The Lock-Down Policy Does Not Save Human Lives

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Abstract

In the absence of medicine and vaccine, the governments have few options in controlling the current pandemics. In time-proved historical tradition, the **suppression** policy [1] is a restrictive containment (lock-down) policy whose declared goal is to slow down and suppress the infection, keep the number of critical patients below the available intensive care capacity, and hope for (scientific) miracles. The **mitigation** policy tries to reach the critical 60% ratio of immune population faster, by applying both strong restrictions and support measures to the vulnerable part of the population only, while life goes on. The **controlled immunization** policy [7] is turbo-mitigation, speeding-up the infection wave by a controlled, non-mandatory in vivo immunization of the system relevant age groups at lowest risk.

Using empirical data from the Table 1 of [1], data for the age pyramid [2], the deaths table [3], the life expectancy data [4], and the actual "Daily Situation Report" from the Robert Koch Institute (RKI) [5] in Germany, an elementary minimization procedure shows that the **total number** of deaths caused by the SARS-CoV-2 pandemics is best reduced by the mitigation policy. This conclusion is robust: it remains true even when there are no available intensive care units (ICU) at all. My prediction is thus that developing countries with a a poor health care system but a young population will suffer less losses per population than rich western countries.

The lost human **years** case mortality ratio is still monotonically increasing in age, albeit at a strongly reduced rate. Minimizing this objective function shows that now mitigation has only a small advantage in saving human years over suppression. However, since the politically relevant cost is the number of deaths per week, supression has a big advantage in the short run but will be eventually switched to mitigation as the economic pain overgrows panic.

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I. INTRODUCTION

A good policy in time of distress needs well defined goals: the strategic command must correctly estimate the value of each significant aspect playing a role in the process and asses the cost to be paid. The "best" strategy is the one which minimizes this total cost under given constraints. Solutions to such problems are delivered by *combinatorial optimization*, not virology. The current health-hazard situation, however, requires the public opinion to gain a full understanding of the situation, the constraints which must be fulfilled, the available policy options, and the costs which must be paid. This memo requires only elementary school calculus and represents the Author's right to control whatever the experts claim.

The main source of uncertainty regarding the SARS-CoV-2 (="virus") pandemics is the "dark number", the total number of people infected by the virus. There are two types of tests: one is showing that someone is actually infected by the virus and is based on very accurate PCR [8] amplification. The problem with this test is that is working only when the person is infectious, not before and not after that period. To obtain a better estimate of the dark number one needs another test, detecting whether the tested person developed immunity to the virus or not. This test cannot be as accurate as the first, because it detects the response of the immune system to the virus, not the virus itself. Therefore, the estimate of the real mortality, the probability that an infected person will die, is and to some extent will remain uncertain.

II. A SIMPLE TWO-POPULATION CALCULATION

When presenting arguments based on statistical data, the best practice is to explicitly declare all hidden assumptions one is aware of. The basic assumption is from epidemiology: the infection chain reaction will stop only if the **epidemiological critical fraction** of the current population is immune, by infection or vaccination. For the SARS-CoV-2 this threshold is about $E = 60\%$ of the population. The situation on the French aircraft carrier *Charles de Gaulle* supports this value: from the 1760 crew, 1046 were positively tested, 20-30 were hospitalized, and one is in critical condition [11]. Other important *assumptions* are that the virus will not change drastically (mutate) in 2020, no remedies (medicine), and no vaccine will be available until end of 2020.

Assume the epidemiological threshold has been reached before a vaccine is found. For a better understanding, consider just two groups of people, one with a high risk making about 20% of the population, and those with a low risk (about 80 % of the population). For Germany, this corresponds roughly to splitting the age pyramid at about 66-67 years, [2]. Around this split-age the infection fatality ratio jumps from 0.6% to over 2% in [1]. Demographic data can be easily found in the web, e.g. [10] or at [2] (available also in English). A population "split" at 65 might correspond to different split-ratios. The percent of the age > 65 years population is about 13-14% in China and India, 18% in USA, in Japan it reaches 28%. The split-ratios change accordingly and can be easily incorporated in the equations below.

Let us call the high risk group "old" and the low risk part "young". Some of the young, say 4-6% of the population, are also vulnerable due their current health problems. They will be added to the "old" group. Furthermore, men are more affected than woman by a 60%/40% = 3/2 ratio [5], so actually some woman should be moved from the "old" to the "young" group, compensating for the added vulnerable young. The data presented by RKI ([5]) partition already the data into < 60 years (in one cumulative group) and then in 10 year groups.

Denote by K the number of confirmed (positive) cases in Table 1 [1]. According to those numbers, about 3% of them died. Table 1 there also shows that only about 1% of the young died. Solving the balance equation

$$0.01 \times 0.2 \times K + x \times 0.8 \times K = 0.03 \times K \tag{1}$$

one gets $x = 11\%$, which is consistent with Table 1 from [1] and also with [5], if the split age is 66-67 years. The number of old group deaths is about 10 times larger than for the young, independently of the factor K in Eq. 1.

The numbers used below are gained from direct measurements: from the death statistics kept by [5] and similar institutes, together with demographic data. RKI publishes every day data about the cumulative number of deaths in different age groups. From [5] page 4 for 16.04.2020, the number of total deaths for the old group / number of deaths in young group = 20.98 if the group split is set at 60 years and 6.31 if it is set at 70 years. This is consistent with a ratio of 11 for a 66 years group split (it still bugs me why WHO and the different countries could not agree to a standardized form of sampling and presenting the data)

If the health care systems is not overloaded, the total number of deaths D will be

$$D_{supp} = D(young) + D(old) = 0.6 \times N \times (0.8 \times 0.01 + 0.2 \times 0.11) = 0.03 \times 0.6 \times N \quad (2)$$

where N is the total population and $E = 0.6 = 60\%$ is the epidemiological threshold for the current virus. Eq. (2) contains the fatality / infection ratio (mortality) of 3%, whose denominator is the total number of infected people, unknown at this time. The ratio $\frac{D(young)}{D(old)}$ depends only on the number of deaths in different age groups and only this number is used when minimizing the lost lives.

The balance equation (2) does not take into account that dead people do not infect anymore. On the right hand side instead of N one should have $N - D_{supp}$. Solving for D leads to $\tilde{D}_{supp} \simeq D_{supp} \times (1 - 0.018)$, just a small correction to Eq. 2 which one can safely disregard.

Eq. (2) RHS reflects a situation where each person has the same probability to get infected, independent of her/his age. However, the minimal number of lost lives is achieved if the E=60% immunized population part comes exclusively from the young group. If only young are immunized, the total number of casualties is

$$D_{mitg} = D(young) = 0.6 \times N \times (1.0 \times 0.01) = \frac{1}{3} \times D_{supp} \quad (3)$$

To prove this is the true minimum, exchange one member of the young group for one in the old and infect both. This exchange increases the total death probability by the difference between $0.022/0.03 = 22/30$ and $0.008/0.03 = 8/30$: by $14/30 > 0$.

The SARS-CoV-2 virus ignores human rights and infringes on EU laws with a much higher mortality rate for the older population. A policy "anti-discriminating" the old group by subjecting them to quarantine and by investing large resources in order to keep that vulnerable part safe - while the young group remains unconstrained - saves 3 times more lives. This type of policy is termed *mitigation* in [1]. The down-part of this choice is that while the chances of death for each individual young person is constant at 1%, the number of extra lives lost by the young group increases by a $1/8 = 1.25$ factor. This factor could be further reduced by a *controlled immunization strategy*, speeding-up the infection dynamics in a strategically controlled way [7].

The World Health Organization (WHO) and almost all European governments favor the so-called *suppression policy*, whose goal is to slow down the infection spread so as keep the health care system properly functioning. In particular, the capacity of intensive care units (ICU) beds with attached mechanical respiratory machines should not be overloaded. Since the Middle Age, but also in recent epidemics like Ebola or MERS, this strict containment policy worked well. In facing an unknown mortality virus like the SARS-CoV-2, it is wise to gain time before clearing up the feasible options. However, the economic and other collateral damage are in meantime so huge, that a sharp discussion emerged between the partisans of the suppression vs. the mitigation policy.

The main claim put forward by the suppression party is that curfew, closing public places and events, closing factories, etc., save lives. Those favoring mitigation are bang-moralized to put economic interests (alias money) before human life. The usual argument goes as following: if the virus is allowed to spread freely among the young group, the shear number of people requiring intensive care overruns the available ICU capacity, leading to more death as otherwise.

In order to sort out this issue, let us estimate first the number of lives saved by a full functioning ICU system. From [1] one can get this information by multiplying column 2 and 3 and comparing to column 4 of the Table 1. Those numbers range from 48% to 50%, so about half of ICU patients survive. Starting with April 3-d, the Robert Koch-Institute (RKI) publishes similar numbers delivered by hospitals. That statistics show that about 80% of the hospitalized patients will be treated in ICU and from those, about 30% die. *Assuming* all critical patients are treated in ICU and not too many die outside hospitals, that points to 70 % survival rate due to ICU. Reports from Italy, USA, and China hint at a number well below 50%. All these numbers ignore brain damage of surviving old patients anesthetized for days, another very dark number indeed. There is no systematic data either on the old patients outside hospitals, nor about their survival chances.

At this time, it seems sound to assume that in average 50% ICU patients will survive, while critical patients without ICU access will all die. Nonetheless, as long as no medicine or vaccine exists, the mitigation policy does indeed save life, a factor of ca. $3/2 > 1$, even if **there are no ICU's at all**. If only half of the critical patients can get an ICU bed, then the mitigation live saving factor is 2. These numbers are simple to calculate on an Excel sheet and must be already known by all serious epidemiologists/virologists. In any case, they are mentioned but ignored in [1].

When human lives are in danger, the time honored objective is to minimize the number of lost human *years*, not single human lives. This is the logic behind the ship captain's rule that children and women must be saved first. The Statistiches Bundesamt has data for the life expectancy for each age and gender group. Hence, one can calculate instead of the number of lost *lives* the average number of lost human *years*. The risk table is still monotonically increasing with age, but at a much lower rate. There is no clear cut for the age-split, because now the cumulated "year" mortality ratio is much smaller. At < 60 years split (corresponding to 73% of the German population), the ratio of lost number of years in the "old" vs. the "young" group will be only around 1.36. There is no real difference between suppression and mitigation, except for the epidemic dynamics and economic damage. In conclusion, the lock-down policy minimize lost human *years*, defends the medical institutions, and maximizes political gain. **It does not save human lives**, as claimed.

III. DYNAMICS PARAMETER ESTIMATES

The time-dependent curve of the number of already infected people follows from a modified stochastic Malthus-Verhulst equation [9], whose result is a $n(t)$ sigmoid curve, where $n(t)$ is the fraction of the immune population as function of time t. As pointed out in [9], while the dynamics for the deterministic time-evolution of the mean value has an unstable fixed point at $n = 0$ (no infection) and a stable one at the $n = 60\%$ (epidemic threshold), the stochastic dynamics display a stable point at $n = 0$ and a **metastable** one at $n = 0.6$. This means that by introducing in the system large fluctuations reducing the virus reproduction rate, the $n = 0$ state can be achieved and also controlled.

The first part of $n(t)$ is characterized by an exponential growth, in the current case with a 3-3.5 days doubling rate. If one assumes that the sigmoid is roughly symmetric, the exponential phase and the following linear phase will generate about half of the infections. When reaching the epidemiological threshold, 60% of Germans are immune, roughly 50 Millions. To reach half of it, 25 Millions, requires about 24 doublings, each takes 3 days $\sim$ 73 days. The exploding part of a laissez-faire pandemics would be over in 70-100 days. To reach the equilibrium point will cost 1.5 Million lives at a 3% mortality rate. A detailed numerical simulation predicts that it would end in July-August [1] and will probably overload the ICU capacity, hence doubling the fatalities, as shown in Italy. The suppression policy slowed down the virus to a doubling period of about 15 days (today over 30 days), so that the acute part of the crisis will take now 365 days: the ICU capacity is not overrun and new medicine/vaccine is may be in sight.

In order to estimate the ICU flow capacity, assume first that the infection wave ends in 4 months. An ICU bed is used in average for about 10 days by the same patient, so during 4 months 12 patients can be treated. In Germany 83 Millions * 0.6 $\sim$ 50 Millions must be immunized. If every fatality were a critical care patient, then ICUs must treat 0.01 * 50 Millions = 500 000 exit patients for the mitigation and 1.5 Millions for the suppression strategy. Since for every ICU bed only half of the patients die in average, one needs twice as many beds as fatality: multiply by 2 the 500000/12 needed beds, resulting in a daily capacity of 83 000 ICU beds for mitigation. This overloads the actual capacity in Germany by a factor of four. The suppression strategy would need about 3 times more beds stretched over a much longer time, except for some miracles: the virus is similar to the influenza and disappears in Sommer (but comes back in Winter), a medicine is available soon, or a vaccine is available in about 1 year from now.

IV. CRYING WOLF AND THE TALL TALES OF BARON MUNCHAUSEN

In all above calculations the big unknown is still the "dark number", the total number of infected (tested and not tested) cases. From the [5] data, about 15% from the tested persons required hospitalization (5% require critical care, half of which will die), leading to around 0.03% infection fatality rate, so the numbers computed from confirmed cases are consistent. Testing is still performed mostly for people with symptoms and/or having had contacts to already infected persons, as also seen from the total number of people showing symptoms in the [5]. This can be expressed as the scheme (cases) $\rightarrow$ (heavy symptoms (15%)$\Rightarrow$ hospitals, light symptoms (85%) $\Rightarrow$ home quarantine). If one extrapolates this to the scheme (total infected) $\rightarrow$ (symptoms (15%) $\Rightarrow$ (test), asymptomatic (85%)$\Rightarrow$undetected), then the dark number would be roughly (85+15)/15 = 6.6 $\times$ tested cases. Due to the many uncertainties a factor 4-10 times larger than the number of confirmed cases alone seems reasonable.

This number falls into the same order of magnitude as the ICU overloading factor for Germany. For simplicity, let us assume that the dark number is so large that the real infection fatality ratio is 10 times smaller, about 0.3 %. A number of $\sim$ 0.37% is suggested by the first mass immunization test study in Heinsberg, Germany (H. Streeck at al, public communication). Even if the real mortality is only 4-times less than the observed 3% (that is 0.25 % for the young, 0.75% in average) the mitigation policy still saves twice as many lives as the current suppression does. Without medicine or vaccine, the Convid-19 disease will realistically kill something between 50 000 - 100 000 persons in Germany in 2020, to be compared to the 954874 of "natural" annual deaths (in 2018 [3]).

When considering the saved human **years**, the ratio between the old year and the young year average loss is much smaller, about 1.4, even if one moves down the age-split to 60 years (28% old, 73% young split percentage in Germany). This factor does not support a two-population approach and hence for saving human years there is no practical difference between mitigation and suppression. The actual slow-lock-down policy makes sense, because it avoids overfilling the ICU beds, which would increase the mortality rate by a factor of 2-3. The down side is the very long time and the strong restrictions needed to keep the virus for re-spreading, achieve the epidemiological threshold, or wait long enough until a vaccine is found, tested, produced, and distributed.

However, locking down Germany for a year or more ("the new normality") and spending trillions of non-existent public money to fill the economic abyss is not bad policy: it is a Revolution. It will trigger worldwide economic disruptions with unforeseen political, military, and strategic effects. As one look at [14] clearly shows, this virus is by far not so bad as the Spanish flu [6]or MERS. The really bad Wolf virus is still in the woods. One day it will be here and catch us with the pants down: we loved Baron's tall story but only once.

With a bit of luck, the mitigation policy might actually NOT overload ICU capacity in Germany. In that case, why not trust the population at large to act rationally, like in Sweden? The mitigation [1] + controlled immunization [7] policies do not force anyone to do something it does not want. Old or sick people do already understand they must take care of themselves. If they are not in that position, let's help them - whatever it takes! Put money in the pockets of poor old, pay better the care personnel and provide masks, disinfectants, etc. so that the virus does not reach any senior, nursing home, hospice, or hospital. All of us are better off with a functional economy and a democratic system in the years to come than with none.

If you think otherwise, please put down first your numbers, not higher moral grounds. Numbers do not lie.

V. REFERENCES

[1] N. M. Ferguson at all, *"Impact of non-pharmaceutical interventions to reduce COVID-19 mortality and healthcare demand"*: DOI: https://doi.org/10.25562/77482

[2] *The age-pyramid of German citizens in 2018* from https://www-genesisi.destatis.de/genesis/online, see also an animated display at RMzQycJS.html

[3] *The death statistics of people living in Germany according to age and gender, 2018* from https://www-genesisi.destatis.de/genesis/online

[4] *The expected lifespan in years for different ages and gender, 2016/18* from https://www-genesisi.destatis.de/genesis/online, see also an animated display at RMzQycJS.html

[5] *Corona virus Disease 2019, Daily Situation Report of the RKI for 16/04/2020* https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte

[6] A. Gagnon at all: *"Age-Specific Mortality During the 1918 Influenza Pandemic: Unravelling the Mystery of High Young Adult Mortality"* , in PLoS ONE 8(8): e69586. doi:10.1371/journal.pone.0069586

[7] www.nzz.ch/video/nzz-standpunkte/die-schweiz-im-wuerdegriff-von-corona-ld.1549929

[8] https://en.wikipedia.org/wiki/Polymerase_chain_reaction

[9] N. G. Kampen: *Stochastic Processes in Physics and Chemistry*, Chapter XI.4, North-Holland, 1990, ISBN 0 444 866650 7

[10] https://www.PopulationPyramid.net

[11] https://www.lefigaro.fr/international/coronavirus-bilan-definitif-de-1046-cas-sur-le-charles-de-gaulle-20200418

[12] https://en.wikipedia.org/wiki/The_Boy_Who_Cried_Wolf

[13] https://blogs.loc.gov/international-collections/2017/08/the-tall-tales-of-baron-munchausen

[14] https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Sterbefaelle-Lebenserwartung/sterbefallzahlen.html