Questions and Answers About the Current Coronavirus Pandemic

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The current pandemic disease, Covid-19, is caused by a coronavirus similar to that of the SARS epidemic of 2002-3; the current virus is named SARS-CoV-2.

There are many facets to this discussion, and many people have spent entire careers on the different facets. First, there is the spread of the epidemic, understandable in terms of simple models that give valuable insight, and I will spend some time on that. Then there are the details of the virus and how it infects the body, once in contact with a mucous membrane, such as those of the eyes, nose, or mouth. Then there are the consequences of the infection, the destruction of lung tissue, or problems of an active immune system—cytokine storm—that kills otherwise quite healthy people, as a consequence of the body's response to the virus invasion.

Here is a graphic comparison of daily deaths in the United States from this coronavirus compared with other leading causes. https://public.flourish.studio/visualisation/1712761/

Then there are the potential responses to the virus, to prevent the consequences of its unimpeded spread—with most of the people infected, and on the order of one or two percent of them dying—with most of the deaths among older people, for whom the death rate for an infected person over 80 is likely to be 10-20%, even with the relatively good care that could be provided in the very small epidemic in Wuhan, and the surrounding province of Hubei, China.

Start of Item 1. On March 8 I circulated this Item 1 to scores of colleagues as *"Fighting Covid-19-- In words of one syllable."* Please note that "[anything]" were in the original document and are additional information; "{ anything } are added for this presentation.

Covid-19 is a matter of life and death for many American families, including yours. You are likely to lose a parent or grandparent in your immediate family unless we are able to affect the behaviors of the vast majority of people in the United States.

[I have a long but not deep background in analyzing and writing about serious pandemics-- e.g., "Next Flu Pandemic: What to Do Until the Vaccine Arrives?" https://fas.org/rlg/929_morse_garwin_olsiewski.pdf]

Under normal social interactions, a communicable disease is characterized by its reproductive factor Ro and incubation interval, i (days). As a result, with an assumed number of index cases No, the number of cases increases exponentially by a factor Ro every i days. Without intervention, it stops when the effective Ro falls below 1.0, because there are insufficient unexposed people left to propagate the exponential. Roughly, this happens when only $1/Ro$ of the population has not been infected-- whether the infection is lethal or not.

[Imagine a fission reaction without energy release-- it would stop with sufficient depletion of the fissionable mass.] [Other ways by

which the epidemic subsides is with effective vaccination or with anti-viral medication taken either after sickness or in a continued, prophylactic dose-- e.g., for health-care folk-- if such existed for this particular coronavirus]

Intervention such as social-distancing aims to reduce Ro to a lower value, R. Even a reduction to $R=2$ from an assumed $Ro=3$ can flatten the curve and ultimately reduce the population infected from 2/3 to 1/2, but reducing to $R=0.5$ can provide essentially "perfect protection" if done soon enough. At that point there might be 100,000 index cases, and, with $R=0.5$, the total ultimately infected would be only 200,000, which is less than 0.1% of the U.S. population.

China forced families to stay in their apartments except for one member every two days, who could go out for two hours to buy food and other essentials.
[Important to understand that Ro differs greatly among sub-populations in dormitories vs. single-family homes, etc.]

With its vast surveillance/enforcement teams, China may well be able to resume "normal" life (with $R=3$) while quarantining new Covid-19 cases.

China seems essentially to have achieved this low infection level in Hubei province, outside of Wuhan. But how low China can maintain R as people return after New Year from their "villages" to resume industrial and commercial and educational and sporting activities remains to be seen. I have pointers to many URLs in China (mostly in Chinese) as to how many have returned to work.

Back to the U.S. problem.

There is no threat where there is no virus. It is really important to understand how long the Covid-19 virus survives on various surfaces, the extent to which it spreads by droplets from sneeze/cough, or by aerosol from normal exhalation by infected people, or by "fomites" from picking up virus from surfaces such as doorknobs, push buttons, handhold or railings in public places. We need as a society to learn from "best practices" elsewhere, and also from "bad practices" such as those in Iran, hiding the presence of Covid-19 cases.

As for procedures for personal protection, here is what I am doing and that can be done by most in the United States.

I have bought and RE-USE blue nitrile 5-mil gloves (XL in my case).
[Details on request]
I have shown that my gloves survive dry heat for an hour in my oven at 200F (verified 200F with a red-liquid thermometer). Since the virus may be disabled by 4logs in 2 minutes at 200F (total conjecture-- please help), this is a reasonable approach to family re-use of

gloves. But what is the protocol for glove use? {Good data by end-March:158F for 5 minute is adequate, but I use 170F}I pull the gloves off from the cuffs, reversing them so that the contamination is now shielded from my clean fingers, and after putting them in the oven or in a bag for storage, I wash my hands in "Mild Bleach Solution" according to CDC-- 100:1 further dilution of 5% liquid (hypochlorite) laundry bleach-- so 0.05% hypochlorite. I add Dawn or other kitchen detergent so that it is a good washing liquid and wash for 20 sec. (What is the 4logs survival time in 0.05% hypochlorite?) I've been doing this for days with no skin problems, but I'll try a Daily Moisture Lotion. Does that interfere with the washing/decontamination-- immediate-result research needed. {These recommendations supplanted by "Protecting yourself and family… Rev. 4 of 04/03/20}
<End of Item 1>

<Start of Item 2, what should countries do now? (Circulated 03//09)>
The attached {Sent separately} email, sent Sunday evening is oriented toward Personal Protective Measures against Covid-19. The ease and cost of several of these depends on the outcome of several simple tests that should have been done years ago and can be done in days now—one in my kitchen and others in any bio lab capable of handling Covid-19 to determine its lifetime on various surfaces at elevated temperatures, its vulnerability to solutions of common kitchen detergents such as liquid Dawn, on lifetime in a 0.05% solution of liquid laundry bleach—sodium hypochlorite diluted 100:1 and named by CDC, "Mild Bleach Solution".
{Data in Appendix to Lancet Microbe https://www.thelancet.com/journals/lanmic/article/PIIS2666-5247(20)30003-3/fulltext}

From the U.S. National point of view, though, the most important guidance would be:

1.   Use "best practices" from other countries such as Singapore and South Korea for outdoor testing so that teams of agents can provide drive-by testing or walk-by testing, photographing a person's face and identity card, together with the bar code/number on swabbed sample container.

2.   Learn and assess best practices in minimizing infection.

3.   BUT THE MOST IMPORTANT is to recognize that without a vaccine for a year, or an effective, affordable anti-viral drug, two million Americans are likely to die, compared with the 35,000 annual average from seasonal flu, AND no matter how assiduously protective measures are practiced by an individual, her or his infection can be delayed but not prevented. Specifically reducing an Ro=3.0, to R=0.5 (by a factor 6{for one individual}), will delay a person's infection by the time required for the epidemic to grow by a factor 6 (about 3 weeks or so). But if we could ALL reduce R to 0.5 at some time, the TOTAL number of people infected in the country would only double from that point, and the epidemic would end. Few people understand this essential point, which means that YOUR health and the survival of your parents and grandparents depends on providing almost everybody else in the country with the tools and interest in social distancing, and personal protection.

4.   Of course we need to fund and test vaccines and anti-viral, and we need to learn soonest about the mutation rate of this RNA virus.

<End of Item 2>

Impact of intervention can be shown by a S-I-R model (susceptible-infected-recovered {or died}), e.g. NYT 03/13/20 by Kristof and Thompson)

https://www.nytimes.com/interactive/2020/03/13/opinion/coronavirus-trump-response.html?searchResultPosition=2

And here a note of progress in the United States: