COVID-19 Fatalities: A Long and Perilous Road Ahead

As a matter of fact, all epidemiology, concerned as it is with the variation of disease from time to time or from place to place, must be considered mathematically, however many variables as implicated, if it is to be considered scientifically at all.—**Sir Ronald Ross, MD, 1857 – 1932**

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ABSTRACT – Despite the rising COVID-19 death toll in America, there are still voices and activities that do not reflect the serious nature of this disease and its associated killing potential.

Health care officials face formidable challenges that include but are not limited to individuals who minimize the seriousness of the COVID-19 pandemic, ignorance and confusion with respect to the true number of those infected, and the number of its related fatalities, as well as general knowledge as to its intrinsic killing potential – the expected death toll if mitigation measures were not employed.

The novel coronavirus is still a potent killer despite hopes, dreams, and rumors to the contrary. Without mitigation, the U.S. death toll would have ranged from about one to two million fatalities

This commentary addresses this and other important questions about COVID-19 with the aim of providing insights as we all work to understand and learn to live with this stealthy disease that is a real threat to the life of those with co-morbidities and those 65 and older who account for 80% of the deaths.

INTRODUCTION – COVID-19 presents the U.S. with a set of complex and formidable challenges. None the least of these challenges are the voices of prominent individuals such as Elon Musk, chief executive of Tesla Inc., who minimize the seriousness of the COVID-19 pandemic. Also consider Alex Berenson, a former reporter at the *New York Times* and author of *Unreported Truths About COVID-19 and Lockdowns,* who not only questioned lockdowns, but also questions whether the novel coronavirus is as deadly as has been suggested.

Another significant challenge is our ignorance and confusion with respect to the true number of those infected and the number of COVID-10 related fatalities. Lauren Gardner, a Johns Hopkins University associate engineering professor who leads the team that built the schools widely-cited COVID-19 tracker, believes countries including the US and China, have broadly undercounted cases and deaths.[1]

Many COVID-19 related deaths do not get reported as related to the new coronavirus because testing not only remains limited, but sporadic as well. Death statistics indicate that few countries are accurately capturing fatalities from the new coronavirus. In some cases the shortfall could be significant—by as much as 2 to 3 times the number of deaths attributed to COVID-19.

It is hoped that the following insights and answers to some of the most important questions about COVID-19 will be of some help as we all work to understand and learn to live with this disease.

COVID-19 IS STILL A REAL KILLER DISEASE – The novel coronavirus is still a real killer that will simply not go away thereby presenting a significant challenge to America's health care systems and to all Americans, especially those with co-morbidities and those 65 and older who, according to CDC, data, account for 80% of COVID-19 related deaths.

Apparently unrecognized by the general public is the viruses' immense potential to wreak havoc on a non-immune U.S. population that does not treat the COVID-19 disease with appropriate caution, after restrictions on businesses and personal behavior are eased as the U.S. labors to reopen its economy.

Super-spreader gatherings are to be avoided.[2] Nevertheless, media reports indicate that many Americans have been participating in such events, most recently in the nationwide protest demonstrations related to the recent tragic homicide in Minneapolis. These protests coupled with Phase 3 business reopening in Chicago prompted pleads for extreme caution by Dr. Allison Arwady, the city's Public Health Commissioner, and this from the World Health Organization:

"We need to be exceptionally careful that we are not creating a sense that all of a sudden the virus has decided to be less pathogenic. That is not the case at all," said Dr. Mike Ryan, executive director of the WHO's emergencies program, while Dr. Maria Van Kerkhove, head of WHO's emerging diseases and zoonosis unit, said "if we let the virus go, it will transmit. If we let the virus go, it will infect people and it will cause severe illness in about 20% of people."[3] Note that the remaining 80% will not seek medical care as they likely have very mild or moderate illness and, in some cases, be asymptomatic—not even know that they have been infected and are contagious.

As the economy reopens with an easing of restrictions, Americans, especially those with co-morbidities and those 65 and older who need to continue voluntary mitigation measures and exercising common sense while hoping for the expeditious development of anti-viral treatment regimens and vaccines that work for the elderly.[4, 5] Also, non-politicized guidance for businesses and others is readily available from the University of Minnesota's Center for Infectious Disease Research and Policy.[6]

REPORTED COVID-19 CASES – As of June 22, 2020, there have been some 2.29 million reported U.S cases of COVID-19, up from 1.9 million reported on June 5, 2020.[7] If we assume that the reported cases are undercounted by a factor of 2, we get a conservative estimate of less than 6 million possible U.S COVID-19 cases. Given a U.S. population of approximately 330 million, there remains a population of some 324 million Americans that are potential targets for the novel coronavirus as the U.S

By the way, 6 million cases would represent less than 2% of the total population and far less than the 70% to 90% required for herd immunity according to the Johns Hopkins Bloomberg School of Public Health.[8] Speaking of herd immunity, Dr. Anders Tegnell, Sweden's chief epidemiologist, while hoping to achieve herd immunity over time, did not shut down the country or its economy but rather relied largely on voluntary action, social distancing and personal hygiene advice. Tegnell has seen worldwide criticism for his country's method of fighting the coronavirus which has resulted in one of the highest death rates per capita in the world.

The development of medications that can provide treatment of the disease and/or the development and widespread distribution of safe and effective vaccines, not herd immunity, will be able to eventually stem the COVID-19 death toll.

REPORTED AND ESTIMATED COVID-19 FATALITIES – The ever increasing number of reported, but likely undercounted, COVID-19 deaths was 120,106 as of June 22, 2020.[7] Multiplying the number of reported deaths by a factor of 2 renders an estimate of less than half a million COVID-19 fatalities to date.

An important related question remains, to wit: How many COVID-19 related fatalities would have occurred in the U.S. if no mitigating intervention measures, such as social distancing/staying at home, mask wearing, and hand washing, were taken.

White House Coronavirus Task Force Estimate – On March 31, the White House Coronavirus Task Force estimated that without intervention 1.5 to 2.2 million Americans would die. It was also estimated that with mitigating intervention the death toll could be significantly reduced to 100 to 240 thousand. The Task Force estimates were based on a model that was, in turn, based on a combination of models from around the world.

Michael Osterholm Estimate – During the course of an interview with Judy Woodruff on the April 24, 2020, *PBS NewsHour program,* Dr. Michael Osterholm, Director of the University of Minnesota's Center for Infectious Disease Research and Policy, estimated that there would be 800 thousand to 1.6 million fatalities under the same circumstances, i.e., in the absence of mitigating interventions.[9]

Modifications of the Michael Osterholm Estimate – It can be shown that a range of from 1.07 million to 2.15 million fatalities would obtain in Osterholm's modeling if a population of 330 million rather than 320 million is used and that 65% infection of the exposed population is used rather than 50%.[10]

The upper and lower limits of the modified Osterholm model not only include the upper limit of the Osterholm original upper and lower limits of the Task Force estimate, but also that the average value of the modified Osterholm model's upper and lower limits, 1.5 million fatalities, are approximately equal to the these two other limits. Furthermore, the average value of the lower limits for the three scenarios is 1.12 fatalities and 1.98 fatalities for the average of the upper limits—suggesting that without mitigation, the death toll would have ranged from about one to two million.

According to CDC data, fatalities for Americans 65 and older account for about 80% of the COVID-10 death toll. Reference to Note 10 will show, via an additional modification of the Osterholm model, that there would have been from about 700 to 1,400 thousand fatalities in this older group with no mitigation while those younger than 65 would have accounted for about 180 to 360 thousand fatalities, so that the total number of fatalities without any mitigation would have ranged from about 880 to 1,760. Based on this and the above estimates, for all intents and purposes, the death toll would have ranged from about one to two million without mitigating interventions.

Reference to Note 10 will also show that the death toll can be limited to about 88 thousand to 176 thousand if the equivalent of 90% of the population is quarantined while the remaining 10% do not employ mitigating intervention measures. This estimated death toll range is comparable to that of the March 31, 2020, White House Task Force's estimated reduced range of 100 thousand to 240 thousand fatalities with intervention.

CONCLUDING REMARKS – The novel coronavirus is still a potent killer despite hopes, dreams, and rumors to the contrary. Without mitigating intervention, the U.S. death toll would have ranged from about one to two million fatalities—a rough estimate of the killing potential of COVID-19.

Fatalities for Americans 65 and older account for about 80% of the COVID-10 death toll or from about 700 to 1,400 thousand fatalities with no mitigating intervention while those younger than 65 would have accounted for about 180 to 360 thousand fatalities, so that the total number of fatalities without any intervention would have ranged from about 880 to 1,760 thousand.

The U.S. death toll would have ranged from about 88 thousand to 176 thousand fatalities if the equivalent of 90% of the population is quarantined while the remaining 10% do not employ mitigating intervention measures—an estimated death toll range comparable to the March 31, 2020, White House Task Force's estimated reduced range of 100 thousand to 240 thousand fatalities with intervention.

Virus-laden aerosols, particles smaller than droplets, can hang in the air for hours after being released in confined spaces, so large groups of people gathered indoors in close proximity without proper ventilation are a recipe for numerous infections and potential fatalities.

Today there remains a population of at least 324 million Americans that are potential targets for the novel coronavirus. Of those that become infected, about 20% will deal with a serious illness while the remaining 80% will likely have very mild or moderate illness and not seek medical care. In some cases they can be asymptomatic—not even know that they have been infected and can be contagious.

The U.S. is not even close to establishing herd immunity and so must rely on the development of medications that can provide treatment of the disease and/or the development and widespread distribution of safe and effective vaccines that will be able to stem the COVID-19 death toll over time.

In the meantime, cautious human behavior should be the watchword—Americans, especially those 65 and older as well as those with co-morbidities, need to continue voluntary mitigation measures consisting of social distancing/staying at home and avoiding gatherings in confined spaces, mask wearing, hand washing, and exercising common sense while hoping for the expeditious development of effective treatments and vaccines.

All indications are that there is a very long and perilous road ahead as Americans go on to live and work with a stealthy killer.

NOTES

1. Michaels, Daniel, "Statistics suggest virus deaths undercounted," *The Wall Street Journal*, May, 29, 2020.

2. A recent study by the National Academy of Sciences discussed the mechanisms involved in spreading the novel coronavirus—indicating that one minute of loud speech was enough to produce thousands of droplets that remain airborne for about 12 minutes, potentially able to infect anyone in the area. Similar studies have shown that virus-laden aerosols, particles smaller than droplets, can hang in the air for hours after being released in confined spaces. Without safe and effective vaccines and treatments, large groups of people gathered indoors in close proximity are a recipe for numerous infections and potential fatalities. Also see Hernandez, Daniela, et al, "How Exactly Do You Catch Covid-19? There Is a Growing Consensus." *The Wall Street Journal,* June 17, 2020, page 1, https://www.wsj.com/articles/how-exactly-do-you-catch-covid-19-there-is-a-growing-consensus-11592317650

3. Lovelace, Berkeley Jr., "WHO says coronavirus isn't losing potency: 'This is still a killer virus,'" *CNBC News,* June 1, 2020, https://www.cnbc.com/2020/06/01/who-says-coronavirus-isnt-losing-potency-this-is-still-a-killer-virus.html

4. Hopkins, Jared S., Vaccine Efforts Turn to Seniors," *The Wall Street Journal*, June 22, 2020. Page 1, https://www.wsj.com/articles/efforts-for-coronavirus-vaccine-focus-on-vulnerable-group-older-adults-11592731801

5. Even without an effective treatment or vaccine, the novel coronavirus can still be effectively controlled, when reopening the economy by banning mass gatherings, hardening all home and business spaces against infections, and executing behavioral protocols based on the assumption that all contacts are potentially infectious. This would require that:
　　1) Everyone behaves with caution, especially the most susceptible (people with underling conditions and those beyond 65 years of age).
　　2) The standard infection prevention mechanisms be employed: a) Finding and isolating exposed people who have been identified by testing and contact tracing, b) Practicing strict social distancing and avoiding crowds, c) Wearing masks, d) Washing hands, and e) Cleaning surfaces.
　　3) Hardened business and worship spaces with tight control of the purity of air flow in confined spaces via a combination of HEPA filtration and UV radiation.

6. "CIDRAP at the University of Minnesota outlines COVID-19 realities, advises on next steps," at https://twin-cities.umn.edu/news-events/new-report-cidrap-university-minnesota-outlines-covid-19-realities-advises-next-steps

7. Johns Hopkins COVID-19 Dashboard, https://coronavirus.jhu.edu/map.htm

8. D'Souza, Gypsyamber, and Dowdy, David, "What is Herd Immunity and How Can We Achieve It With COVID-19?," April 10, 2020, https://www.jhsph.edu/covid-19/articles/achieving-herd-immunity-with-covid19.html

9. https://www.pbs.org/newshour/show/an-infectious-disease-expert-on-the-dangers-of-trumps-non-scientific-claims

10. COVID-19 Fatality Modeling
General – Mathematical modeling of the spread of infectious diseases is quite complex, for example, see Weiss.[11]
　　To get a sense of what's going on in the segment concerned with fatality modeling, consider the following models that all stem from the *PBS NewsHour* presentation by Dr. Michael Osterholm.[9]
　　It goes like this: Given a well-mixed population P of Americans. Of these, assume that there is a subpopulation, (1-s)P, with this entire subpopulation not only exposed and susceptible to the disease, but

also taking no precautions to prevent/mitigate its spread. Here, the sequestration factor (1-s) represents the percentage of the population that is exposed to infection.

Of those exposed to infection k_1% will likely get infected. Of those infected, about k_2%, will likely seek medical care (those not seeking medical care will likely have very mild or moderate illness and, in some cases are asymptomatic—not even know that they have been infected and can be contagious). Of those seeking medical advice, about k_3%, will likely require hospitalization. Of those requiring hospitalization, about k_4% will likely require intensive care in an ICU. Of those admitted to the ICU, about k_5% will not survive.

All of these percentages represent mutually exclusive events so the percentage divided by 100 corresponds to an approximation of the probability of that event. Thus, the number of fatalities, F, would be given by $F = (1-s)P(k_1/100)(k_2/100)(k_3/100)(k_4/100)(k_5/100)$

Osterholm's PBS Model Example – If we take the likely population parameter and "k" percentages used by Osterholm on the *PBS NewsHour* Program, then $(1-s)P = 320$ million, $(k_1/100 = 0.5)$, $(k_2/100 = 0.2)$, $(k_3/100 = 0.5)$, $(k_4/100 = 0.5)$ and $(k_5/100 = 0.1$ or $0.2)$, so that $F= 320 \times 10^6 (0.025)(k_5/100)$, and $F = 800$ thousand for $k_5 = 10$%, and $F = 1.6$ million for $k_5 = 20$%

Modifications of the Osterholm Model – Fatality data from the CDC indicates that the fatalities, f_O, for Americans 65 and older account for about 80% of the COVID-10 death toll while the fatalities, f_Y, for Americans younger than 65 account for the remaining 20% of the total fatalities, i.e., $F = f_O + f_Y$, where $f_O = 0.8F$, and $f_Y = 0.2F$.

To develop an estimate for the number of fatalities in each group we partition the total U.S. population of 330 million Americans into its older group of 54 million, of those 65 and older, and its relatively younger group of 276 million, of those less than 65.

Now assume that $(1-s)P = 54 \times 10^6$—reflecting the fact that the 276 million people in the younger group have been sequestered, so that $f_O = 54 \times 10^6 K_O$ where K_O equals the product $(k_{O1}/100)(k_{O2}/100)(k_{O3}/100)(k_{YO}/100)(k_{O5}/100)$.

Similarly, $f_Y = 276 \times 10^6 K_Y$ where $K_Y = (k_{Y1}/100)(k_{Y2}/100)(k_{Y3}/100)(k_{Y4}/100)(k_{Y5}/100)$

Values for the "k" percentages for each of the two age groups that are consistent with the death toll for each group are as follows: $(k_{O1}/100) = 0.65$, $(k_{O2}/100) = 0.2$, $(k_{O3}/100) = 0.5$, $(k_{O4}/100) = 0.5$, $(k_{O5}/100) = 0.4$ to 0.8 and $(k_{Y1}/100) = 0.65$, $(k_{Y2}/100) = 0.1$, $(k_{Y3}/100) = 0.5$, $(k_{Y4}/100) = 0.2$, $(k_{Y5}/100) = 0.1$ to 0.2 leading to $K_O = 0.013$ to 0.26; $K_Y = 0.00065$ to 0.0013, and $f_O = 54K_O \approx 700$ to $1,400$ thousand fatalities, and $f_Y = 276K_Y \approx 180$ to 360 thousand fatalities, so that the total number of fatalities, the sum of the fatalities in each age group, $F = f_O + f_Y$, $F \approx 880$ to $1,760$ thousand fatalities

Now consider fatalities for this case as a function of s, the mitigation factor. This would give the following linear equations that represent rough approximate bounds on fatalities as a function of the level of mitigation: $F = 0.88(1-s)$ million for $k_5 = 10$%, and $F = 1.76(1-s)$ million for $k_5 = 20$%

To determine the value of F when 90 % of the population is quarantined, we set $s = 0.9$, to render lower and upper limits of 88 thousand fatalities and 176 thousand fatalities.

11. Weiss, Howard "The SIR model and the Foundations Public Health," July 1, 2013, http://mat.uab.cat/matmat/PDFv2013/v2013n03.pdf

In fond remembrance of U.S. Marine Corporal Justin W. Cloe, August 2, 1980 – June 5, 2010

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