It's not the mortality rate, stupid![1]

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About the Author

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From the leader of the Free World to the world press to more than one researcher, there has been a focus on something called the MORTALITY RATE of the new viral disease, COVID-19[2]. We are told that whether we should worry or not worry depends on whether the new(ish)[3] infection does or does not cause many more deaths than traditional infections like the flu, a number apparently to be arrived at by dividing the number of fatalities by the number of infected (or ill or diagnosed) people. If this number is comparable to the flu, then we are supposed to take a break from worrying. On the other hand, if it is significantly higher, then we should go back to worrying. Or instead of flu, we are told to think of the number of people who die in car crashes divided by the total number of people driving or riding in an automobile. These are the supposedly key numbers we heard and read about when the question of locking down arose in the past couple of months. They are now red-hot again as the issue of what to do next (for example, relax the lock-down or maybe make it stricter?) becomes urgent.

This is all entirely wrong – and if many or even just a few researchers and decision-makers continue to think this way, very bad things will happen – or rather bad things will continue to happen and worse things will follow.

Why do I say this? Because there is confusion about just what those supposedly decisive numbers actually measure. There are in reality many different numbers that are studied by epidemiologists, actuaries, statisticians. This is not the time or place to go through all that – and above all not the time to get lost in technical concepts and terminology that is often confusing (and sometimes actually confused).

There are for starters four basic points that everyone needs to understand. The mortality rate constantly talked about seems[4] to be the percentage of people with a given illness that will die. This is a very useful concept in epidemiology and actuarial science, but NOT the way it is being used to inform the response to COVID-19 or any similar epidemic in the future[5]. After all, there are

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[1] Note to the reader: we have deliberately written this article in non-technical language, e.g., avoiding terms like case fatality risk and so on, so as to make it accessible to the largest possible audience affected by the current crisis. It is for the same reason that we tried to write simply, e.g., using the word avoid rather than eschew. We also of necessity oversimplify numerous, indeed almost all, technical points. We would also like to take the opportunity to thank Roman Belolipetsky, Ivan Ivanov, Łukasz Kałużny, Maciej Kulczycki, Yoram Meroz, E.D. Rosenberger, Mikhail Zhivlov for crucial references, discussion, and commentary.

[2] There are several problems with the definitions and terminology currently used. In the case HIV/AIDS, a clear distinction is made between being infected with the HIV virus and having the full-blown disease (AIDS). In the case of COVID-19, anyone infected is considered by definition to have the disease. But if it is agreed that the vast majority of such people do not require any medical care, then it becomes crucial to distinguish degrees of how sick different people are.

[3] It might be very useful if everyone were to understand that this virus (correctly named SARS-CoV-2) is very closely related to one that has been seen before and to others that we will certainly meet in the future.

[4] It is not always possible to be sure because much of what one reads or hears does not specify exactly what number is being referred to. Usually, one can figure it out from the context or from the numbers cited.

[5] The great uncertainty about how many people are actually infected, due to problems with testing and the rarity of truly random testing, is not the ONLY reason that the case fatality risk cannot be calculated. The other reason is that, technically, this can only be validly computed once every case is closed, so that we know how many have died and how many have recovered. So even here we need a rethink, because this technical concept will thus be largely inapplicable in the current situation until long into the future.

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diseases with around 100% mortality[6]. For example, rabies. Yet we do not ring an alarm on a worldwide scale about rabies.

Because such diseases are so rare, you may be tempted to retort.

If so, you have just granted our first point. The very word *rare* means that we are now talking about an entirely different number – not what percentage of PATIENTS stricken with a given disease (flu, COVID-19, rabies, or riding in a motorcar) will die from it – but rather what percentage of the TOTAL POPULATION will. So you have already agreed with point one of what we wanted you and everyone else to understand.

And just to drive this point home, think of how many hospital beds Denmark has versus China, Monaco versus the United States. Obviously, rabies is equally deadly wherever it is found, but just because it is rare, it can be handled everywhere. But there is always a limit on the amount of medical care that is obviously connected[7] to the size of the population – and the big question before us is whether COVID-19 will exceed (or in some places already has exceeded) that limit. So yes it has to be, at least in part, about the number of people who will die of COVID-19 IN RELATION TO THE TOTAL POPULATION.

Here is another way to approach this. A study in California claims that the real infection rate is 50–85 times higher than the rate deduced from the tests done so far. The study was not properly randomized, and so means nothing. But if these numbers WERE valid, would this be good news or bad? Good if we care about mortality rate (per infected population), which would be that much lower! But maybe not SUCH good news if it revealed that our testing is wholly inadequate, that the infection has spread much more rapidly than was thought, perhaps that the measures taken to slow the spread or stop the infection have not worked, and that soon we may expect many more (PER POPULATION) very sick and dying people than expected arriving much faster than expected on the doorsteps of hospitals that cannot possibly grow the number of beds or doctors or equipment at the same rate. So we have to understand what the numbers mean before we can decide if they are good or bad news.

But, second, counting deaths per population is not enough (which is why there is this point and two more). After all, life itself like rabies has a 100% mortality rate, and since life is a condition we all suffer from, it is all 100% mortality per capita. But with recent advances, people with rabies, as we know, can be saved. While people with life cannot. This may sound flippant, but it is not. We need to know not just how many people will likely die of COVID-19 if untreated but also how many will die even if treated. And again this is because there is every indication that we may reach (or in some places have already reached) a situation where people who could be saved with medical care[8] will die because there will not be enough of that care to go around (or it will be misallocated). And this would be (or is) a key concern for a civilized society, placing the medical profession in an impossible situation.

Third, ordinarily, people do not all die at the same time. It happens over years and decades, at a more or less constant (and more or less known) rate. So time is an essential factor in the calculations that we really need. This is what the flattening of the curve has been all about, trying to buy time. But the "mortality rates" being talked about do not take time into account – by design. It is important for various scientific and practical purposes to know that rabies (if untreated) will be uniformly fatal – while the time it takes is not so significant. So the mortality rates that ignore time are not invalid. They just were never intended to guide policy in a situation such as the one we face. With COVID-19 the time factor is critical. And so any time you hear or read some mortality rate cited, ask yourself and if possible ask THEM whether it is a rate calculated PER UNIT OF TIME.

Fourth, and perhaps even more important, medicine does not SAVE lives. I am very sorry, but it does NOT. It is simple logic that if life has a 100% DEATH rate, then no one's life gets saved. That would be just a flat contradiction. What medicine does do is to PROLONG lives and to REDUCE the SUFFERING of the living. None of us wants to suffocate or see someone else suffocating on the doorsteps of a hospital or in the waiting area – or at home because no ambulance is available to take us to the hospital. So, even if many of the most seriously ill COVID-19 cases will die, it would be intolerable for a civilized society to refuse them medical care if at all possible. So it is not about the DEATH rates alone. It is also vital to think of what I will call the SUFFERING rate[8], the number of people (again per population and per time) who, whether they soon die or not, will require intensive care in the interim.

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[6] This conflates at least two technically different concepts, case fatality risk and infection fatality risk (in both the word risk is often, somewhat misleadingly, replaced by rate).

[7] There are of course other factors, economic, social, political – and there is an important connection between what is available and what had been budgeted decades before based on the ORDINARY projections of DEMAND for medical services.

[8] Technically of course we are talking about one or another (because again there is more than one way to count) MORBIDITY rate. This will mostly depend on how we define serious COVID-19, which is itself a critical issue.

Let us try to think this through another way. Forget the infection for a second and think of an airplane or train or bus crash or a major accident at sea. Even as it is, any of these will shock people more than a car crash or a "normal" death from the complications of diabetes. This is because the more people die (or even are merely injured) at once, the more it threatens the fabric of society, beginning with the all-important question of whether we can guarantee them the care we can and do offer to individuals. If the rate of such incidents increased just a little over what it is, the health system would soon find itself unable to receive and treat the survivors. That is precisely the issue with the corona virus. And again the point is that the capacity of a health care system is related not to the number of infected cases (or the number of airplane crash survivors) but roughly proportional to the population. If the number of airplane crashes doubles or triples or whatever, we cannot instantly double, triple, etc. the number of ambulances, of emergency room beds, of medical personnel, of equipment. Exactly the same as in the case of an infection such as COVID-19 is or may be or may become.

The reason this new infection has been so difficult and threatens to become disastrous is not just the biology of the corona viruses. There is also a vast lack of RELEVANT and VALID information[9]. An influential and highly-placed physician writes:

> But is the outbreak… currently trending downward, or increasing linearly or exponentially? Unfortunately, it is impossible to answer this question with certainty, because of the "masking effect". By just observing the numerical totals of patients we are essentially flattening a complex, multilayered picture and only seeing its projection, like a shadow on the wall[10].

To have better information, we need to know WHAT to count. At the very least we need to know the number of infected people in relation to population and time, then the number who will require intensive care (whether they will be saved or not), then the number that can be kept by intensive care from the death that will some other, hopefully distant, day come from some other cause[11]. And HOW to count, too: most of the figures reported to date are wholly meaningless (and the constant repetition of meaningless numbers by the WHO, by governments, by the media does not help). It HAS to be done on RANDOM samples of the relevant populations (and subpopulations)[12]. This is just beginning to be done (notably in Germany), of course months too late[13], while at the same time elsewhere in the world studies are being done on samples that are not random at all and serve no purpose (e.g. volunteers responding to ads placed on social media!)[14].

And what if you should wonder whether the measures taken to date (or maybe which particular measures) have had the desired effect – or anyway SOME effect? The answer is basically the same. Supposing that you now know what to count and how to count, then someone needs to calculate each of the RIGHT numbers multiple times: once if NO measures of social distancing or hygiene are (or had been) taken, a second time in relation to the measures in place, a third time in relation to any new measures (either stricter or more relaxed) that anyone is contemplating. And so on. The mathematics and science to do this exist, some mathematicians and scientists have been calling for better information from the beginning – and the majority who have not been heard from have kept quiet because they did not EXPECT TO BE HEARD. Plato fantasized about philosopher kings. We need, at least, for those mathematicians and scientists who understand what and how to count to be listened to. Only then can we begin to figure out the answers to the two essential questions before us:

1. Is the pandemic we are seeing (with its actually historically quite low numbers) just a pale preview of

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[9] I do not mean trivial errors, though these also take a toll, as when an M.D. writes in a major newspaper that viruses are ordinarily treated with antibiotics: https://www.haaretz.com/israel-news/.premium-the-dangerous-illusion-that-governments-know-how-to-fight-coronavirus-1.8730776.

[10] https://www.haaretz.com/opinion/post-lockdown-routine-will-look-nothing-like-the-life-we-knew-1.8764434. While the reference is to the situation in Israel, it applies worldwide.

[11] Again this is oversimplified. It is crucial to sample different subpopulations separately as well.

[12] See f.ex. https://theconversation.com/want-to-know-how-many-people-have-the-coronavirus-test-randomly-135784. https://www.independent.co.uk/news/world/europe/coronavirus-germany-test-antibody-immunity-random-sample-a9472701.html.

[13] https://www.independent.co.uk/news/world/europe/coronavirus-germany-test-antibody-immunity-random-sample-a9472701.html.

[14] https://www.medrxiv.org/content/10.1101/2020.04.14.20062463v1, https://www.sfchronicle.com/health/article/UC-Berkeley-launches-study-to-test-5-000-healthy-15206367.php, and others.

a major disaster that has already been stopped in time, or the beginning of a major disaster that has to be stopped ɴᴏᴡ, or something else?[15]

2. On various scenarios, what can our health care systems (and social order in general) handle, or what can they potentially be redesigned to handle in the future?

Nor is this the end. Next we really have to have a little talk about the mutations that have already arisen[16], not to mention a bigger talk about those that science tells us to expect...

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[15] There are many possibilities besides the simplistic alternatives of a quick exit NOW from the current emergency measures or a much slower exit much later (perhaps only after a vaccine comes into universal use), but both assuming that at some point fairly soon life will return to normal. A particularly unsettling possibility is that COVID-19 becomes chronic or recurrent, so that the vast majority of people are not threatened but a much higher rate of patients that we are accustomed to continue to require intensive care (and perhaps many cannot obtain it) and/or die. In other words, a partial return to the way the human kind lived before the explosive advances in science, medicine, and public health that we all have been taking for granted.

[16] Jamal S, Singh J, Sheikh JA, et al. Molecular Analyses of Over Hundred Sixty Clinical Isolates of SARS-CoV-2: Insights on Likely Origin, Evolution and Spread, and Possible Intervention. Preprints 2020, 2020030320 (DOI: 10.20944/preprints202003.0320.v1).