Japan	22.8	33.8	46.8	50.3	52.3

Source: The Global Economy, "Purchasing Managers Index (PMI), services by country," April 30, 2020, https://www.theglobaleconomy.com/rankings/pmi_services/.

Notes: >50 = expansion

<50 = contraction

This is based on a survey of businesses as to whether their supplier deliveries, inventory levels, production, employment, and new orders are expending, contracting, or staying the same. Each factor is equally weighted.

This table was prepared by Peter Murphy.

Table 24. Near-term visible expressions of long-term pathways to deaths of despair

Forms of despair *Despair: "sentiment affecting entire segments of a population in response to the bleak conditions that follow economic stagnation"*					
Cognitive despair	***Emotional despair***	***Behavioral despair***	***Biological despair***	***Social despair***	***Pathways to deaths of despair***
-Thoughts indicating defeat, hopelessness, guilt, worthlessness, learned helplessness, pessimism, and limited positive expectations for the future -Cognitive biases including repeated mistakes in perceiving, interpreting, and remembering others' actions as antagonistic (e.g., hostile attribution bias) -Hyperbolic discounting: giving undue weight to current outcomes and discounting the value of long-term outcomes; assuming the long-term future may never come to pass -Depressed thoughts of resignation, defeat; anxious thoughts	- Feelings of excessive sadness, irritability, hostility, or loneliness - Anhedonia and apathy: the inability to experience pleasure and reward and the resulting lack of motivation and action	- Risky, reckless, or unhealthy acts that are self-destructive and reflect limited hope for the future - Examples: high-risk sexual behaviors, gambling, self-harm, reckless driving, excessive spending, criminal activity, smoking, substance use, low physical activity - Inaction, learned helplessness, sickness behaviors	- The body's stress reactive systems no longer function homeostatically and show signs of dysregulation or depletion. - Biological despair manifests itself in the hypothalamic–pituitary–adrenal axis, the autonomous nervous system, and the immune system. - Biological despair can be inferred from changes in body functions (e.g., sleep, appetite, concentration or restlessness, and somatic symptoms or pain).	- Arises in networks and communities when their members are exposed to the same distressing event - Social contagion: the diffusion of (or increasing similarity in) emotions, cognition, behavior, or biology in social contexts	- Increase in *despair in different domains* leads to *diseases of despair* (suicidal ideation and attempts, illicit drug use, alcohol abuse, and addiction) *leads to* increased risks of deaths of despair as well as autoimmune and infectious diseases

Source: Shanahan et al. (2019).

Note: This table was prepared by Peter Murphy.

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