The Sober Math Everyone Must Understand about the Pandemic

March 18, 2020

Photo Credit: Steve R Giss, MD, FACS.

This post is a little long, but i**t has been viewed 2.9M times in less than 36 hours. You should read it, too. It's critical that you understand the math regarding the pandemic that is unfolding.**

This is a long post addressing two underlying issues with the current response to the pandemic that leave me concerned. It's the longest post I've ever written.

For those of you not taking action, or believing the pandemic to be "over hyped" I can tell you this is not hype. It's math. And you need to understand it.

WHY YOU SHOULD TAKE 5 MINUTES TO READ AND CONSIDER THE INFORMATION I AM SHARING:

For those of you who don't know me well, I am analytical and metered. I don't freak out nor do I respond emotionally. I also don't post a bunch of bullshit or political or controversial stuff on Facebook. I founded and am CEO of a successful software company that provides SaaS based data, analytics, and dashboards to recruiting departments at companies we all know. As you would expect, I am data driven and fact based. Before founding my company I held executive roles leading very large recruiting teams at some of the world's fastest growing companies such as Starbucks and Google. At Google I was fortunate enough to report to Sheryl Sandberg before she took the Facebook COO role. I was a Chemical Engineering major in college and have a business degree from a top undergraduate business school. I am not one for hyperbole or histrionics. **My bullshit factor is close to zero.**

I share all this personal information only to help you understand that I am not a journalist, and I'm here to tell you the whole truth about what is happening with the pandemic and explain the math in simple terms, because that's why many people do not understand what is happening with the pandemic to the degree required.

Now that I've gotten the introduction out of the way, here are two issues I want to bring to everyone's attention.

ISSUE ONE: SOCIAL NORMS ARE POWERFUL MOTIVATORS AND GETTING IN THE WAY OF PEOPLE TAKING THE RIGHT STEPS IN RESPONSE TO THE PANDEMIC:

One of the current problems with addressing the pandemic is the social pressures of taking action today. It's awkward, and feels like an over-reaction. The reason it feels like an overreaction is that most people OVERWEIGHT the currently reported cases and inherently UNDERWEIGHT the mathematics of how the virus is spreading and what will happen in about 30 days time. This is because our brains tend to think linearly as opposed to logarithmically. It's the same reason many people don't save for retirement or understand compound interest.

To create a new social norm, human beings like to see behavior modeled. This serves as a signal that says, "oh, someone else is doing it so I should do it also."

SO HERE IS A SOCIAL BENCHMARK FOR REFERENCE — THIS IS WHAT I'VE DONE FOR MY FAMILY TO DATE:

I have already isolated my family. We have canceled EVERYTHING. We have canceled previously scheduled doctor visits. Social get togethers. No play dates. Normal routine meetings. Everything has been canceled. It's difficult and socially awkward. Some of you think I'm crazy, but I'm doing it not because I am afraid, but because I am good at math (more on that in part 2). I had to have my 16 year old daughter quit her job coaching junior gymnasts at the local gym, with one day's notice and also tell my kids they can't attend youth group at church. Both of those were tough discussions. I told a very close friend he shouldn't stay at my house this weekend even though he was planning to and had booked his flight from the Bay Area. I canceled another dear friend's visit for later this month to go snowboarding on Mt Bachelor.

We are not eating out. Our kids are already doing online school so we don't have to make changes there. I would not send my kids to school even if they were in public or private school. We have eliminated all non-essential contact with other people. We will only venture out to grocery shop when required. We will still go outside to parks, go mountain biking, hiking, and recreate to keep ourselves sane and do other things as a family, just not with other people. We have stocked up on food and have a supply for ~2 months. We have stocked up on other goods that if depleted would create hardship, like medicines and feminine hygiene products. We have planned for shortages of essential items.

THE REASON I HAVE CHOSEN THIS ROUTE FOR MY FAMILY IS MULTI FACETED:

1. Although my family is considered low risk (I'm 49 in good health, Angi is 46 and in good health, and our kids are 14 and 16), **we must assume that the healthcare system cannot help us, because the hospitals will become overwhelmed very quickly. Most American hospitals will become overwhelmed in approximately 30 days unless something**

changes. More on this in part 2 below. So although we are in great health and unlikely to become gravely ill, the risk is greater if you do not have access to the medical care that you need. This is something for everyone to consider. As a society we are accustomed to having access to the best medical care available. Our medical system will be overwhelmed unless we practice social distancing at scale. That said, the medical teams in Italy are seeing an alarming number of cases from people in their 40s and 50s. Triage tents are already going up in the parking lots at many hospitals close to the epicenters in the United States.

2. **It's not a matter of if social distancing will take place, it's a matter of when.** This is because social distancing is the only way to stop the virus today.

As I will explain in part 2 below, **starting now is FAR more effective than starting even 2 days from now or tomorrow.** This has been proven by Italy and China (and soon to be France and other European countries who have been slow to respond.) [updated as of 3/14 France is now on lockdown mandated by the government]. Wuhan went on lockdown after roughly 400 cases were identified (and they had access to testing that America has systematically failed to do well to date). The US already has more than 4 times this number of known infected cases as Wuhan did when it was shut down, and our citizens are far more mobile and therefore spreading the virus more broadly when compared to Wuhan. Yet our response is tepid at best.

If hand washing and "being smart" were sufficient Italy would not be in crisis. So I pray the draconian measures are coming from our government, because they are required to stop the spread of the virus. It's better to start sooner than later as the cost is actually far greater if we wait. I pray they close all schools and non-essential services the way that Italy and China have done.

3. **Spreading the virus puts those in the high-risk category at much greater risk. This is the moral argument.** It's a strong argument because there are only two ways, as of today, that the virus can be stopped: let it run its course and infect 100s of millions of people, or social distancing. There is no other way today. If you don't practice social distancing, people downstream from you that you transmit the virus to will die, and many will suffer.

4. **The risk of infection is increasing exponentially, because the quantity of infected people, most who will not show symptoms, is doubling every three days.** So the longer you wait to self-isolate, the greater the chance of you or someone you love becoming infected and then you infecting others because more of the population is becoming infected. There are twice as many infected people today as there was on Tuesday.

5. **The virus is already in your town. It's everywhere.** Cases are typically only discovered when someone gets sick enough to seek medical attention. This is important as it typically takes ~5 days to START showing ANY symptoms. Here's the math: For every known case there are approximately 50 unknown cases. This is because if I become sick, I infect several

people today, and they infect a few people each tomorrow (as do I), and the total count of infected people doubles every 3 days until I get so sick I get hospitalized or get tested and become a "known case". But in the time it takes me to figure out I am sick 50 others downline from me now have the virus. So every third day the infection rate doubles until I get so sick that I realize I have the virus an am hospitalized or otherwise tested. Harvard and Massachusetts General Hospital estimate that there are 50x more infections than known infections as reported (citation below). The implication of this is that the virus is already "everywhere" and spreading regardless if your city has zero, few or many reported cases. So instead of the 1573 reported known cases today there are likely 78,650 cases, at least, in the United States. Which will double to 157,300 by this Sunday. And this will double to 314,600 cases by this coming Wednesday. So in less than 1 week the number of total infected in the United States will quadruple. This is the nature of exponential math. It's actually unfortunate that we are publishing the figures for known cases as it diverts attention away from more important numbers (like the range of estimated actual cases). [Update as of 3/15/20 — I've been sent more research that may add clarity to the ACTUAL cases vs CONFIRMED cases and will update this post with any conclusions]

6. **Some people cannot, or will not, practice social distancing for a variety of reasons and will continue to spread the virus to many people. So everyone else must start today.**

The reasons above are why I have begun to practice social distancing. It's not easy. **But you must do it. It's not optional, because the virus is spreading exponentially. Social distancing is the only way to stop the spread of the virus.**

The hospitals will be at capacity and there are not enough ventilators or personal protective equipment (PPE). You will hear a lot about this issue in the coming few weeks... the shortage of ventilators and PPE.

ISSUE TWO: MANY PEOPLE ARE FOCUSED ON THE WRONG NUMBERS:

Yes, the virus only kills a small percentage of those afflicted. Yes, the flu kills 10s of thousands of people annually. Yes, 80% of people will experience lightweight symptoms with COVID19. Yes the mortality rate of COVID19 is relatively low (1–2%). **All of this true, but is immaterial. They are the wrong numbers to focus on...**

The nature of exponential math is that the infection rates start slowly, and then goes off like a bomb and overwhelms the hospitals. You will understand this math clearly in the next section and do the short math exercise. Evergreen hospital in Seattle is already in triage. I have heard credible reports from people on the ground that they are already becoming overwhelmed. And the bomb won't really go off for a few more days. Probably by

Wednesday, March 18th (next week). In just a few days from now we will hear grave reports from Seattle hospitals. [update as of 3/15/20 — see the comments section below for an update from a staff member at Evergreen Hospital in Kirkland, WA]

You should assume the virus is everywhere at this point, even if you have no confirmed cases in your area.

YOU MUST DO THIS 2 MINUTE, 3 STEP MATH EXERCISE TO UNDERSTAND. REALLY, DO THE EXERCISE AND IT WILL BE CLEAR (grab a calculator):

STEP 1: To further understand exponential growth, take the number of confirmed cases in your area and multiply by 10 (or 50 if you believe Harvard and Massachusetts General estimations) to account for the cases that are not yet confirmed. If you have no confirmed cases choose a small number. I'd suggest 10 cases in your city, if no cases are yet reported. But you can use whatever number you like. This number of infected people doubles every ~3 days as the infection spreads. So literally take your number, and multiply by 2. Then do it again. Then do it again. Then do it again. Do this multiplication exercise 10 times in total.

2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x (the number of estimated infections in your city today (not just the reported cases)).

This result is the estimate for the actual cases in your area 30 days from now. The math will take 30 seconds to complete with a calculator and you must do it to understand the math to see how it grows. This end number is the number of cases in your city 30 days from today if a large percentage of the population do not practice social distancing.

Example from where I live in Bend, Oregon:

6 confirmed cases x 10 = 60 Actual Cases. (as of 3/18/20)

60 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 = 61,440 COVID Positive cases in 30 days.

2 to the 10th power is 1024. When something doubles 10 times, it's the same as multiplying by 1024. **This is not hype, it's math.** The infection rate of the virus doubles every 3 days. **In thirty days there will be 1,024 times the number of infected people in your area as there is today if your community does not immediately put extreme social distancing into practice.**

PART 2: THIS NEXT PART OF THE EXERCISE IS SUPER IMPORTANT: Next calculate 15% (multiply by 0.15) of that final 30 day number of total infected people (the number you calculated by multiplying by 2 ten times). This will provide an estimate of the serious COVID positive cases which will require hospitalization, and compare it to the number of

beds and ventilators available at your local hospital. Google the "number of beds" and the name of your local hospital now. It takes 2 seconds and the number of beds is easy to find. Write this number of total beds at your local hospital down.

Example using Bend, Oregon: 0.15 x 6,144 total cases = 921 COVID Positive cases in 30 days (if we don't practice extreme social distancing and do it well).

PART 3: But, on average 65% of beds are already occupied by patients unrelated to the coronavirus. Some hospitals are at 90% or 95% capacity already. So multiply the number of beds at your local hospital by 0.35 (35%) and that is how many beds are available for COVID Positive patients.

Example: St Charles in Bend, Oregon where I live, has 226 beds and the town is roughly 100,000 people. Some hospitals run much closer to maximum capacity, including St. Charles, but let's stick with the nationwide average of 35%. Therefore, unfilled beds at St Charles is 0.35 x 226 = 79 beds to treat COVID Positive patients who require hospitalization to recover.

FINAL STEP: Multiply the total number of beds at your local hospital by 0.35 to understand how many beds can be used for COVID patients in your area and compare to your the numbers from Step 1 and Step 2 for your area. **See the problem? This is why governments are locking down cities and countries around the world.**

I pray you believe the math, because there are other issues: Most hospitals have on average, 40 or fewer ventilators. 5% of patients require ICU treatment and most of these require ventilators. There are very few ICU beds compared to regular beds in hospitals, which have negative pressurization to keep airborne diseases from spreading throughout the hospital. There are very few negative pressure areas in any hospital to deal with the containment of airborne diseases. Hospitals don't have enough personal protective equipment like masks and PAPR hoods (Google it).

These numbers you just calculated are The Big Problem: Too many patients, not enough beds, and a serious shortage of ventilators, masks and other PPE if we don't practice extreme social distancing.

COUNTRIES AND CITIES THAT GET OVERWHELMED WILL HAVE A MUCH GREATER MORTALITY RATE BECAUSE THEY WON'T BE ABLE TO ADEQUATELY PROVIDE MEDICAL CARE.

And by medical care I mean not just coronavirus patients. Your son or daughter that needs acute care surgery this May for his badly broken leg will be attended to by an orthopedic doctor that has been working at maximum capacity and working 18 hour shifts for 7 days every week for 6 weeks because it was required to care for all the coronavirus patients at her hospital. Or the orthopedic surgeon will be sick with the virus and your son or daughter will be operated on in a tent in the hospital parking lot by a non-expert or a

member of the National Guard. Your elderly Mom that has diabetes and goes into acute distress next month may not receive ANY medical care because the doctors are consumed and have to prioritize patients based on triage guidelines based on success rate probabilities. Your sibling's family that are all injured in a terrible car crash in June will have diminished care. If one of them needs a ventilator there will be none available because all of them will be in use by critical coronavirus patients. Your young friend with cancer and a compromised immune system from treatment will succumb even though the cancer was curable and the treatment was working, because their body was too fragile to combat the coronavirus due to the chemotherapy and they couldn't receive the customized, acute care required due to the hospital being overwhelmed. All of the above is currently happening in Italy, who had the same number of infections we have today just 2 weeks ago. You must start social distancing today.

The count of actual virus infections doubles every ~3 days. The news and government agencies are lagging in their response. So we hear that the US only has 1573 cases today (3/12/20) [update as of 3/15/20: 3115 confirmed cases), (see https://www.worldometers.info/coronavirus/) and it doesn't seem like a lot. It would be better to report the estimated actual cases, since reported cases don't tell us much. However, we know from China that the actual number of cases are at least an order of magnitude greater than the reported cases, because people get infected and do not display symptoms. In math, an "order of magnitude" means ten times difference, or put another way, a factor of 10. 100 is 10 times greater than 10, so it's an order of magnitude greater.

Harvard Medical School / Massachusetts General Hospital just released their estimate (recording is here: https://externalmediasite.partners.org/.../53a4003de5ab4b4da5...) that the actual cases are 50x greater than the reported cases. So we likely have 75,000 cases in the United States already. The number of reported cases is not that important.

But let's assume the current number of cases is only 10,000 ACTUAL cases in the United States just to be conservative and model out what will happen:

If we don't stop the virus from spreading, in 30 days we will have 2 to the 10th power more cases of infected people because the infection count doubles every 3 days (the virus doubles every 3 days and there are 10, 3 day periods in 30 days).

This math is familiar if you did the exercise above. If not, go up and do the math exercise. Seriously. It's important. The math: 2 to the 10th power means 1,024 times as many cases as we have today (2 times 2 repeated 10 times).

This number is a catastrophically big problem for all of us: We will have 10 million+ actual cases (10,000 actual cases today x 1,024) in the United States in just 30 days' time if we continue without extreme social distancing. 10 million people with the virus. And it will keep doubling every 3 days unless we practice social distancing.

15% of cases require significant medical attention, which means that 1.5 million people will require significant medical attention if 10 million people get infected (15% of 10 Million total infections = 1.5 million people requiring hospitalization).

1.5 million hospitalizations is way more than we have beds for at hospitals in the United States. And 65% of all beds are already occupied in our hospitals. But many patients (5%) with the virus need ICU beds, not just any old hospital bed. Only about 10% of hospital beds are considered intensive care beds. So we will have a huge bed shortage, but that is not the biggest problem, as we can erect temporary ICU shelters and bring in more temporary beds, as Italy has already done, and California and Washington hospitals have already done. Evergreen Hospital in Seattle has already erected temporary triage tents in the parking lot as of 3/13/20. All regular beds are full at Evergreen Hospital as of 3/14/20.

Once the government of China, Norway, and Italy came to understand this math, they reacted accordingly and shut EVERYTHING down. [update as of 3/15/20 now France has done the same lockdown]. Extreme social distancing is the only response available to stop the virus today. The United States is not responding well nor are other countries like the UK. Countries that do not respond well will pay a much larger, catastrophic price.

But hospital beds are not the big problem. **The lack of ventilators is the big problem.** Most estimates peg the ventilators in the United States at roughly 100,000 to 150,000 units. See the study from last month: http://www.centerforhealthsecurity.org/.../200214-VentilatorA...

The primary and most serious comorbid (comorbid is a medical term that means co-existing or happening at the same time) condition brought on by the Coronavirus is something called bilateral interstitial pneumonia which requires ventilators for treatment of seriously ill patients. So if 1.5M people of the 10 million infected 30 days from now require hospital care (15% of the 10M estimated total infections), 1.3M may not get the care that they need because we don't have enough ventilators, beds, and ICU beds in the United States. And remember, this is only if ALL OF US EFFECTIVELY start social distancing by April 11th (30 days from today). This increases the mortality rate significantly.

BUT IF WE START EXTREME SOCIAL DISTANCING BY MARCH 23 (12 days from original writing), WE AVOID OVER 1.4 MILLION PEOPLE GETTING CRITICALLY ILL AND OVERWHELMING THE HOSPITALS:

If everyone takes extreme measures to social distance, and the United States can dramatically reduce the spread of the virus 12 days from now, the math is very different, as the exponential growth will only be 2 to the 4th power (12 days divided by the doubling rate of every 3 days equals the exponent of 4):

2 x 2 x 2 x 2 = 16

So instead of 10 Million cases in the United States if we wait 30 days, if we act 18 days sooner, we will have only 160,000 cases (16 times the estimated 10,000 actual cases as of today), of which 15% are likely to require hospitalization. This is 24,000 critical patients (a huge difference compared to 1.5 million acute patients). The difference between taking extreme measures now, versus waiting even a few days, is very large due to how exponents work in math.

THE OUTCOME IS EVEN BETTER IF WE TAKE ACTION IN THE NEXT 6 DAYS: If the vast majority of the population self isolates and implements social distancing in only 6 days from now the exponential math is 2 to the 2nd power (6 days divided by the 3 days it takes the virus to double means the exponent is only 2). In math this is "two squared".

2 x 2 = 4

Multiplied by the estimated 10,000 ACTUAL cases as of today (3/12/20) that means only 40,000 total cases will develop, 15% of which may be critical which is 6,000 critical patients.

This is why you should share this post broadly. If people begin social distancing in the next 6 days it will greatly reduce the impact on all of us. It's why they say a "post goes viral".

SOCIAL DISTANCING WILL REDUCE THE FINANCIAL IMPACT TO YOU AND YOUR FAMILY:

Finally, the longer everyone waits to practice significant social distancing the greater the economic hardship will be on all of us. Lost jobs. Mortgage defaults. Closed businesses. Bankruptcies. All will be minimized if you start social distancing today.

Some of the reasons the economic impacts will be reduced are worth mentioning: If we stop the virus now the overall duration of the outbreak will be far shorter. The stock market will normalize more quickly and recover more quickly. Businesses and people will be able to survive a shorter duration outbreak vs a longer duration outbreak. More companies will avoid bankruptcy if we begin to practice social distancing now.

This is a big financial reason to begin social distancing if you are employed by any company: if companies see that the virus is being slowed, they will be less likely to conduct layoffs. You will be more likely to be laid off or experience a job-related event if we don't practice social distancing immediately. As an HR executive, I've been involved in many, many layoffs. It's the last thing companies want to do. But if they see that the pandemic will be shorter lived vs long and drawn out, they are less likely to make the permanent decision of laying off staff.

The overall economic impact that hits your bank account will be greater if you wait or you don't practice social distancing. This is why Norway acted now, because it's less economic impact to take drastic measures early than to do them later, and it saves a lot of lives and

suffering by doing so. And Norway has only one confirmed death as of this writing.

Many people have suggested they want to support local restaurants and other businesses, who have seen sales drop by 50–90%. Stopping by and visiting them won't save them. What will save them is social distancing and what you do after the pandemic is over. If you are concerned, call them and buy a gift certificate over the phone.

START TODAY. I CAN'T STRESS THIS ENOUGH. YOU MUST START TODAY.

Finally, the article that I posted yesterday written by Tomas Pueyo has been read 30M times in the last few days and has been updated with new information. It's worth reading again.

Here's that link:

https://medium.com/.../coronavirus-act-today-or-people-will-d...

Other up to date data I frequently consult regarding the pandemic is here:

https://www.worldometers.info/coronavirus/

I hope this is helpful and useful. My brain focuses on the math and I try and be fact based in my analysis and interpretation of how I should respond.

THERE IS MORE INFORMATION IN THE COMMENTS ON WORTH READING AND I WILL BE UPDATING THAT POST, AND THE COMMENTS, WITH MORE INFORMATION

MY FINAL PARTING THOUGHT: Please share or forward this post at your discretion. If everyone shares this post and two of your friends share this post and so on, we use the power of exponential math to work in our favor, which seems appropriate given the virus is using that same exponential math against us.

HOW YOU CAN REALLY HELP: If you know people who have large numbers of followers, or people in the media, please leverage your personal relationship with them and ask them to amplify this post by sharing it.

It would be useful to get the post on Twitter and LinkedIn. If you know people in government this fact-based post may help inform them to make the best decisions. **I am not active on Twitter.**

It's time for us humans to go on the offensive against the virus. We must fight back.

There is only one way to do so: Social Distancing.

Do it today.

NOTE: Anyone, including the media, is free to use this post, any related content, in all or in part, for any purpose, in any format, with no attribution required. Please direct message me if you have other ideas for how to raise awareness.

Finally, I can no longer keep up with friend requests given how much this post has been shared. To receive updates or follow me, please use the "Follow" button on Facebook. My page Facebook page is here, or follow me here on Medium (or both!).

My facebook page: https://www.facebook.com/jason.scott.warner

If anyone wants to translate this into any other language please do so and contact me and I'll repost it in that language.

3/18/20: I am preparing a second post, now that 4 days have gone by since the first post. To receive it please follow me on FB. I can not keep up with the friend requests.

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