Do COVID-19 death rates by age suggest a path to staying open in a second wave?

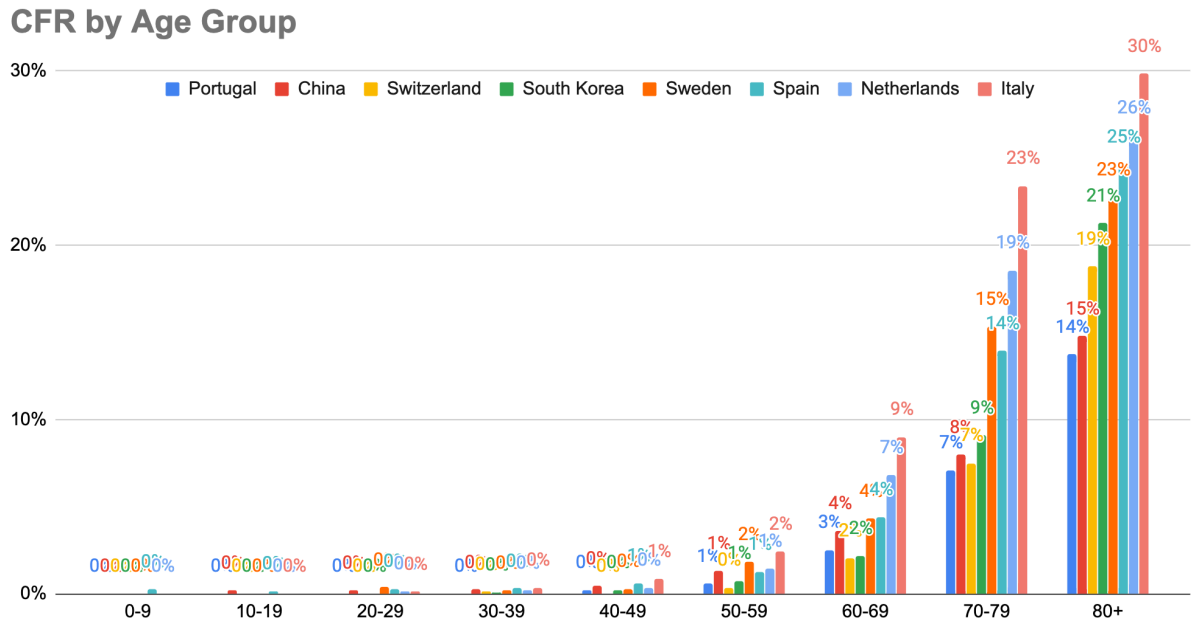
Written by Elad Gil. Many thanks to Shin Kim for help with data aggregation and analysis.

This post is meant in the spirit of sparking a conversation versus claiming to provide all the solutions, or even the correct solution. It is meant to spark a data-driven, logic-based discussion of COVID-19 and paths to re-open society. A number of friends have lost family members to COVID-19 and many more lives are at stake. At the same time, a vaccine may in reality still be many years away. As a society we need a path to reopen safely or the resultant economic toll may hurt those already most marginalized by society.

The reality of COVID-19 is that somewhere between 30-70+% of the human population needs immunity to the virus for the disease to stop spreading. This can be accomplished via a vaccine (more on that below) or infection. But no matter how you look at it, life will not return to "normal" until there is herd immunity. For example, if 1% of California exits the first wave immune to COVID-19, you still need *up to 70X more people* to get sick with COVID before society can return to normal. This means multiple more waves are COVID-19 are likely coming (and perhaps inevitable).

A look at global COVID-19 data quickly reveals that in terms of deaths, COVID-19 is a disease that impacts the old and sick most (see data on hospitalizations below, which are more widespread but still concentrated). This fact may suggest a way to re-open the country long term while protecting our most vulnerable, and while building necessary herd immunity.

Death rates from COVID-19 under age 50 are low on relative basis



Looking at multiple countries, COVID-19 CFRs track to age. People under age 50 represent 54-67% of many countries' populations, but represent only roughly 0.6% to 6% of the total deaths from COVID-19. Under 60 you capture roughly 70%-80% of a population but only 3 to 9% of deaths (China is an exception at 20% of deaths under 60. In general, ongoing China data adjustments raises questions about data certainty in China). Given how under tested many countries are, and how testing correlates to hospital (versus outpatient) cases, this suggests the true infection fatality rate of people under 60 is even lower.

Population, COVID-19 Deaths for Under 40 Age Group

Country	Pop <40	% Pop <40	Deaths <40	Total Deaths	% Deaths <40
Italy	23,831,000	39.4%	44	16,653	0.3%
United States *	172,815,000	52.2%	102	9,681	1.1%
Spain	19,490,000	41.7%	54	9,482	0.6%
Netherlands	7,902,000	46.1%	7	2,821	0.2%
China **	751,249,000	52.2%	26	1,023	2.5%
Sweden	4,918,000	48.7%	5	919	0.5%
Switzerland	3,980,000	46.0%	4	884	0.5%
Portugal	4,145,000	40.7%	0	535	0.0%
South Korea	22,702,000	44.3%	1	211	0.5%

** US data as of 4/15/20, as reported to National Center for Health Statistics (NCHS). Data is lagged by 1-2 weeks. Under 40 represents under 35 for the US.*

*** China data as of 2/11/20.*

Population, COVID-19 Deaths for Under 50 Age Group

Country	Pop <50	% Pop <50	Deaths <50	Total Deaths	% Deaths <50
Italy	32,853,000	54.3%	197	16,653	1.2%
United States *	213,164,000	64.4%	319	9,681	3.3%
Spain	27,429,000	58.7%	163	9,482	1.7%
Netherlands	10,054,000	58.7%	17	2,821	0.6%
China **	967,361,000	67.2%	64	1,023	6.3%
Sweden	6,182,000	61.2%	9	919	1.0%
Switzerland	5,147,000	59.5%	5	884	0.6%
Portugal	5,720,000	56.1%	6	535	1.1%
South Korea	30,921,000	60.3%	4	211	1.9%

** US data as of 4/15/20, as reported to National Center for Health Statistics (NCHS). Data is lagged by 1-2 weeks. Under 50 represents under 45 for the US.*

*** China data as of 2/11/20.*

Population, COVID-19 Deaths for Under 60 Age Group

Country	Pop <60	% Pop <60	Deaths <60	Total Deaths	% Deaths <60
Italy	42,420,000	70.2%	834	16,653	5.0%
United States *	255,284,000	77.1%	877	9,681	9.1%
Spain	34,475,000	73.7%	443	9,482	4.7%
Netherlands	12,578,000	73.4%	85	2,821	3.0%
China **	1,189,546,00	82.6%	194	1,023	19.0%
Sweden	7,478,000	74.1%	44	919	4.8%
Switzerland	6,468,000	74.7%	24	884	2.7%
Portugal	7,201,000	70.6%	23	535	4.3%
South Korea	39,398,000	76.8%	18	211	8.5%

** US data as of 4/15/20, as reported to National Center for Health Statistics (NCHS). Data is lagged by 1-2 weeks. Under 60 represents under 55 for the US.*

*** China data as of 2/11/20.*

(Note, due to how USA data is provided, under 40 = under 35, under 60 = under 55 etc specifically for the USA. in the 3 charts above, and the “Deaths per 100,000 chart below).

If you look at deaths per age per capita, people over 60 are in many countries 30X to 100X more likely to die of COVID then people under 60 (see chart below).

Deaths Per 100,000 Under 60, Over 60

	Deaths Per 100,000		
Country	Under 60	Over 60	Over / Under 60 Ratio
Switzerland	0.37	39.29	105.9x
Netherlands	0.68	60.03	88.8x
Spain	1.28	73.62	57.3x
Sweden	0.59	33.40	56.8x
Portugal	0.32	17.10	53.5x
Italy	1.97	87.67	44.6x
South Korea	0.05	1.63	35.6x
United States *	0.34	11.63	33.8x
China **	0.02	0.33	20.4x
Median			53.5x

** US data as of 4/15/20, as reported to National Center for Health Statistics (NCHS). Data is lagged by 1-2 weeks. Under 60 represents under 55 for the US.*

*** China data as of 2/11/20.*

Indeed, the per country data below illustrates how stark this difference is. Notably, many countries have only been testing people who are hospitalized or very ill, which would bias the case numbers down for the young and healthy if they are not as affected by the disease.

Italy

Age Group	Population	Cases	Attack %	Deaths	CFR
0-9 years	4,995,000	938	0.0%	1	0.1%
10-19 years	5,733,000	1,432	0.0%	0	0.0%
20-29 years	6,104,000	6,360	0.1%	7	0.1%
30-39 years	6,999,000	9,956	0.1%	36	0.4%
40-49 years	9,022,000	17,745	0.2%	153	0.9%
50-59 years	9,567,000	26,391	0.3%	638	2.4%
60-69 years	7,485,000	21,734	0.3%	1957	9.0%
70-79 years	6,029,000	22,934	0.4%	5366	23.4%
80+ years	4,529,000	28,478	0.6%	8495	29.8%
Total	60,463,000	135,968	0.2%	16,653	12.2%

Data as of *4/9/20*

Source *https://www.epicentro.iss.it/coronavirus/sars-cov-2-*

In Italy, only 8 people out of 16,653 who died of COVID-19 were under the age of 29. Only 44 people who died of COVID were under age 40 died (0.2%). 197 (1.1%) of 16,653 people who died of COVID were under 50. <60 represented 835 deaths (out of 16,653 total - or roughly 5%)

South Korea

Age Group	Population	Cases	Attack %	Deaths	CFR
0-9 years	4,154,000	130	0.0%	0	0.0%
10-19 years	4,753,000	558	0.0%	0	0.0%
20-29 years	6,716,000	2,856	0.0%	0	0.0%
30-39 years	7,079,000	1,115	0.0%	1	0.1%
40-49 years	8,219,000	1,399	0.0%	3	0.2%
50-59 years	8,477,000	1,926	0.0%	14	0.7%
60-69 years	6,454,000	1,327	0.0%	29	2.2%
70-79 years	3,561,000	694	0.0%	63	9.1%
80+ years	1,856,000	475	0.0%	101	21.3%
Total	51,269,000	10,480	0.0%	211	2.0%

Data as of *4/11/20*

Source *https://www.cdc.go.kr/board/board.es?mid=a30402*

In South Korea, only 4 people out of 211 dead of COVID were under age 50. Only 17 people out of 211 who died were under age 60.

Netherlands

Age Group	Population	Cases	Attack %	Deaths	CFR	Hospitalized	Hosp. %
0-9 years	1,753,000	71	0.0%	0	0.0%	37	52.1%
10-19 years	1,954,000	214	0.0%	0	0.0%	25	11.7%
20-29 years	2,098,000	1,973	0.1%	3	0.2%	113	5.7%
30-39 years	2,097,000	2,152	0.1%	4	0.2%	233	10.8%
40-49 years	2,152,000	2,839	0.1%	10	0.4%	606	21.3%
50-59 years	2,524,000	4,719	0.2%	68	1.4%	1,408	29.8%
60-69 years	2,130,000	3,805	0.2%	259	6.8%	1,973	51.9%
70-79 years	1,591,000	4,531	0.3%	841	18.6%	2,604	57.5%
80+ years	837,000	6,219	0.7%	1,636	26.3%	1,728	27.8%
Total	17,136,000	26,523	0.2%	2,821	10.6%	8,727	32.9%

Data as of *4/13/20*

Source *https://www.rivm.nl/coronavirus-covid-19/grafieken*

In the Netherlands, 17 out of 2821 people who died of COVID were under the age 50. 85 out of 2821 people who died were under 60.

Similarities abound in other countries:

Germany

Age Group	Population	Cases	Attack %	Deaths	CFR
0-60 years	59,793,000	87,375	0.1%	134	0.2%
60-79 years	18,116,000	23,795	0.1%	922	3.9%
80+ years	5,875,000	11,645	0.2%	1,737	14.9%
Total	83,784,000	122,815	0.1%	2,793	2.3%

Data as of *4/13/20*

Source *https://www.rki.de/DE/Content/InfAZ/N/Neuartiges*

In Germany, less than 5% of COVID deaths were under age 60, while roughly 71% of the population is under 60.

Israel

Age Group	Population	Cases	Attack %	Deaths	CFR
0-9 years	1,671,000	480	0.0%	0	0.0%
10-19 years	1,405,000	1,205	0.1%	0	0.0%
20-29 years	1,197,000	2,267	0.2%	0	0.0%
30-39 years	1,123,000	1,369	0.1%	1	0.1%
40-49 years	1,041,000	1,310	0.1%	1	0.1%
50-59 years	796,000	1,283	0.2%	1	0.1%
60-69 years	704,000	1,030	0.1%	11	1.1%
70-79 years	460,000	518	0.1%	25	4.8%
80+ years	208,000	347	0.2%	52	15.0%
Total	8,605,000	9,809	0.1%	91	0.9%

Data as of *4/11/20*

Source *https://t.me/MOHreport* *https://t.me/MOHreport/3884*

In Israel there are 2 deaths of 91 under age 50, and 3 deaths under age 60.

Switzerland

Age Group	Population	Cases	Attack %	Deaths	CFR	Hospitalized	Hosp. %
0-9 years	885,000	98	0.0%	0	0.0%	24	24.5%
10-19 years	835,000	660	0.1%	0	0.0%	25	3.8%
20-29 years	1,040,000	3,023	0.3%	0	0.0%	95	3.1%
30-39 years	1,220,000	3,349	0.3%	4	0.1%	110	3.3%
40-49 years	1,167,000	4,056	0.3%	1	0.0%	209	5.2%
50-59 years	1,321,000	5,321	0.4%	19	0.4%	459	8.6%
60-69 years	978,000	3,217	0.3%	66	2.1%	537	16.7%
70-79 years	752,000	2,561	0.3%	192	7.5%	771	30.1%
80+ years	459,000	3,205	0.7%	602	18.8%	938	29.3%
Total	8,657,000	25,490	0.3%	884	3.5%	3,168	12.4%

Data as of *4/13/20*

Source *https://www.bag.admin.ch/bag/de/home/krankheiten/ausbrueche-epidemie*

In Switzerland, 5 out of 864 COVID-19 deaths are under 50 and only 24 of 864 under 60 years old.

Sweden

Age Group	Population	Cases	Attack %	Deaths	CFR	ICU Admits	ICU %
0-9 years	1,194,000	63	0.0%	0	0.0%	1	1.6%
10-19 years	1,127,000	162	0.0%	0	0.0%	0	0.0%
20-29 years	1,277,000	802	0.1%	3	0.4%	36	4.5%
30-39 years	1,320,000	1,025	0.1%	2	0.2%	39	3.8%
40-49 years	1,264,000	1,400	0.1%	4	0.3%	99	7.1%
50-59 years	1,296,000	1,900	0.1%	35	1.8%	213	11.2%
60-69 years	1,094,000	1,529	0.1%	66	4.3%	262	17.1%
70-79 years	994,000	1,541	0.2%	236	15.3%	179	11.6%
80+ years	532,000	2,520	0.5%	573	22.7%	30	1.2%
Total	10,098,000	10,942	0.1%	919	8.4%	859	7.9%

Data as of *4/13/20*

Source *https://experience.arcgis.com/experience/09f821667ce64bf7be6f9f874*

Sweden: 9 out of 919 deaths are people under the age of 50 (1%).

Spain

Age Group	Population	Cases	Attack %	Deaths	CFR	Hosp.	Hosp. %	ICU Admits	ICU %
0-9 years	4,234,000	396	0.0%	1	0.3%	154	38.9%	20	5.1%
10-19 years	4,736,000	647	0.0%	1	0.2%	129	19.9%	5	0.8%
20-29 years	4,618,000	6,137	0.1%	17	0.3%	914	14.9%	53	0.9%
30-39 years	5,902,000	11,484	0.2%	35	0.3%	2409	21.0%	170	1.5%
40-49 years	7,939,000	17,962	0.2%	109	0.6%	5500	30.6%	424	2.4%
50-59 years	7,046,000	22,336	0.3%	281	1.3%	8933	40.0%	938	4.2%
60-69 years	5,340,000	19,747	0.4%	873	4.4%	11469	58.1%	1563	7.9%
70-79 years	4,015,000	18,716	0.5%	2,607	13.9%	13726	73.3%	1519	8.1%
80+ years	2,923,000	22,569	0.8%	5,558	24.6%	13738	60.9%	176	0.8%
Total	46,753,000	119,994	0.3%	9,482	7.9%	56,972	47.5%	4,868	4.1%

Data as of *4/13/20*

Source *https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-Ch*

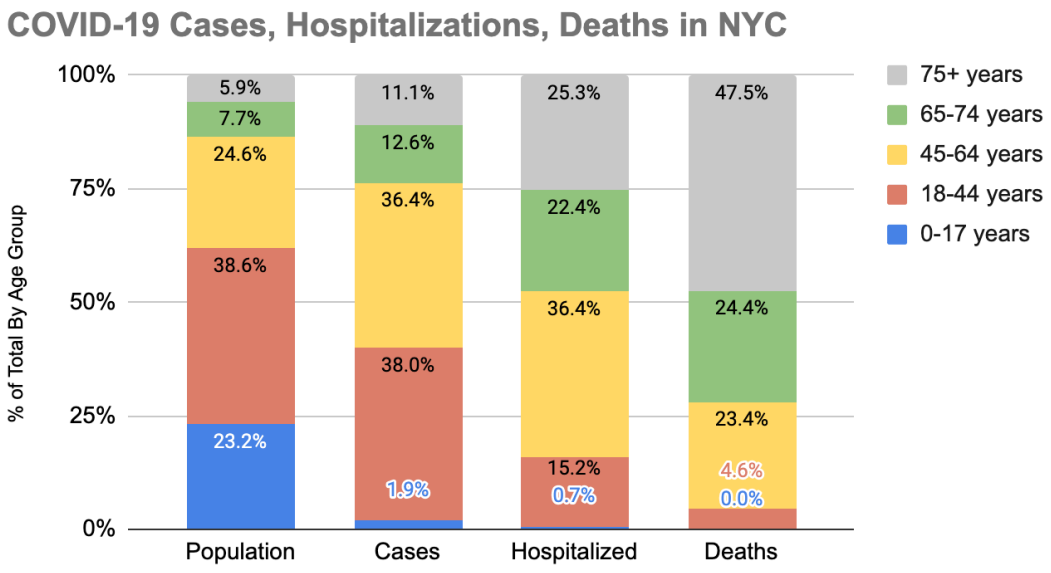
In Spain, 54 of 9482 (0.57%) COVID-19 deaths were under the age of 40. 163 of 9482 under the age of 50 (1.7%). 58% of the Spanish population is under 40, and 73% under 50.

New York State

Age Group	Deaths
0-4	1
5-14	6
15-29	45
30-39	155
40-49	371
50-59	941
60-69	1,809
70-79	2,507
80-89	2,365
90+	1,171
Total	9,371
Data as of	*4/12/20*
Source	*https://covid19tracker.health.ny.gov/*

In New York State, 207 of 9371 (2.2%) of COVID deaths were under age 40. 588 (6.2%) under age 50.

NY City provides per capita data that shows a 65X+ difference in deaths between people aged 18-44 and those aged 75+. It should be noted that a number of states have held off on testing outpatients, as well as people with COVID symptoms under a certain age. This means that the real infection rates in individuals in younger age groups under 70 may be incrementally understated.



Of those who died of COVID-19 in NYC, 90% of people 19-44 had a comorbidity such as diabetes. By age 75+, 99% of people have an underlying illness other than COVID.

The data in this report reflect events and activities as of **April 14, 2020 at 6:00 PM.**

All data in this report are preliminary and subject to change as cases continue to be investigated.

These data include cases in NYC residents and foreign residents treated in NYC facilities.

This table shows only confirmed deaths. A death is considered confirmed when the person had a positive COVID-19 laboratory test.

NYC COVID-19 Deaths

	Underlying Conditions[1]	No Underlying Conditions	Underlying Conditions Unknown	Total
Age Group				
- 0 to 17	3	0	0	3
- 18 to 44	244	25	40	309
- 45 to 64	1343	59	179	1581
- 65 to 74	1272	26	385	1683
- 75 and over	2289	27	947	3263
- Unknown	0	0	1	1
Sex				
- Female	1873	37	620	2530
- Male	3087	96	912	4095
- Unknown	191	4	20	215
Borough				
- Bronx	1431	18	135	1584
- Brooklyn	1342	50	562	1954
- Manhattan	533	18	220	771
- Queens	1592	46	541	2179
- Staten Island	250	5	94	349
- Unknown	3	0	0	3
Total	5151	137	1552	6840

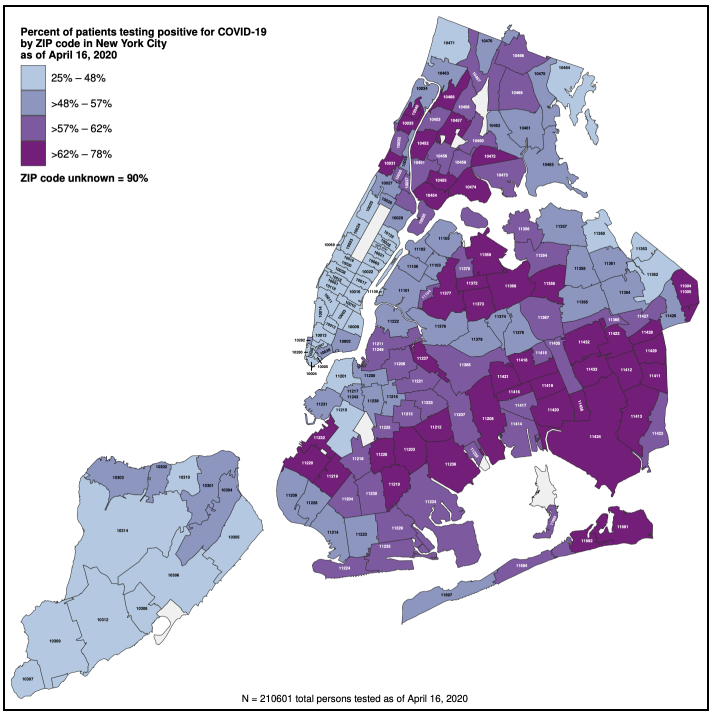
The takeaway from all this is that under a certain age people rarely die of COVID-19, and 90% of those that do have diabetes, are immune compromised, have cancer, COPD, or another pre-existing condition. Although people under 50 represent 54-67% of many countries' populations, they tend to represent roughly 0.5% to 5% of deaths. If you remove people with comorbidities, it is possible this number is as low as 0,05% to 0.5%.

Hospitalizations

[Note: Age 44 is used in this section as this is how ages are bucketed in reported data from NYC.]

In parallel, the hospitalization in NYC and NY State of COVID infected individuals 18-44 appears to be around 11%. Note that “hospitalization” does not mean ICU. Given the high positive rate on tests, and the asymptomatic carrier rates, many people think that NY (and many other US) numbers may be understated by 5-10X or more (well known virologist Trevor Bedford mentions a ball park estimate of 10-20X). This raises the possibility that only 1-2% of infected 18-44 year olds will need hospitalization at a population level. Additionally, NY has avoided testing outpatients for COVID-19 - which means only the sickest people (who tend to be older) have been tested.

Depending on your belief around the real proportion of NYC that has now had COVID-19, NY may already have the hospital surge capacity in place to deal with the epidemic spreading in populations under 50 (or 60) only. This merits detailed analysis and planning.



NYC COVID-19 Hospitalizations

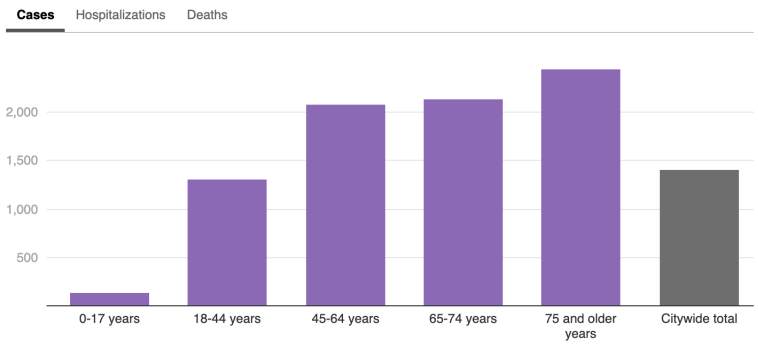
	Ever Hospitalized Cases[1]	All Cases
Age Group		
- 0 to 17	199 (9%)	2150
- 18 to 44	4493 (11%)	42127
- 45 to 64	10799 (27%)	40559
- 65 to 74	6659 (47%)	14025
- 75 and over	7589 (62%)	12331
- Unknown	2 (1%)	232

New York City

Age Group	% of Total Population Rep'ed in Age Group	% of Total Hospitalizations Rep'ed in Age Group
0-17	23.2%	0.7%
18-44	38.6%	15.2%
45-64	24.6%	36.4%
65-74	7.7%	22.4%
75+	5.9%	25.3%

Rates by Age

COVID-19 rate per 100,000 people



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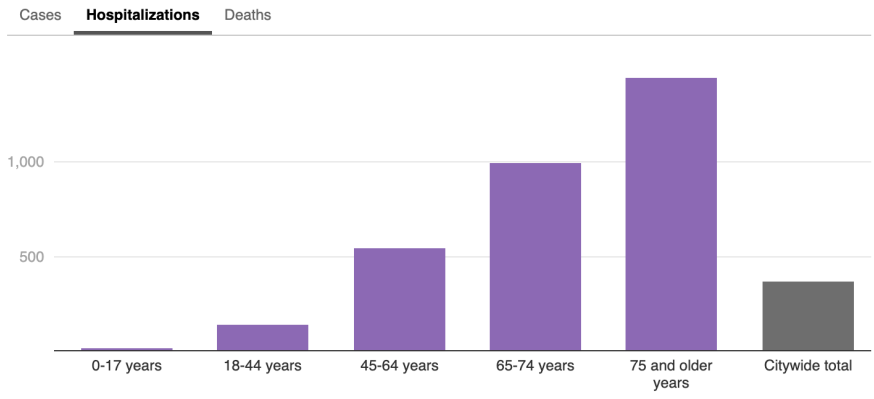
Rates by Age

COVID-19 rate per 100,000 people



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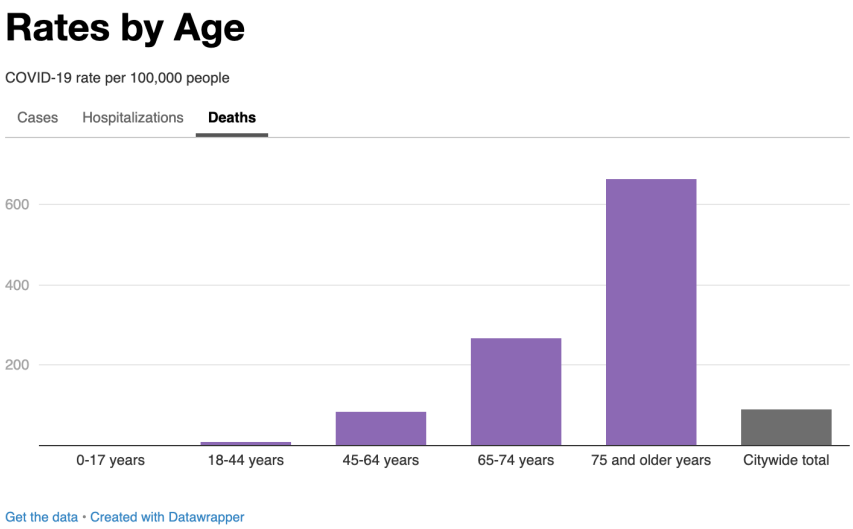

Looking at NY data, people aged 75+ see 11X more hospitalizations per capita than those 18-44, and 130X the hospitalizations of those 0-17. Similarly individuals 65-74 are 7.5X more likely to be hospitalized per capita than those 18-44 and 87X more likely than those under age 18. This merits further analysis relative to surge capacity, as it is possible that on a per capita basis much less surge capacity is needed for younger individuals. **In NY, those over 45 have ~14X the hospitalizations per capita versus those under 45.**

As a reminder, Of those who died of COVID-19 in NYC, 90% of people 19-44 had a comorbidity such as diabetes. By age 75+, 99% of people have an underlying illness other than COVID-19.

So protecting people with a handful of key diseases (diabetes, COPD, some cancers, some heart disease) may significantly reduce disease and death burden to hospitals and help to protect people in our society.

NYC COVID-19 Deaths

	Underlying Conditions[1]	No Underlying Conditions	Underlying Conditions Unknown	Total
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- 0 to 17	3	0	0	3
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- 45 to 64	1343	59	179	1581
- 65 to 74	1272	26	385	1683
- 75 and over	2289	27	947	3263
- Unknown	0	0	1	1
Sex				
- Female	1873	37	620	2530
- Male	3087	96	912	4095
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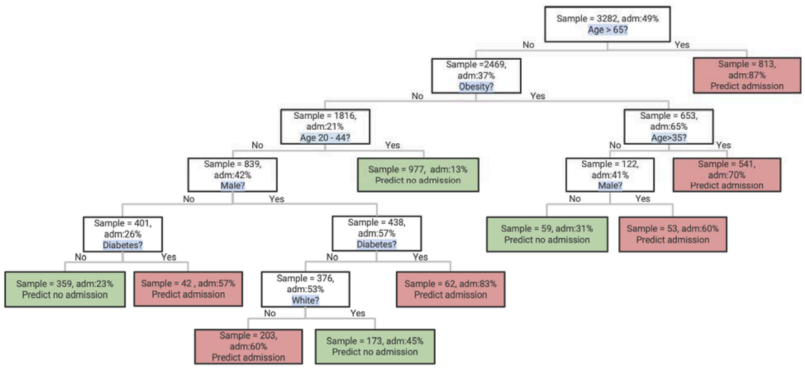
Borough				
- Bronx	1431	18	135	1584
- Brooklyn	1342	50	562	1954
- Manhattan	533	18	220	771
- Queens	1592	46	541	2179
- Staten Island	250	5	94	349
- Unknown	3	0	0	3
Total	5151	137	1552	6840

We may also be able to pre-identify those people under 50 or 60 most likely to get hospitalized. For example, this non-peer reviewed paper suggests a decision tree that may impact who may be asked to stay home to protect themselves during surge lock downs (TL;DR diabetes and age are example important factors).

Figure2A: Maximum likelihood classification tree for hospitalization



Focusing on keeping people with comorbidities home, and safe, during periods of epidemic surges may be a way to decrease hospitalizations of young people as surges occur.

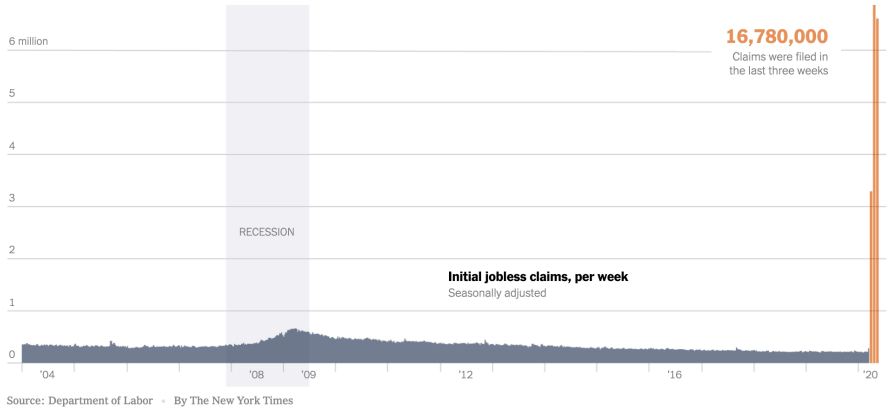
Vaccines and the economy - can we wait?

The reality of our current situation is that we need to get to somewhere between 30-70% of the population with immunity to COVID-19 before the disease stops spreading. This can be accomplished either via a vaccine, or through people getting infected.

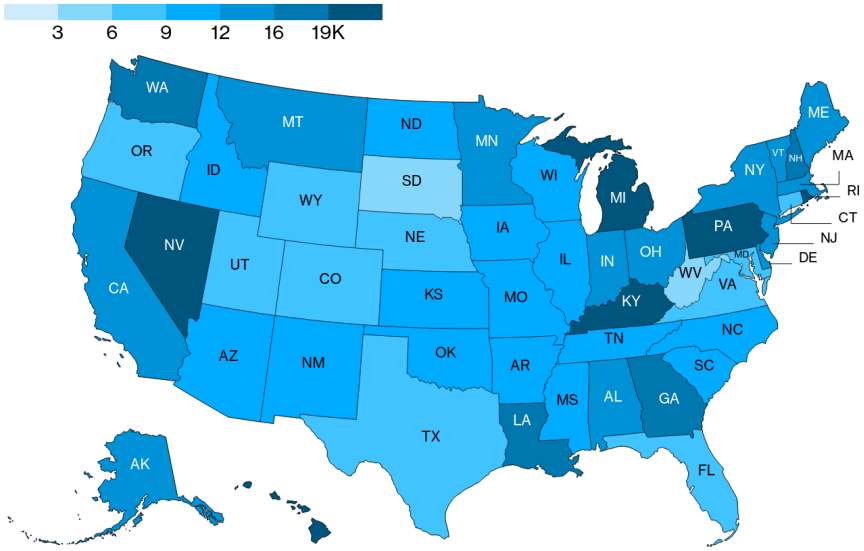
Unfortunately a vaccine may take many years to develop. While many people speak of a “very best case scenario” of 12-18 months to a vaccine, in reality **the fastest modern production of a vaccine took about 5 years (for Ebola)**. The base case for society is that we are many years away from a vaccine and should not plan around one. It would be great to be pleasantly surprised. This means building immunity in the population is paramount. In parallel, the US economy is being devastated by the COVID-related closure.

Despite massive federal stimulus, economic indicators are negative due to the blunt instrument, societal shut downs associated with our current COVID-19 public health policy in the US. The economic shock to the system via large scale shut downs have only just started to cascade in the economy. Unfortunately, it is often the most vulnerable and marginalized in our society who suffer most in economic down turns.

NYTimes jobless claims. Economists estimate 20-30% of the US population will be unemployed.



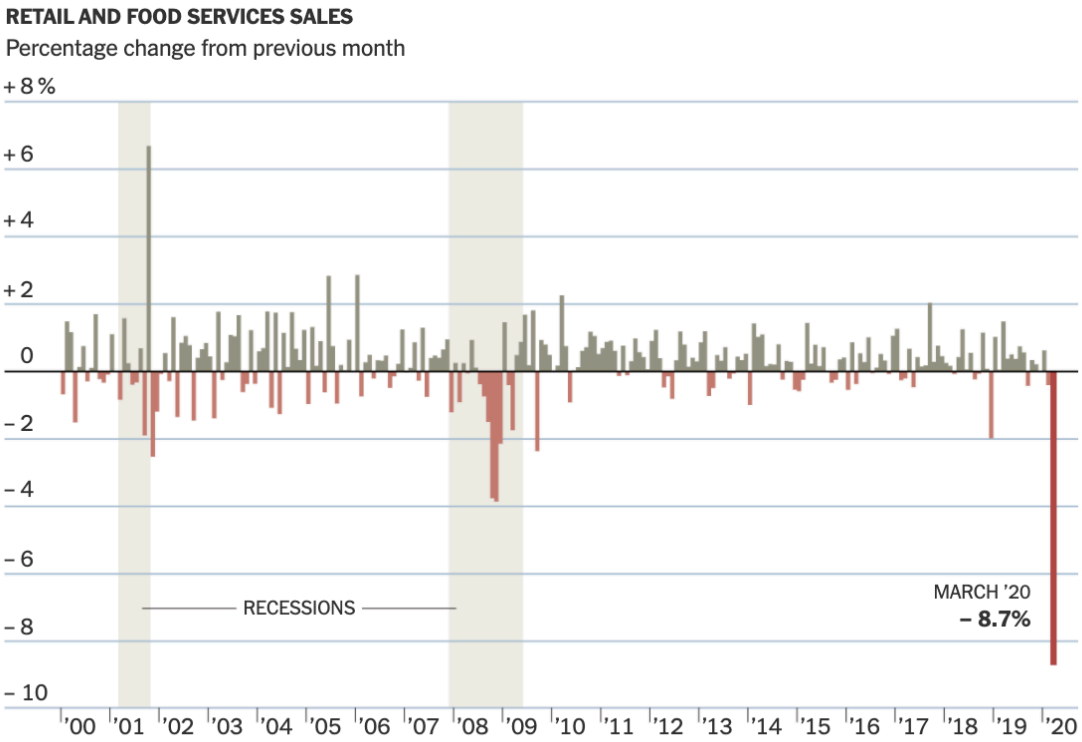
Covid-19 Takes a Toll on Labor
Jobless claims per 100K of workforce since March 15



Source: U.S. Department of Labor; U.S. Bureau of Labor Statistics
Note: Data as of April 16th

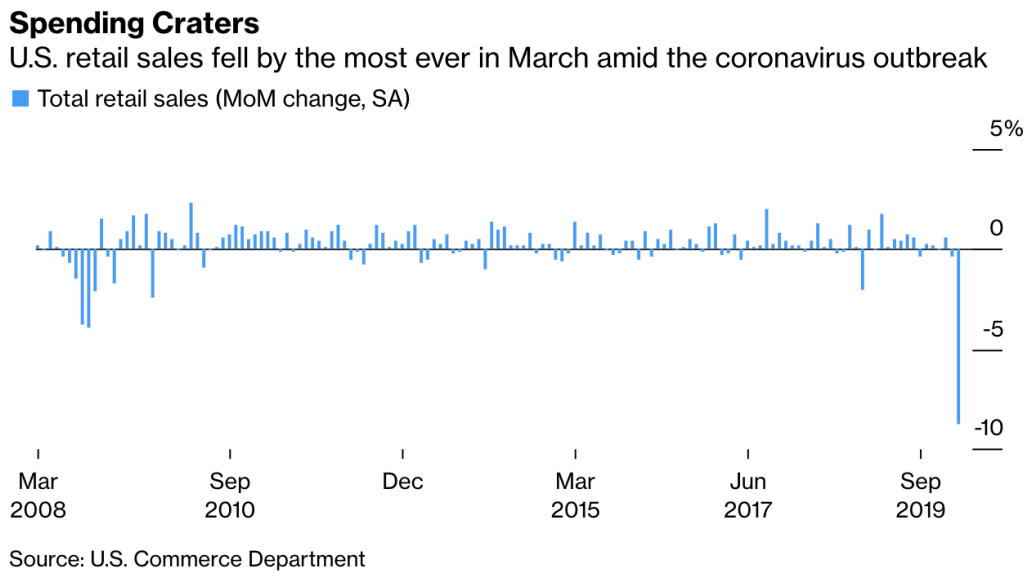
Bloomberg

Retail and food sales plummeting

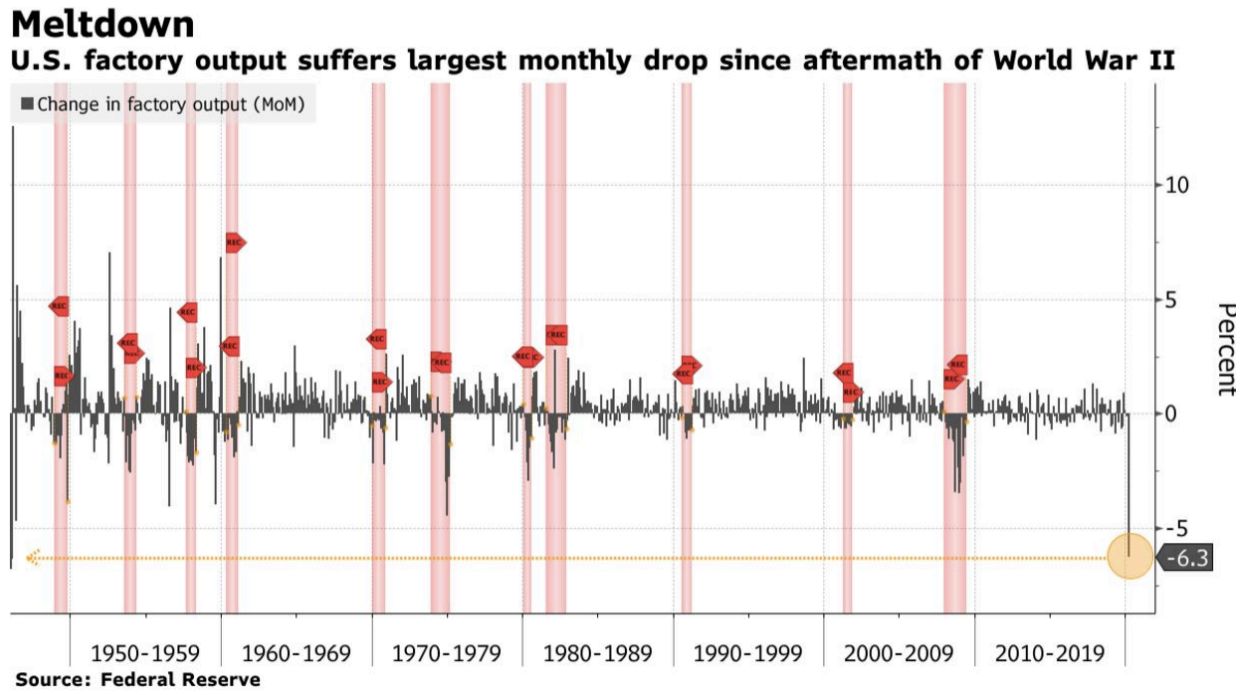


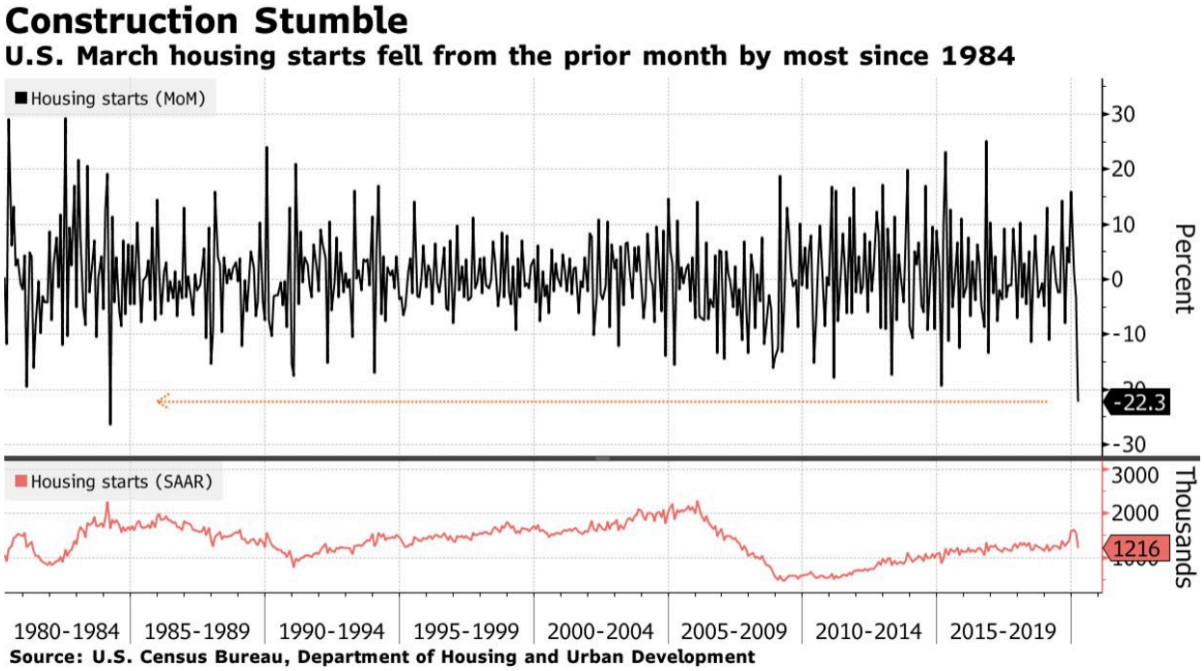
Note: Seasonally adjusted • Source: U.S. Department of Commerce • By The New York Times

Retail spending has plunged:



And factory output drop is largest since WW2





Restaurants and in a nuclear winter with shut down. [OpenTable data for restaurants].

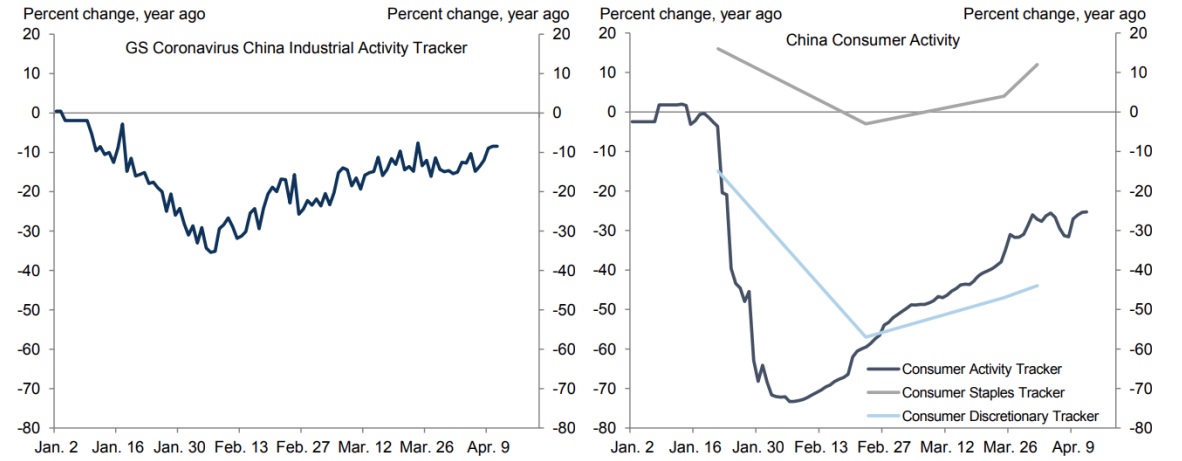
Name	4/12	4/11	4/10	4/09	4/08	4/07	4/06	4/05	4/04	4/03	4/02	4/01	3/31	3/30	3/29	3/28	3/27	3/26	3/25	3/24
Global	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Australia	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Canada	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Germany	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Ireland	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Mexico	-100%	-100%	-100%	-100%	-100%	-100%	-99%	-100%	-99%	-100%	-100%	-99%	-99%	-98%	-99%	-97%	-97%	-97%	-97%	-96%
United Kingdom	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
United States	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%

Hospital systems are losing large amounts of money due to a lack of elective procedures. [Revenue at many non-profit hospitals has fallen 50%] or more in the last few weeks.

Cities and municipalities are heading towards large [budget deficits] due to drop in tax receipts.

China is an interesting early indicator for what the US may see. So far Chinese industrial output is still down ~10%, and consumer demand is down ~30%. China is still not entirely out of shutdowns or social approaches, and if a second or third (or fourth?) wave comes back one can expect more lock downs.

Exhibit 8: Industrial Activity in China Is Closer to Recovering than Consumer Activity



Source: Goldman Sachs Global Investment Research

Re-Opening Society

The reality is that the best case scenario for a vaccine is 12-18 months away, with the likely base case being many years. **The fastest moden vaccine development was about 5 years for Ebola in 2014.** As such, society should hope for the best (there will be a vaccine at some point) but plan for the base case (a vaccine may take many years and should not be counted as the default case soon unless new data suggests otherwise). As J.R.R. Tolkien once wrote "False hopes are more dangerous than fears".

We are facing an economic crisis that will hurt those vulnerable and marginalized in our society most. Our city and state budgets are facing large shortfalls due to COVID-19 shutdowns, which means it will be harder for them to provide social services to the poor and disadvantaged. Our hospital systems are losing revenue and starting to struggle. Tens of millions of Americans are soon to be jobless and in many cases without health insurance. Once this first wave passes, we need a way to keep at least a large portion of our society open so that we can maintain basic services, and preserve the well being and health of our society and population.

It makes sense for society to reopen in a thoughtful, cautious, step-wise manner. Based on the data above, people in their 50s or below have a low morbidity rate associated with COVID-19. Once society re-opens we may, as a thought experiment, consider keeping it permanently re-opened for healthy people under 50 (barring unexpected surges elsewhere). This could be done post a controlled repoening with other initiatives in place to protect those most at risk for COVID-19 severe illness or death.

Below is a potential rough draft on how to approach this. The proposal is incomplete and is not meant to be definitive. Rather, it is meant to spark rational, data driven conversation. The goal is to get to a solution that protects the most vulnerable in our society, while also restarting society

and the economy. Deep recessions hurt the poor and marginalized in society most as people lose not only their jobs, but may lose healthcare and other services.

1. **Anyone under the age of 50 who does not live with anyone above that age, and lacks comorbidities, is no longer subject to any future quarantines once society reopens slowly**. Anyone age 50 who lives with someone older and violates a quarantine is subject to large fines.
    a. For the US 213MM (64%) are under age 50, out of 331M total. This means a large proportion of the population can get back to work. Importantly, this group can also build herd immunity in parallel. We could optionally also include anyone 50-65 without comorbidities but this would merit more analysis.
    b. Anyone with a serious comorbidity (diabetes, immune compromised, etc) would be asked to stay home during lock down disease surge periods. There is a recently published (non-peer reviewed) decision tree that may suggest simple web tools or phone apps that would allow a person to know if it is risky for them to get sick / go out.
    c. This age range can be moved up over time. For example, if things look stable with over 50, people aged 50-60 and then 60-65 etc. can be excluded from future quarantines as epidemic surges occur. Alternatively, this strategy could start with <60 as long as those with comorbidities are excluded.
2. **Anyone who tested positive for COVID-19 and recovers** (or later, who tests positive on antibody tests once they work) has a permanent "social distancing passport" in society irrespective of future lock downs.
3. **Make sure sufficient surge capacity exists in hospitals.**
    a. While fewer people under 50 go to the ICU per capita, somewhere around 10-15% may need hospitalization for oxygen to be administered or other therapies. Surge capacity should be planned for this loosening in society.
    b. In NYC 29,740 people have been hospitalized from COVID-19, of which ~16% are 44 or younger. Collectively, people 65 and up have 17 times as many people per capita hospitalized then those under 65. This merits further analysis in terms of how much incremental surge capacity would be needed for this strategy.
4. **Protect the elderly.** The elderly are most vulnerable to COVID-19 and we should protect them as best we can. See details in "challenges" below.
    a. Special store hours for elderly only.
    b. Special access controls for elder care and nursing homes.
    c. Protect the elderly in hospitals.
5. **Isolate the young who catch COVID-19.** Provide options in hotels or other locations to prevent cross infection of the young and elderly who live in common households.
6. **The US will still need test, trace, isolate approaches,** antibody testing, and other initiatives to truly open up society for everyone for all time. However, once society opens back up it may be able to permanently re-open for a large subset of the population under age 50 while furthering these approaches in tandem for full population lockdown easement. Test trace isolate will need:

a. **Large scale COVID-19 testing.** Current testing is still at lower levels then is needed.
b. **Tooling to allow for contact tracing and isolation.** Software may help healthcare workers to trace contacts and remind people under quarantine to stay home. Google and Apple also announced a mobile initiative that may help with this.
c. **Fines of other regulations**. If people violate quarantine, there needs to be a mechanism to fine or otherwise encourage people to stay home.
d. It would be interesting to consider an approach where all test capacity goes to protecting the vulnerable. Today, healthy people under a certain age are not being tested at scale if they have COVID symptoms (for example any out patient in NY or LA). While it is much better to test everyone, perhaps test capacity should be focused in the short run exclusively on protecting the vulnerable - for example should healthcare workers and elder care workers get tested 2-3X per week instead of testing everyone if tests are lacking? This might allow us to reopen sooner as we would not need to treat everyone of every age and health status the same. Instead we could focus care and protection on those most likely to suffer.

7. The above approach will **build herd immunity** starting in under 50s and anyone who is infected and recovers. In parallel, emphasis will be placed on protecting the elderly and vulnerable.

Challenges to this approach

There are numerous challenges to this approach. The idea is to start to build herd immunity, get much of the country back to work, while also building out test, trace, isolate and other tools to manage the entire population. No matter what the strategy it is best to ease into it to ensure it is working.

Some challenges include (and there are undoubtedly many others not listed here):

1. **Properly protecting the elderly and vulnerable.** One of the challenges to this approach is that particularly in elder care facilities and hospitals, it is largely younger people taking care of the elderly.
    a. **Elder care facilities.** A focus on nursing homes is crucial given the spread of COVID-19 within them to date.
        i. Optimally elder care facility staff should be tested for COVID-19 on a daily or weekly basis until they have had the disease and are immune. Random testing of people in nursing homes ongoing could also create an early warning system to identify and stop localized out breaks.
        ii. PPE and other protective great should be widely available.
        iii. Serology tests could also be rolled out once they exist.
        iv. Alternatively (or in addition), care facility staff could be paid a bonus by the government for staying COVID-free and allowing the GPS trace of their phone to be used to show they are staying at home and work.

Alternatively, a subset of the staff could be put on paid leave while qualified people displaced by the epidemic who have had COVID and recovered/immune can temporarily fill a subset of roles.

b. **Grocery stores.** Stores should have special hours during which only people over a certain age can go.
c. **Hospitals**. Inter-hospital transmission ("nosocomial transmission" is the fancy term) is always a concern in an epidemic. It will be important to maintain non-COVID floors in hospitals or even if possible open COVID-specific care facilities to isolate sick people from the elderly who are in the hospital for other reasons.
d. **Isolation housing for sick young people**. For sick people who live with people above a certain age, hotel rooms or other temporary living facilities can be provided during the course of their illness.

2. **Issues with those 50+.** The idea is *not* to have an ongoing divide between people above 50 and those below, but rather to only do surge-based lockdowns for those over 50 (and then later 55, 60, 65 etc.) as herd immunity builds. However, there may be circumstances where over 50+ immediately need to be in the workforce or economy for example:
    a. **Having an essential services job.** You could allow anyone without a co-mrobidity between 50 and 65 to rejoin society in the same manner.
    b. Teaching at a school or facility with young people. Schools are crucial to the functioning of society:
        i. 40% of nurses in the USA have children in K-12. Shutting schools decrease healthcare worker capacity.
        ii. Grandparents are often roped in to help with care of children, decreasing their safety.
        iii. Schools are the biggest form of child care for society.
        iv. Schools are a major part of the economy and employ over 3 million people.
        v. For teachers age 50 and up, what is the best approach? Should their classes be paired over video with an in-class assistant teacher (paid for by the government to facilitate school opening)? Are there other ways to keep schools running while virtualizing those teachers at highest risk? Or do teachers get an optional exemption from ages 50-65 if they have no comorbidities?
3. **Should this actually be <60 or <65 instead of <50?**
    a. A number of proposals focus on 60. JP Morgan for the UK, where they suggest a similar strategy but using age 60 as a cutoff). Another proposal from Israel suggests 67 without comorbidities.
    b. In countries surveyed 70-80% of the population is under 60, but only 3-10% of the countries COVID-19 deaths are from people aged <60 (excluding China at 20%).

c. By including people between ages 50 and 60, who do not have comorbidities, you capture much of the remaining workforce. The % of total deaths represented 50-59 tends to be 3X deaths below 50. This tends to represent an incremental 1.5-10% of total COVID deaths. However, 90%+ of these deaths are people with comorbidities. Removing the comborbid population from consideration decreases the impact of including ages 50-60 significantly.
d. Notably, be including anyone under 60 you capture roughly 85%+ of the workforce (See table below).

4. **You still need to develop test, trace, isolate and other tools for the at-risk populations and to control spread in <50.** As mentioned above, to robustly re-open society we need test/trace/isolate, sufficient surge capacity in hospitals, PPE and protective equipment for healthcare workers, and other capacity to be built out. The approach mentioned is not a stand-alone panacea and requires other additional infrastructure and approaches. However, it may be a solution for a large subset of the population once the country reopens.
5. **Lots of other challenges.** There are undoubtedly lots of other challenges to this approach that are not explored here.

Employed Persons by Age in the United States (2019)

Age group	Employed Persons (000's)	% of Empl. Persons in Age Group
16 to 19 years	5,150	3.3%
20 to 24 years	14,172	9.0%
25 to 34 years	35,807	22.7%
35 to 44 years	33,127	21.0%
45 to 54 years	32,042	20.3%
55 to 64 years	26,893	17.1%
65+ years	10,347	6.6%
Total, 16+ years	157,538	100.0%

Source *https://www.bls.gov/cps/demographics.htm*

The goal of the above approach is to to protect the people who are at risk, to re-open society economically, and to start to build herd immunity so all of society can go back to functioning as it once did.

The smaller proportion of deaths in COVID-19 patients under the age of 50 suggests a potential path forward to permanently re-open a large productive subset of society. This post was meant to spur additional thinking, analysis, and discussion of this and related approaches. It is quite possible this is the wrong approach. However, data-driven logical conversations around this and other ideas may yield insights that will allow us to keep open, once we slowly re-open.

NOTES:

1. A colleague pointed out a similar analysis done by JP Morgan for the UK, where they suggest a similar strategy but using age 60 as a cutoff). Another proposal from Israel suggests 67 without comorbidities as the cutoff.

2. Written by Elad Gil. Many thanks to Shin Kim for help with data aggregation and analysis.