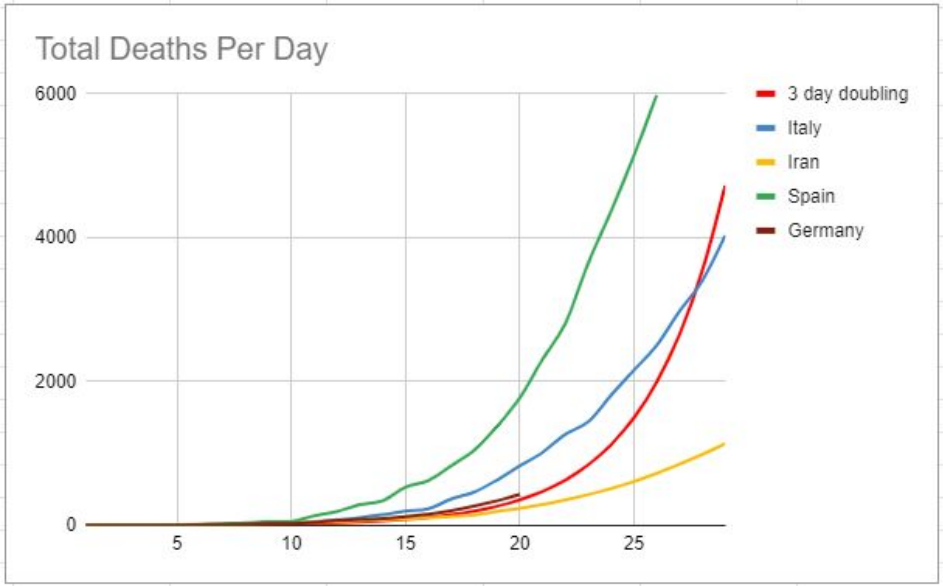
Covid Regional Planning

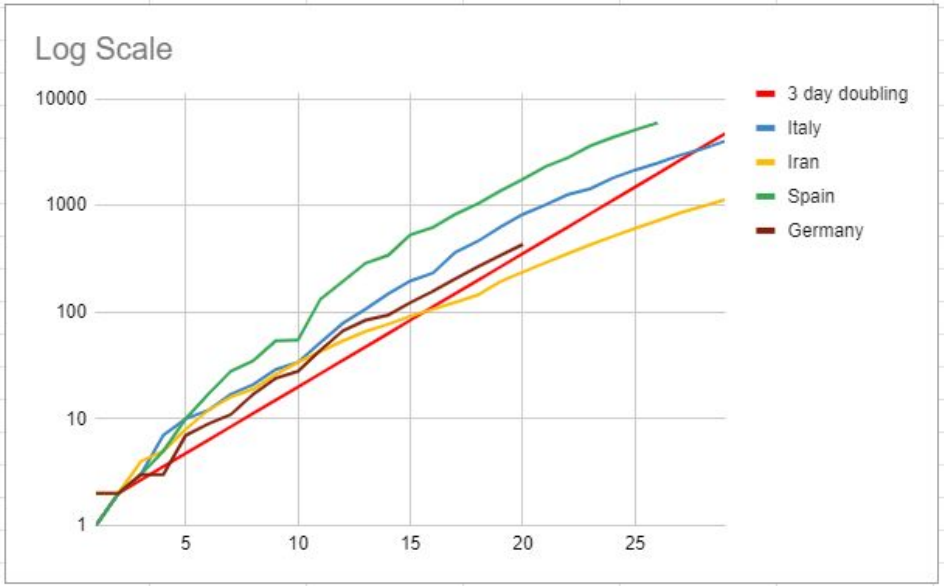
Using Death Rate Tracking to Plan Medical Capacity

Created by W. Ridgway
3/30/2020

Death Rate Doubling

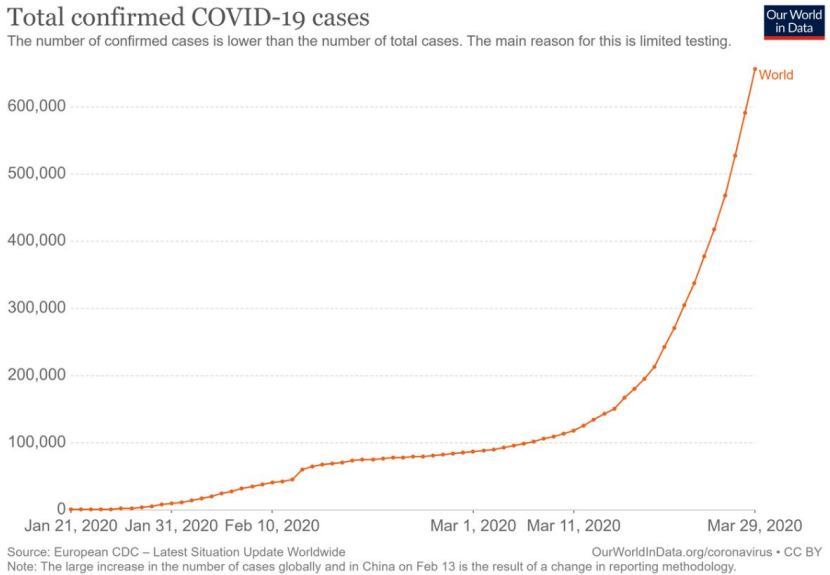
With no lockdown in place, Covid has a predictable 3-day doubling behavior to the total number of deaths:

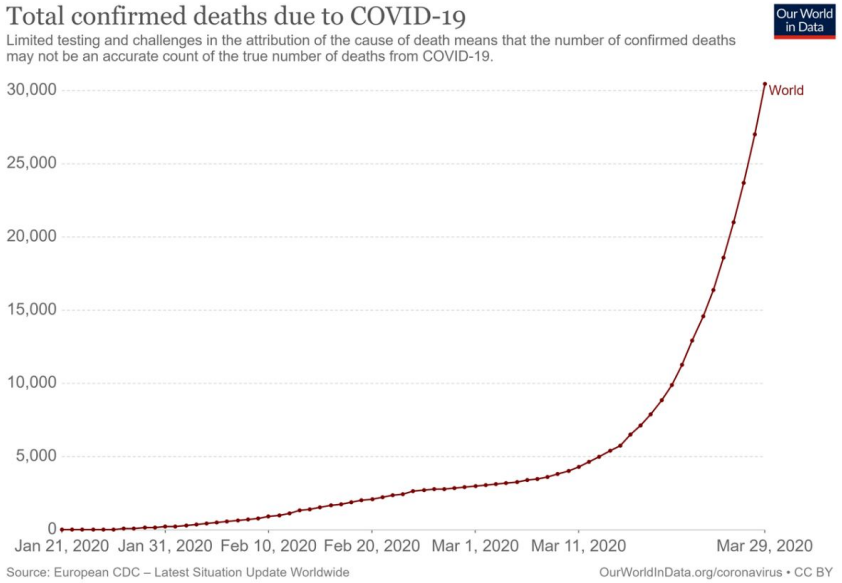




Infection Doubling: 3 days

If the rate of deaths is doubling in three days, the rate of infection is doubling in three days. This can be seen with the curvature of both graphs:





Tracking Death Totals

Early testing of a few thousand can possibly be done with some accuracy, but once 10’s or 100’s of thousands are infected, this can no longer be accurately measured on a daily basis.

However, daily death totals very accurately tracked, and used to forecast.

Death Totals - The Trailing Indicator

Anyone who died today was likely infected ~14 days ago.

If the mortality rate is 0.6%, that means 1 / 0.6% or 167 people were infected 14 days ago.

That number has doubled 4-5 times in 14 days (three day doubling) so every death today represents 5,300 people who are newly infected today.

Of those 5,300 people 0.6% (32 people) will die in the next 14 days.

For every person that dies, 3x or more are hospitalized (96 people, data from Italy). Use the ratio experienced by your community for local projections.

Flattening the Curve

Three day doubling is unsustainable for any medical capacity.

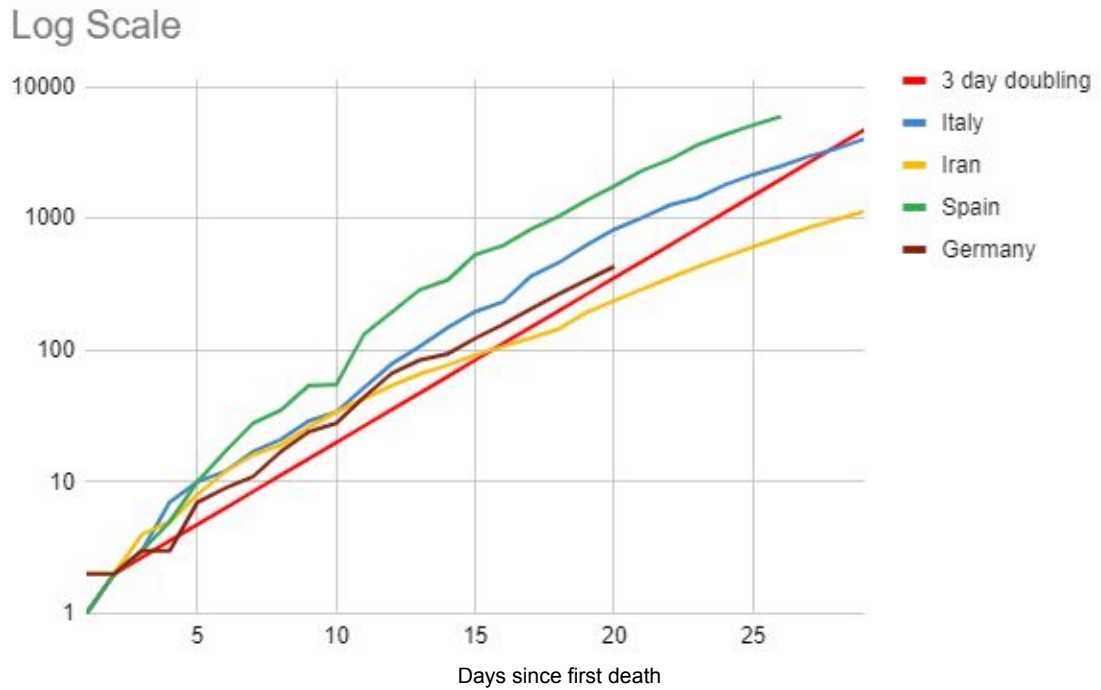
The rate of doubling must be extended with social isolation practices.

Assume the average Covid hospital stay is 14 days. Monitoring the daily death total will reveal one of two situations:

1. If the death total rate of doubling is 14 days or more: hospital needs are going down in the future
2. If the death total rate of doubling is 14 days or less: hospital needs are going up in the future

Case Study: Italy

Italy began worse than 3 day doubling for total death rate:



Above the red line on a logarithmic scale means its worse than the 3-day doubling baseline

Case Study: Italy

Once a lockdown was started, there was no benefit for 14 days:

Italy Case Study

Date	2/21/2020	2/22/2020	2/23/2020	2/24/2020	2/25/2020	2/26/2020	2/27/2020	2/28/2020	2/29/2020	3/1/2020	3/2/2020	3/3/2020	3/4/2020	3/5/2020	3/6/2020	3/7/2020	3/8/2020	3/9/2020	3/10/2020	3/11/2020	3/12/2020	3/13/2020	3/14/2020	3/15/2020	3/16/2020	3/17/2020	3/18/2020	3/19/2020	3/20/2020	3/21/202
Total Deaths (Actual)	1	2	3	7	10	12	17	21	29	34	52	79	107	148	197	233	366	463	631	827	1,016	1,266	1,441	1,809	2,158	2,503	2,978	3,405	4,032	4,82
New Deaths	1	1	1	4	3	2	5	4	8	5	18	27	28	41	49	36	133	97	168	196	189	250	175	368	349	345	475	427	627	79
Three-day Doubling	1	2	3	4	5	6	8	11	15	20	27	36	47	63	84	112	150	200	266	355	473	631	841	1,121	1,495	1,993	2,658	3,544	4,725	6,30

Lockdown

First downturn in death totals

3/7/2020	3/8/2020	3/9/2020	3/10/2020	3/11/2020	3/12/2020	3/13/2020	3/14/2020	3/15/2020	3/16/2020	3/17/2020	3/18/2020	3/19/2020	3/20/2020
233	366	463	631	827	1,016	1,266	1,441	1,809	2,158	2,503	2,978	3,405	4,032
36	133	97	168	196	189	250	175	368	349	345	475	427	627
112	150	200	266	355	473	631	841	1,121	1,495	1,993	2,658	3,544	4,725

Updated

Case Study: Italy

We can now review the effect of Italy's lockdown, which appears to be a steadily increasing in doubling rate starting at 14 days after the lockdown:

Date	3/15/2020	3/16/2020	3/17/2020	3/18/2020	3/19/2020	3/20/2020	3/21/2020	3/22/2020	3/23/2020	3/24/2020	3/25/2020	3/26/2020	3/27/2020	3/28/2020	3/29/2020	3/30/2020
Total Deaths (Actual)	1,809	2,158	2,503	2,978	3,405	4,032	4,825	5,476	6,077	6,820	7,503	8,215	9,134	10,023	10,779	11,591
New Deaths	368	349	345	475	427	627	793	651	601	743	683	712	919	889	756	812
Three-day Doubling	1,121	1,495	1,993	2,658	3,544	4,725	6,300	8,399	11,199	14,932	19,910	26,547	35,395	47,194	62,925	83,900
Days to Double	3.9	5.2	6.3	5.3	7.0	5.4	5.1	7.4	9.1	8.2	10.0	10.5	8.9	10.3	13.3	13.3

Updated

Case Study: Italy - Forecasting

If we reach 14 days to double, then the newly infected population is decreasing.

Date	3/19/2020	3/20/2020	3/21/2020	3/22/2020	3/23/2020	3/24/2020	3/25/2020	3/26/2020	3/27/2020	3/28/2020	3/29/2020	3/30/2020	3/31/2020	4/1/2020	4/2/2020	4/3/2020	4/4/2020	4/5/2020	4/6/2020
Total Deaths (Actual)	3,405	4,032	4,825	5,476	6,077	6,820	7,503	8,215	9,134	10,023	10,779	11,591							
New Deaths	427	627	793	651	601	743	683	712	919	889	756	812							
Three-day Doubling	3,544	4,725	6,300	8,399	11,199	14,932	19,910	26,547	35,395	47,194	62,925	83,900							
Days to Double	7.0	5.4	5.1	7.4	9.1	8.2	10.0	10.5	8.9	10.3	13.3	13.3	14.0	16.0	18.0	22.0	26.0	32.0	64.0
Expected Death Total	3,405	4,032	4,825	5,476	6,077	6,820	7,503	8,215	9,134	10,023	10,779	11,591	12,419	13,195	13,928	14,561	15,121	15,594	15,838
New Deaths	427	627	793	651	601	743	683	712	919	889	756	812	828	776	733	633	560	473	244

In the above forecast model (yellow) we assume Italy continues its lockdown, so this lengthening of the days-to-double trend will continue to increase.

We could likewise use this model to forecast loosening isolation practices, but that effect would also lag 14 days behind the commencement of the policy change.

Updated

Case Study: Italy - ICU Vs. Admissions

Italy reported that 229 patients needed ICU out of 1263 admitted (18%).

We can use that data to roughly estimate how many people may soon need to be admitted. These numbers are cumulative day over day.

Date	3/19/2020	3/20/2020	3/21/2020	3/22/2020	3/23/2020	3/24/2020	3/25/2020	3/26/2020	3/27/2020	3/28/2020	3/29/2020	3/30/2020	3/31/2020	4/1/2020	4/2/2020	4/3/2020	4/4/2020	4/5/2020	4/6/2020
Total Deaths (Actual)	3,405	4,032	4,825	5,476	6,077	6,820	7,503	8,215	9,134	10,023	10,779	11,591							
New Deaths	427	627	793	651	601	743	683	712	919	889	756	812							
Three-day Doubling	3,544	4,725	6,300	8,399	11,199	14,932	19,910	26,547	35,395	47,194	62,925	83,900							
Days to Double	7.0	5.4	5.1	7.4	9.1	8.2	10.0	10.5	8.9	10.3	13.3	13.3	14.0	16.0	18.0	22.0	26.0	32.0	64.0
Expected Death Total	3,405	4,032	4,825	5,476	6,077	6,820	7,503	8,215	9,134	10,023	10,779	11,591	12,419	13,195	13,928	14,561	15,121	15,594	15,838
New Deaths	427	627	793	651	601	743	683	712	919	889	756	812	828	776	733	633	560	473	244
Needing ICU	854	1,254	1,586	1,302	1,202	1,486	1,366	1,424	1,838	1,778	1,512	1,624	1,656	1,552	1,466	1,266	1,120	945	487
Needing Hosptial Care	4,744	6,967	8,811	7,233	6,678	8,256	7,589	7,911	10,211	9,878	8,400	9,022	9,199	8,624	8,145	7,034	6,223	5,250	2,707

Assumes 50% of ICU patients die.

Updated

Case Study: Italy

Analysis:

Italy has almost met the 14 day-to-double goal and should be on a significant downward trend.

Future needs of hospital care and ICU should now begin lessen day over day, so long as social isolation practices remain in place.

Updated

Summary

Tracking the death-rate-doubling as demonstrated here can be an important tool in planning future medical needs in different social isolation levels.

It would be inadvisable for any community to have a doubling rate below 14 days. Medical facilities will eventually become overrun.

This tracking method does not require any widespread testing for Corona, making it instantly adoptable for any community.

Citations / References

- Death rate doubling graphs created from data sourced here: https://github.com/CSSEGISandData/COVID-19
- Hospital stay of 14 days taken from: https://www.astorsquare.com/covid
- Italian ratio of ICU to Admitted taken from: https://www.washingtonpost.com/world/europe/coronavirus-in-italy-fills-hospital-beds-and-turns-doctors-into-patients/2020/03/03/60a723a2-5c9e-11ea-ac50-18701e14e06d_story.html
- Mortality rate of ICU patients estimated from: https://www.physiciansweekly.com/mortality-rate-of-covid-19-patients-on-ventilators/
- Mortality rate of 0.6% derived from German actuals on 3/30/2020 (66,885 positive, 645 dead) divided in half based on Iceland's "50% of positive tested are non-symptomatic" here: https://www.covid.is/data

About Me

Wyeth Ridgway

I am a Computer Scientist have no background in Biology or the Medical professions. I do spend quite a bit of time processing and analyzing data.

These conclusions are largely based on findings from scientists doing the real work.

Feel free to email me with questions: WyethR@gmail.com