A **logistic function** or **logistic curve** is a common "S" shape (sigmoid curve), with equation:

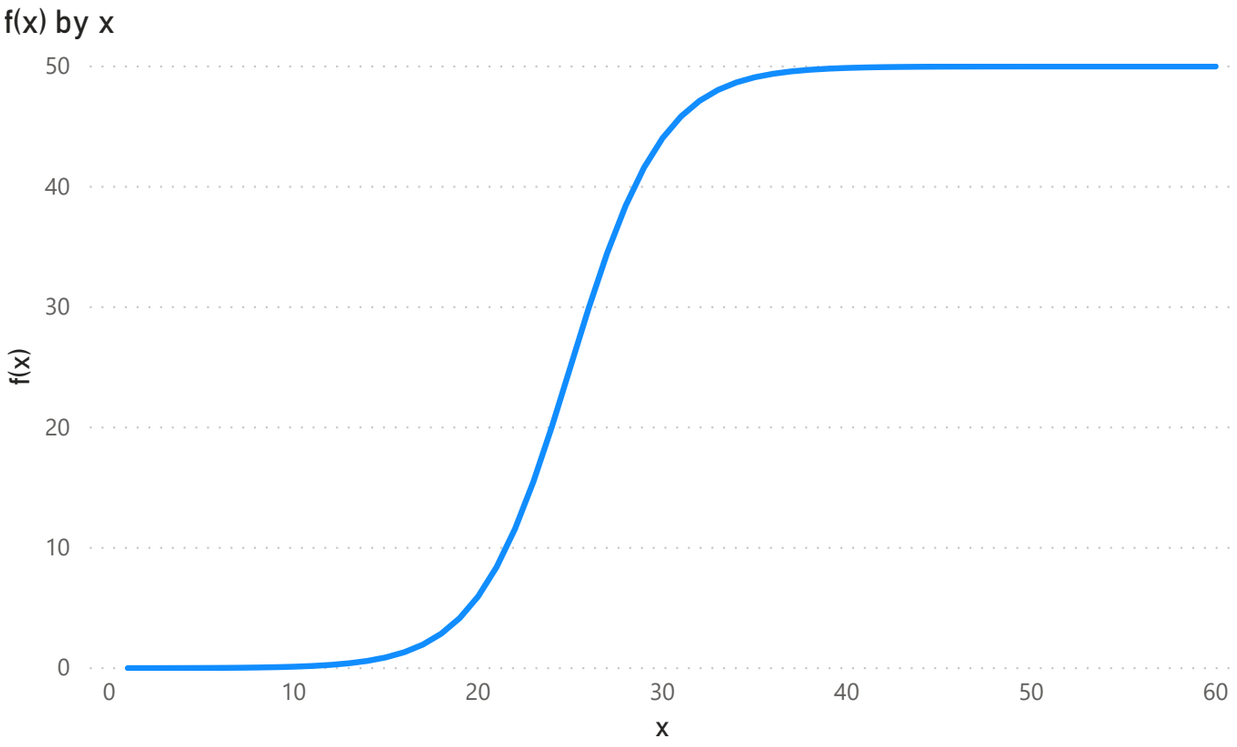
$$f(x) = \frac{L}{1 + e^{-k(x-x_0)}}$$

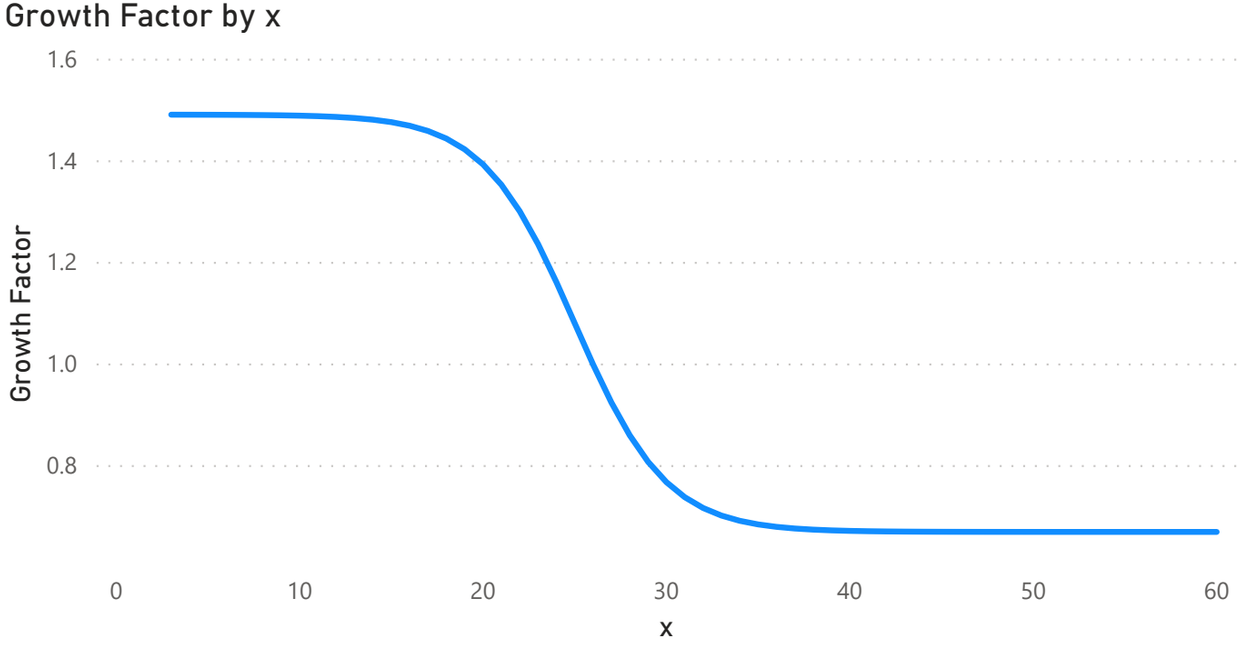
where

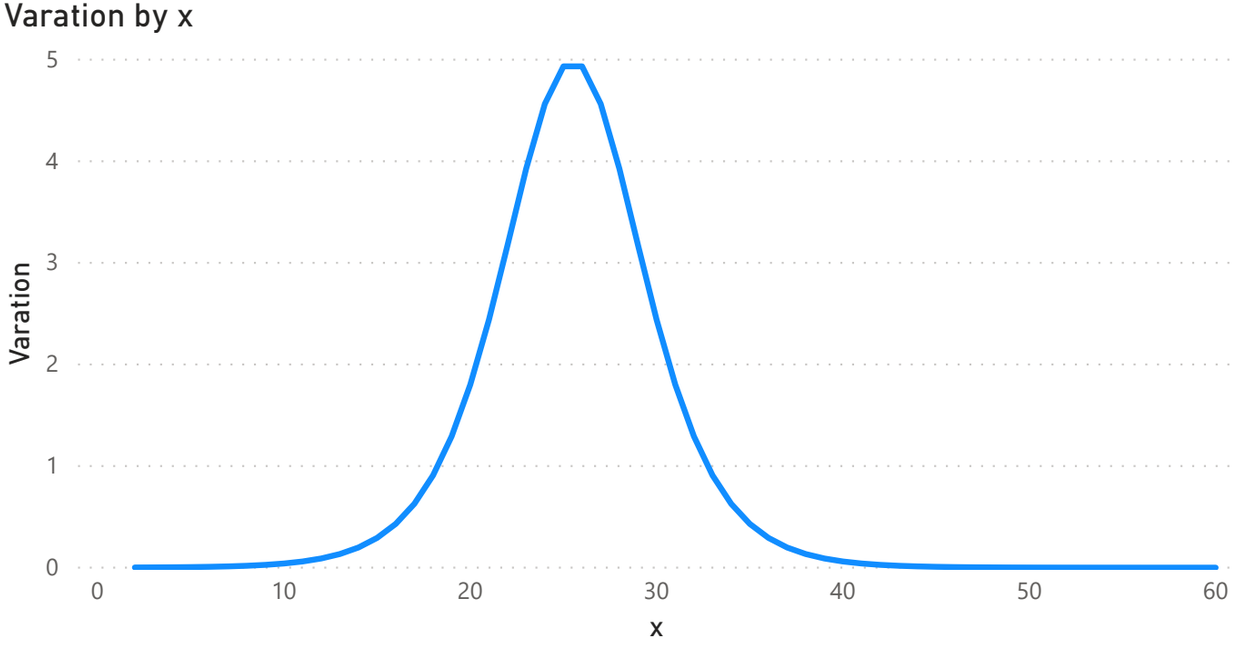
- e = the natural logarithm base (also known as Euler's number),
- x_0 = the x-value of the sigmoid's midpoint,
- L = the curve's maximum value, and
- k = the logistic growth rate or steepness of the curve.[1]

More information on wikipedia

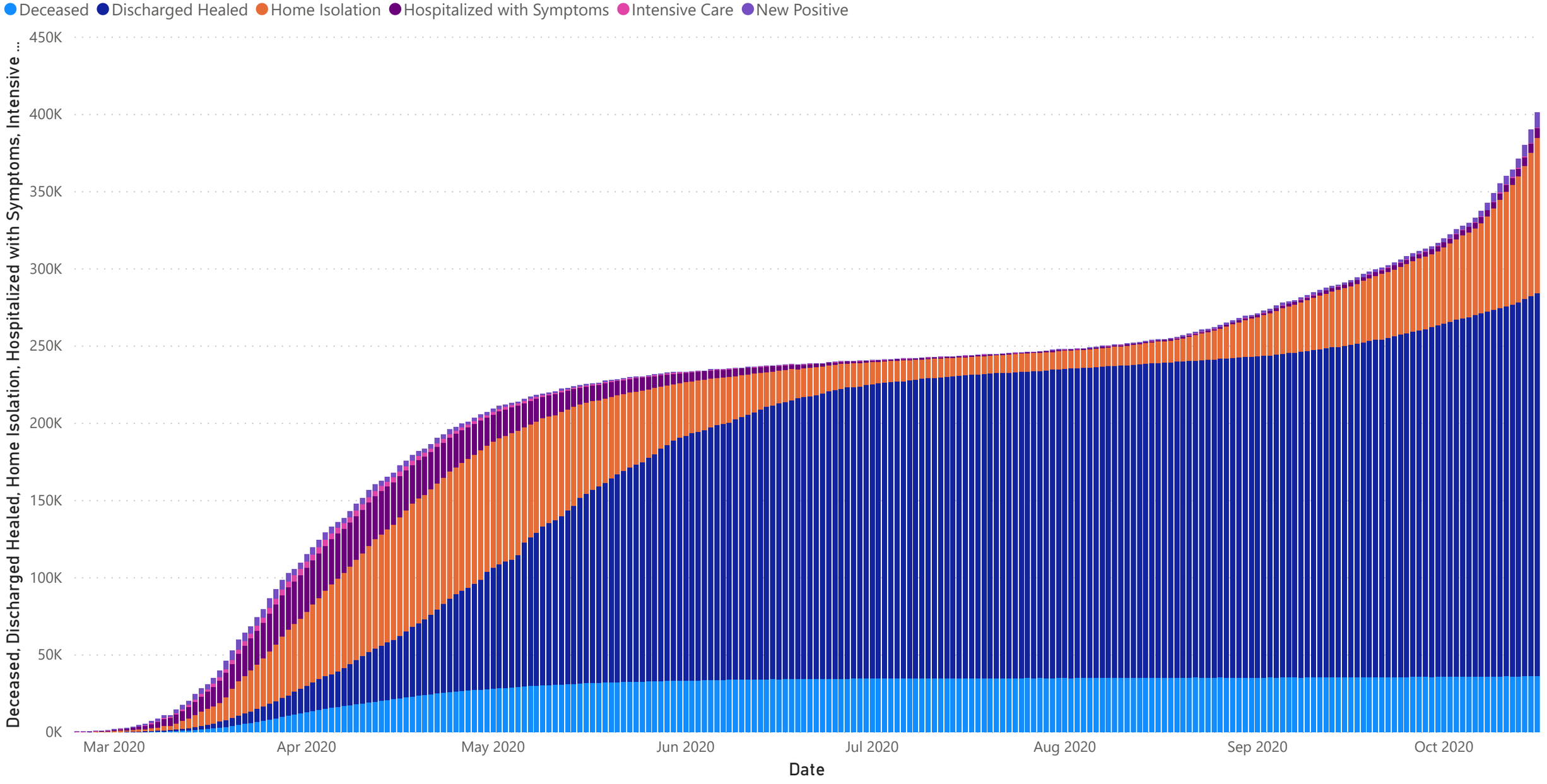
In this example we are using: L=50, k=0.4, x0=25



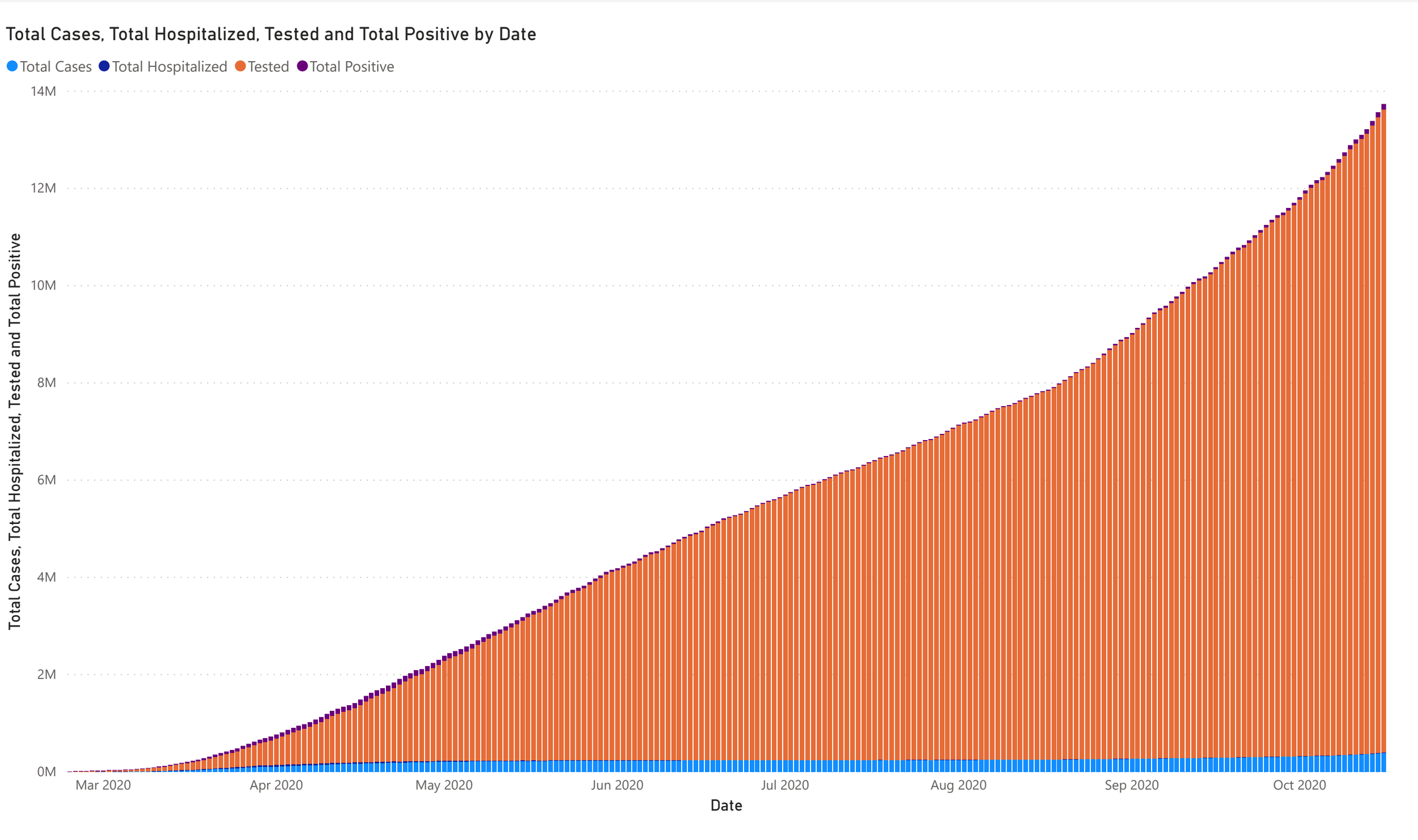




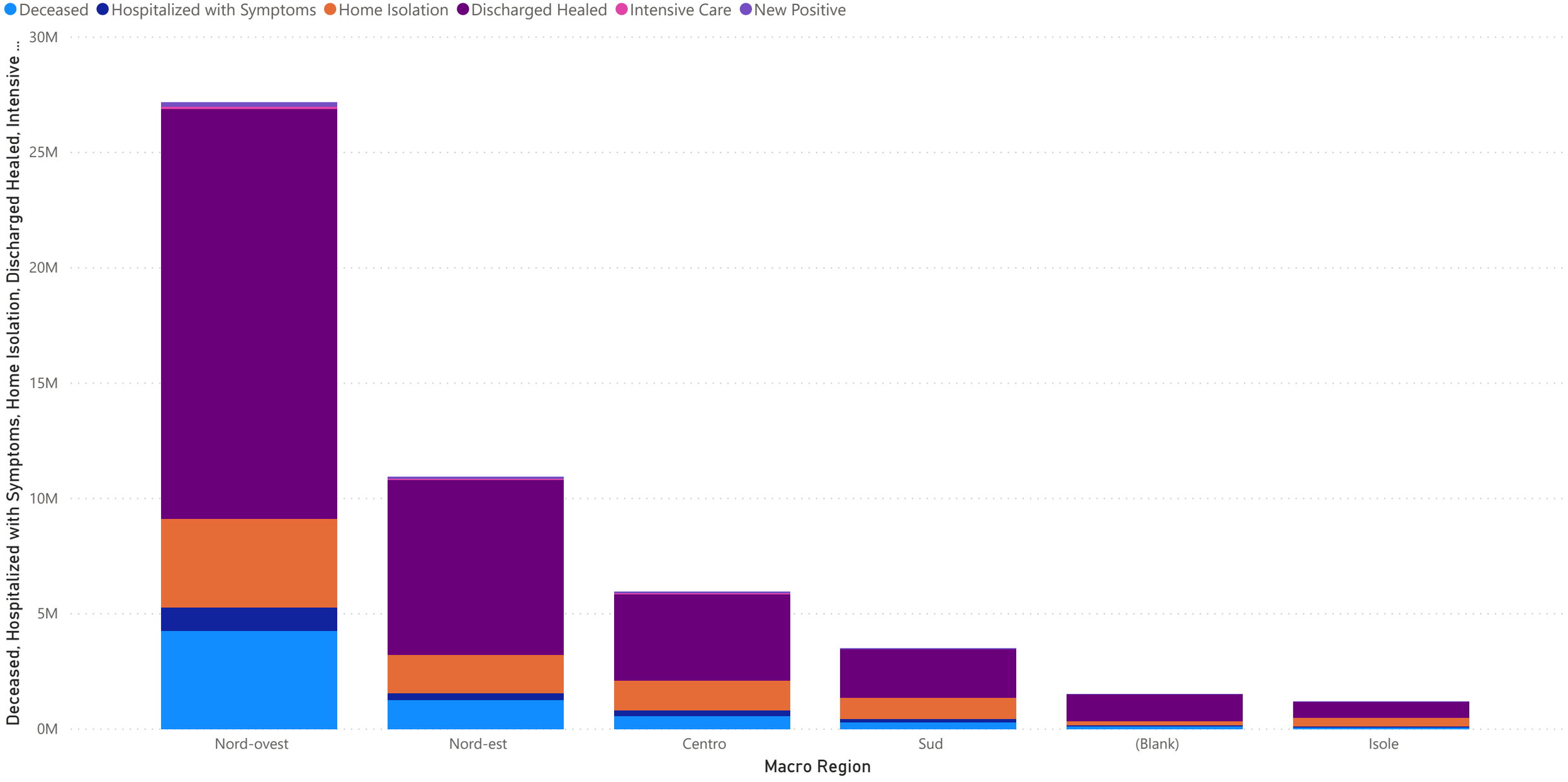
Deceased, Discharged Healed, Home Isolation, Hospitalized with Symptoms, Intensive Care and New Positive by Date



Data from [Protezione Civile]

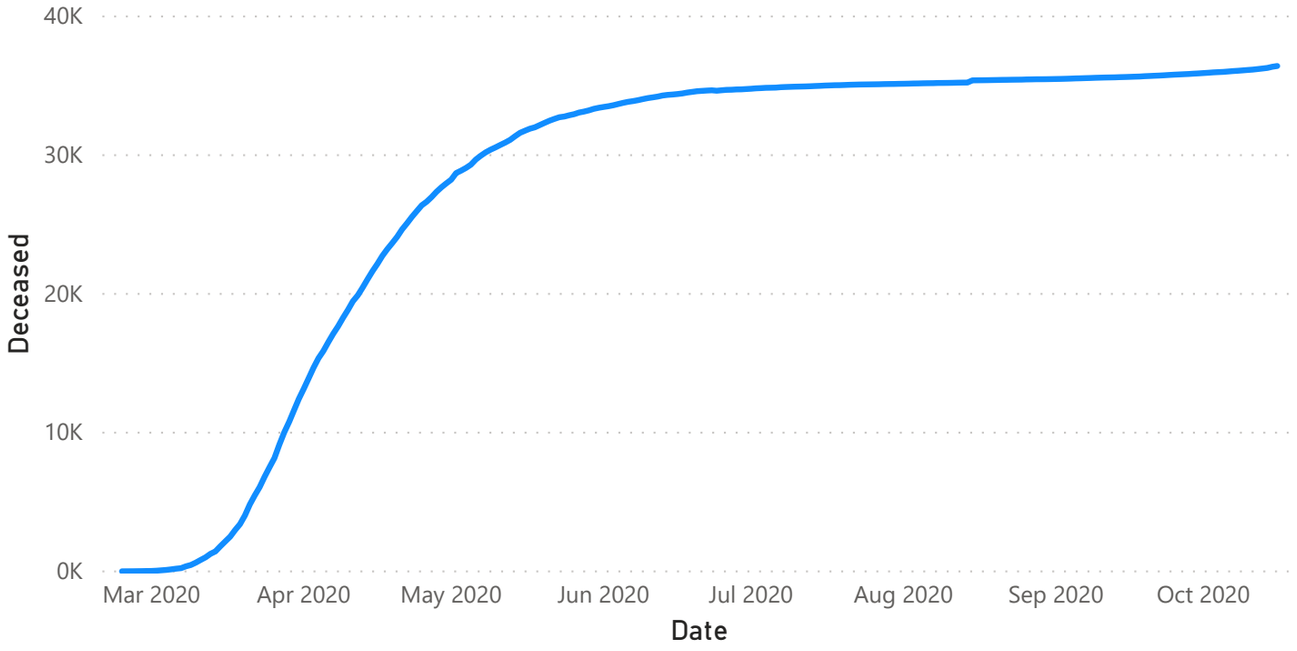

Total Cases, Total Hospitalized, Tested and Total Positive by Date
Total Cases
Total Hospitalized
Tested
Total Positive
14M
12M
10M
8M
6M
4M
2M
0M
Total Cases, Total Hospitalized, Tested and Total Positive
Mar 2020
Apr 2020
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Date

Deceased, Hospitalized with Symptoms, Home Isolation, Discharged Healed, Intensive Care and New Positive by Macro Region

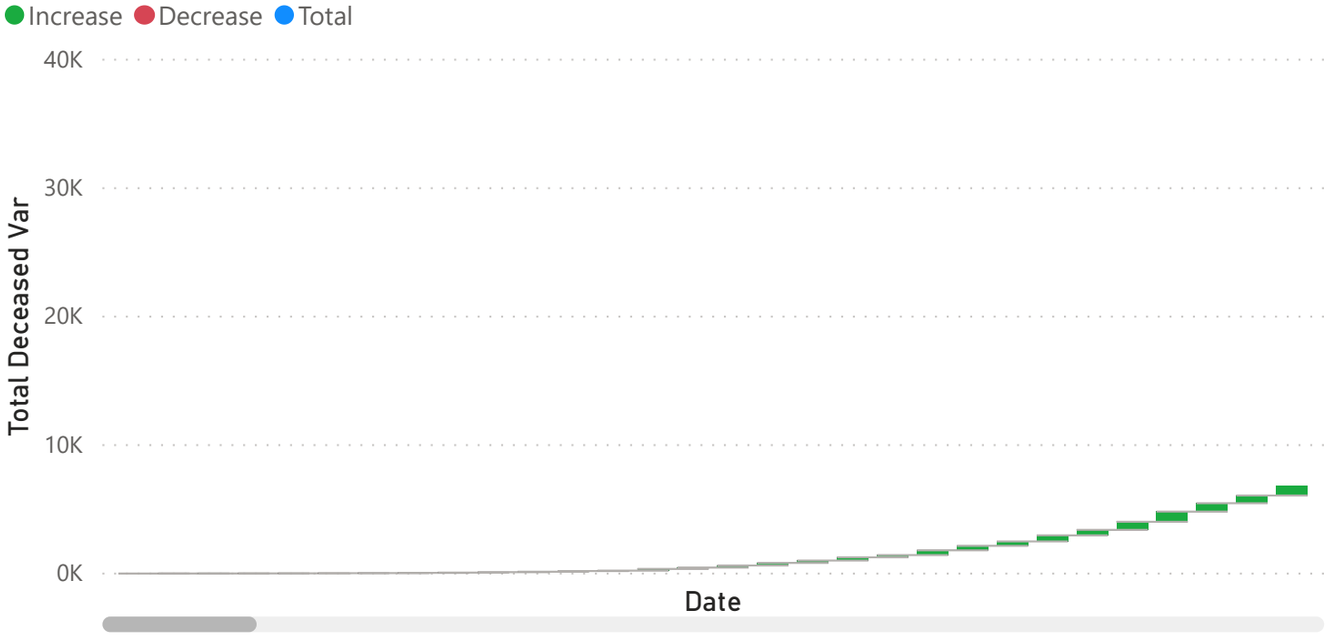


The virus started spreading in North Italia especially in Lombardia

Deceased by Date



Total Deceased Var by Date

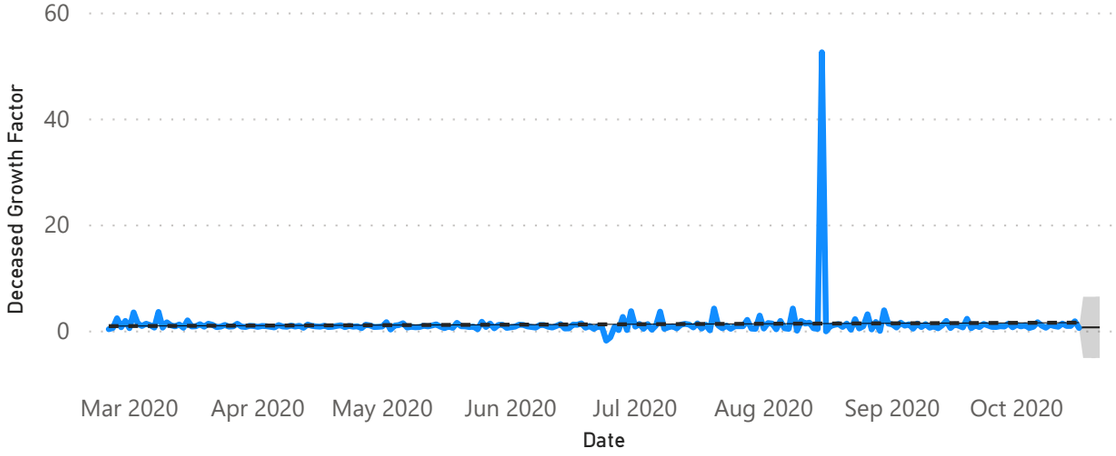


Because it is not possible to test all the population everyday to get the real number of infected people let's consider the number of deaths as starting point for our analysis

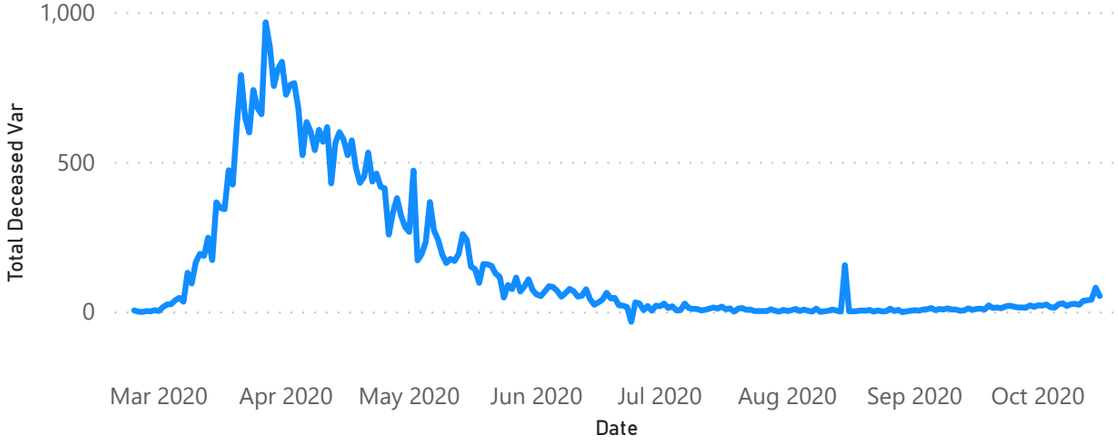
How many infected people are needed to get the the deaths we see? Of course to compute this we need to know the death_rate of the disease

Let's take China as reference country because the disease started there and we can a have a look at the complete evolution of the spreading, in fact their data match pretty well a logistic curve which is the common math model for the spreading of a virus

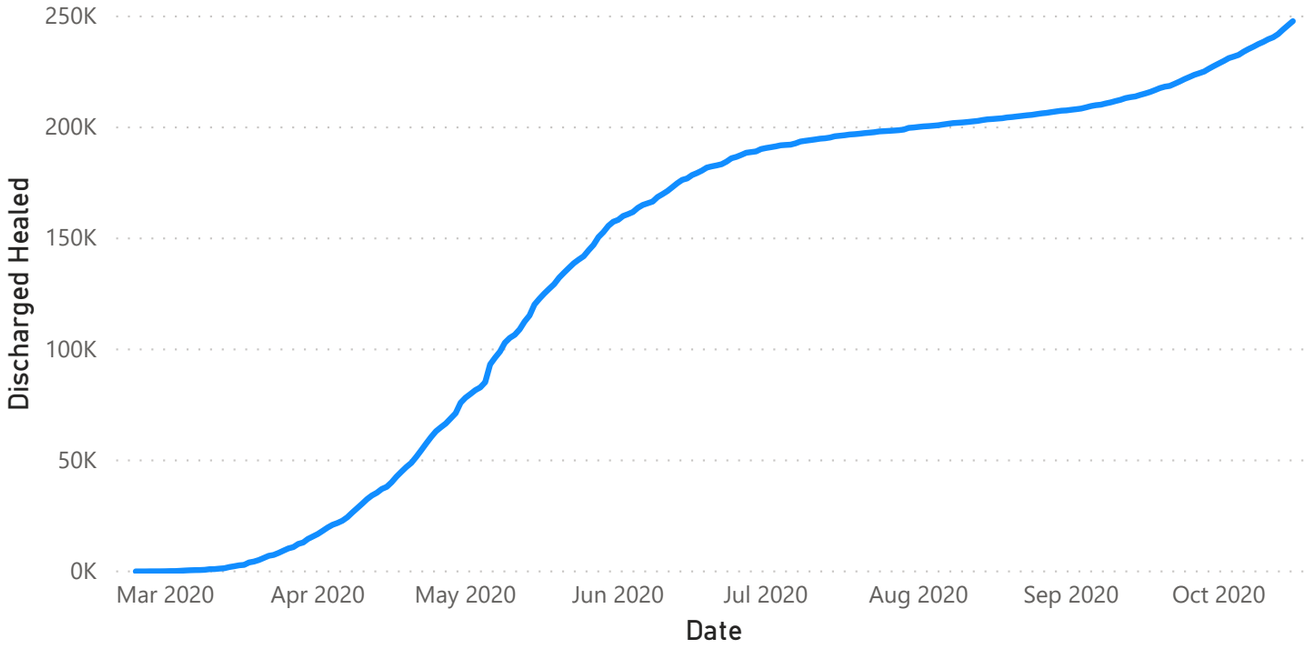
Deceased Growth Factor by Date



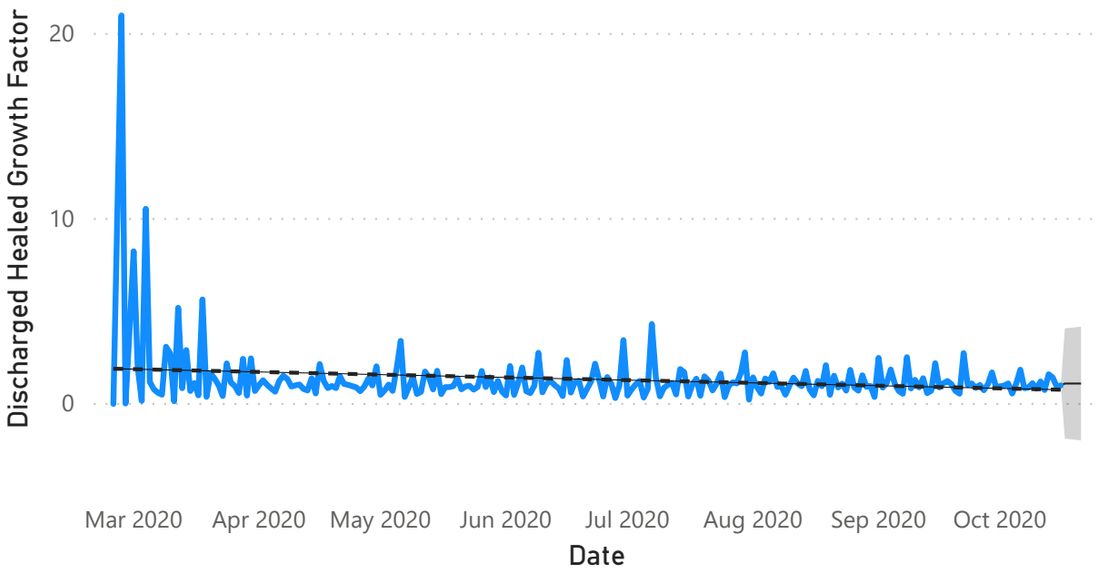
Total Deceased Var by Date



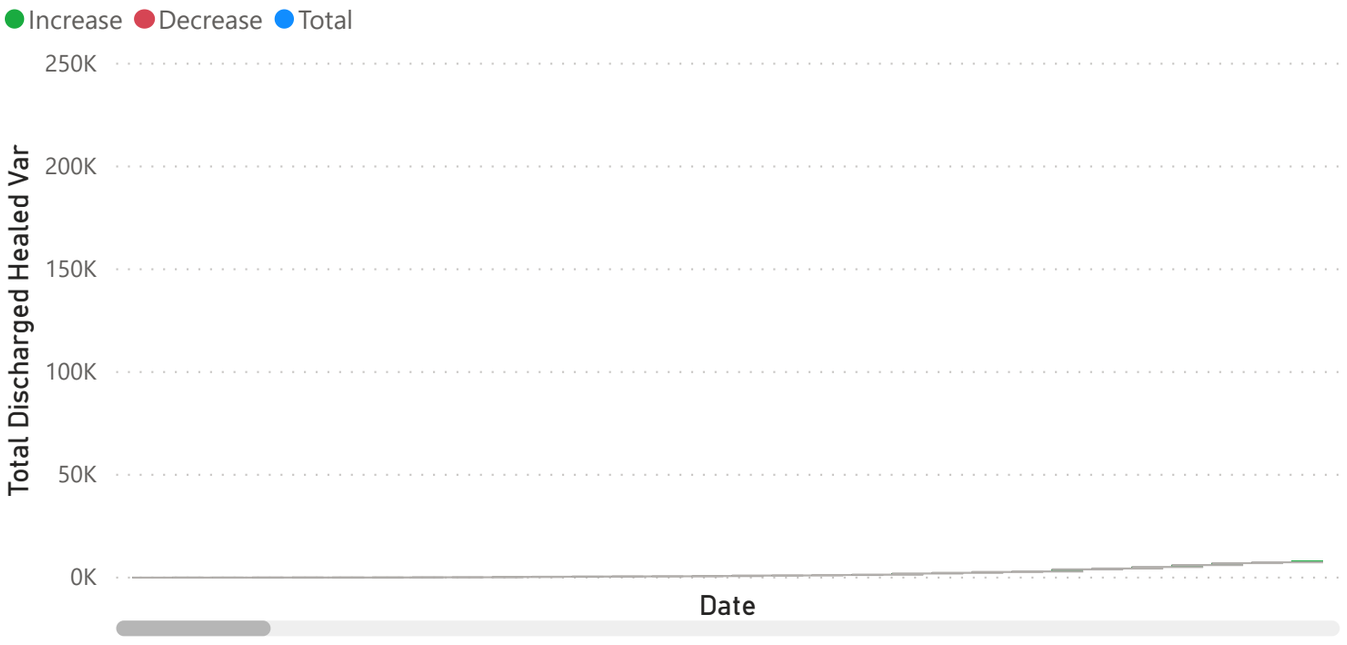
Discharged Healed by Date



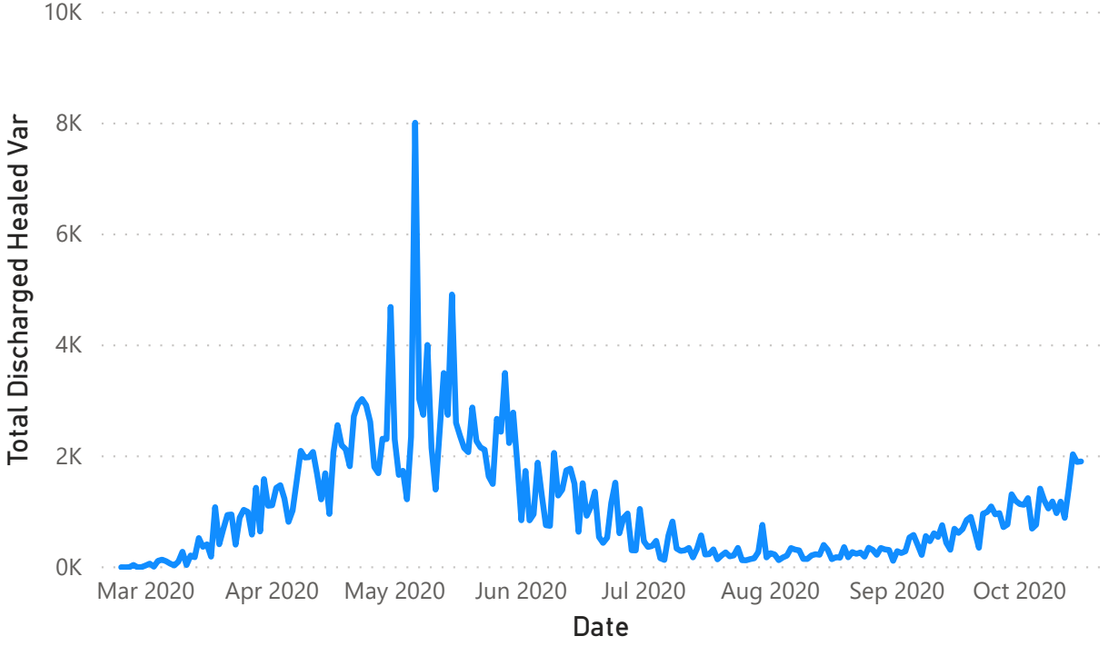
Discharged Healed Growth Factor by Date



Total Discharged Healed Var by Date



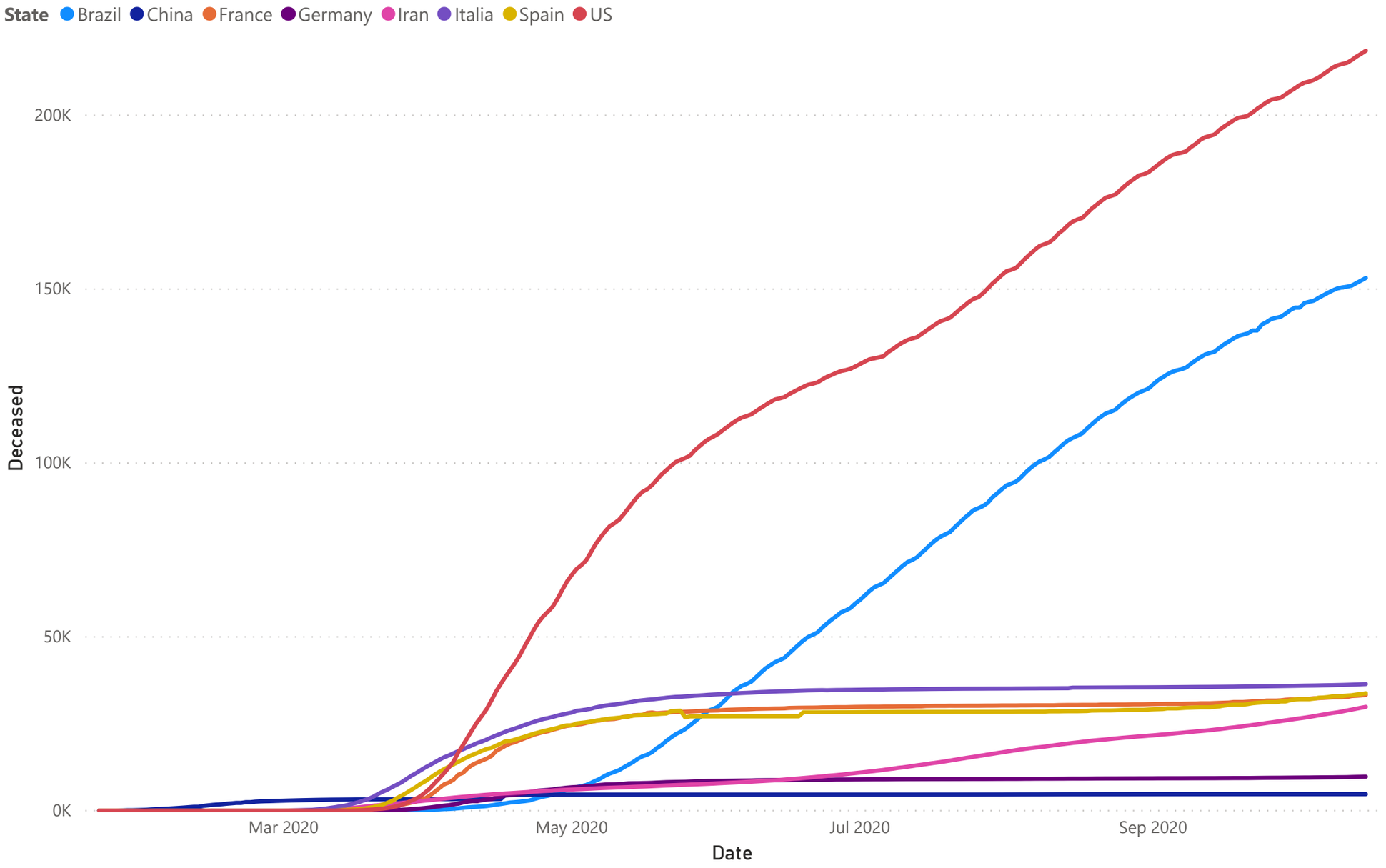
Total Discharged Healed Var by Date



State

- [ ] (Blank)
- [ ] Afghanistan
- [ ] Albania
- [ ] Algeria
- [ ] Andorra
- [ ] Angola
- [ ] Antigua and Barbuda
- [ ] Argentina
- [ ] Armenia
- [ ] Australia
- [ ] Austria
- [ ] Azerbaijan
- [ ] Bahamas
- [ ] Bahrain
- [ ] Bangladesh
- [ ] Barbados
- [ ] Belarus
- [ ] Belgium
- [ ] Belize
- [ ] Benin
- [ ] Bhutan
- [ ] Bolivia
- [ ] Bosnia and Herzegovina
- [ ] Botswana
- [x] Brazil
- [ ] Brunei
- [ ] Bulgaria
- [ ] Burkina Faso
- [ ] Burma
- [ ] Burundi
- [ ] Cabo Verde
- [ ] Cambodia
- [ ] Cameroon
- [ ] Canada
- [ ] Central African Republic
- [ ] Chad

Deceased by Date and State



Data from data.humdata.org

We can see the delay in time needed to covid-19 to reach the others countries from China and the spreading phase

State

- [ ] (Blank)
- [ ] Afghanistan
- [ ] Albania
- [ ] Algeria
- [ ] Andorra
- [ ] Angola
- [ ] Antigua and Barbuda
- [ ] Argentina
- [ ] Armenia
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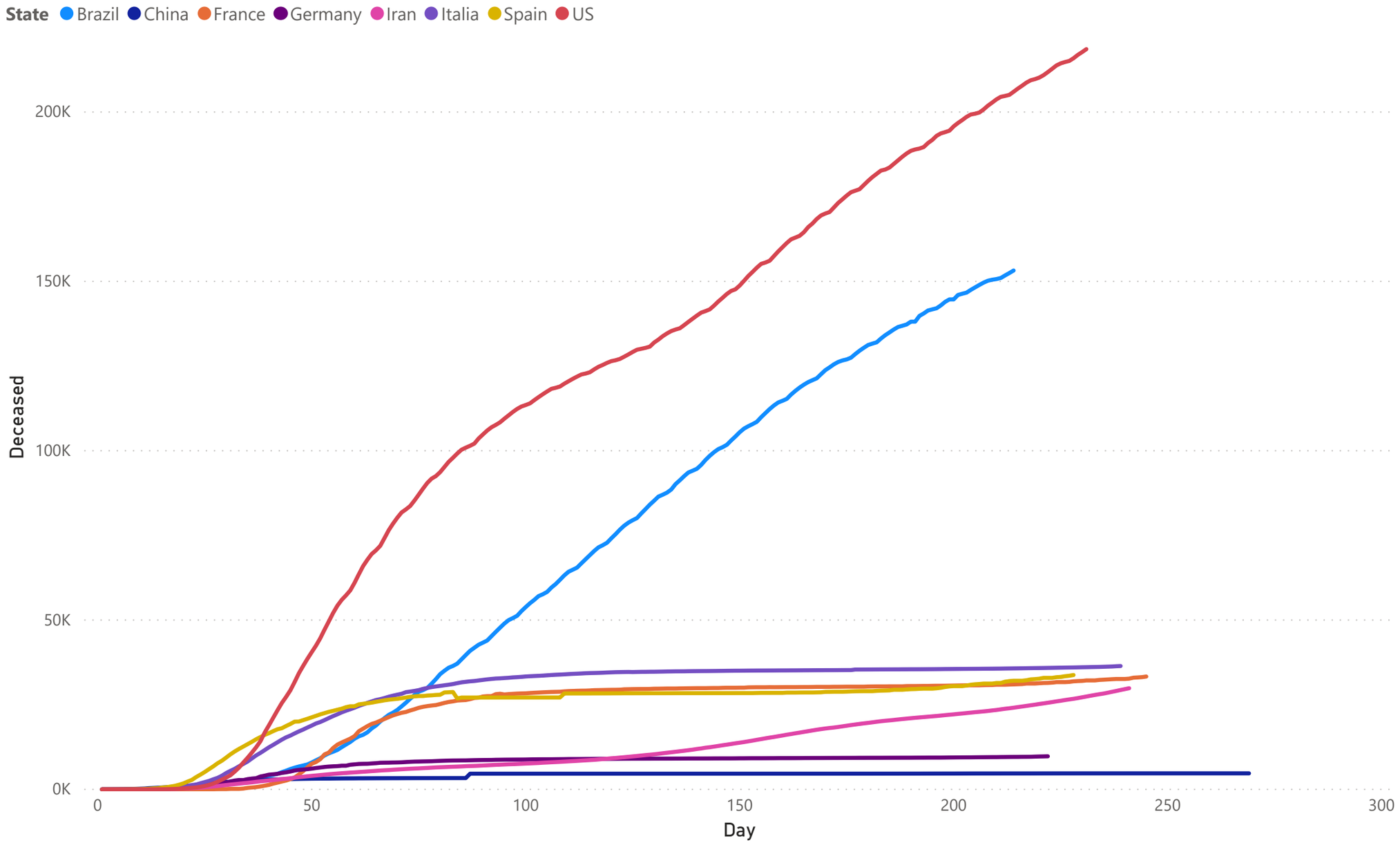
- [ ] Burkina Faso
- [ ] Burma
- [ ] Burundi
- [ ] Cabo Verde
- [ ] Cambodia
- [ ] Cameroon
- [ ] Canada
- [ ] Central African Republic
- [ ] Chad

Deceased by Day and State

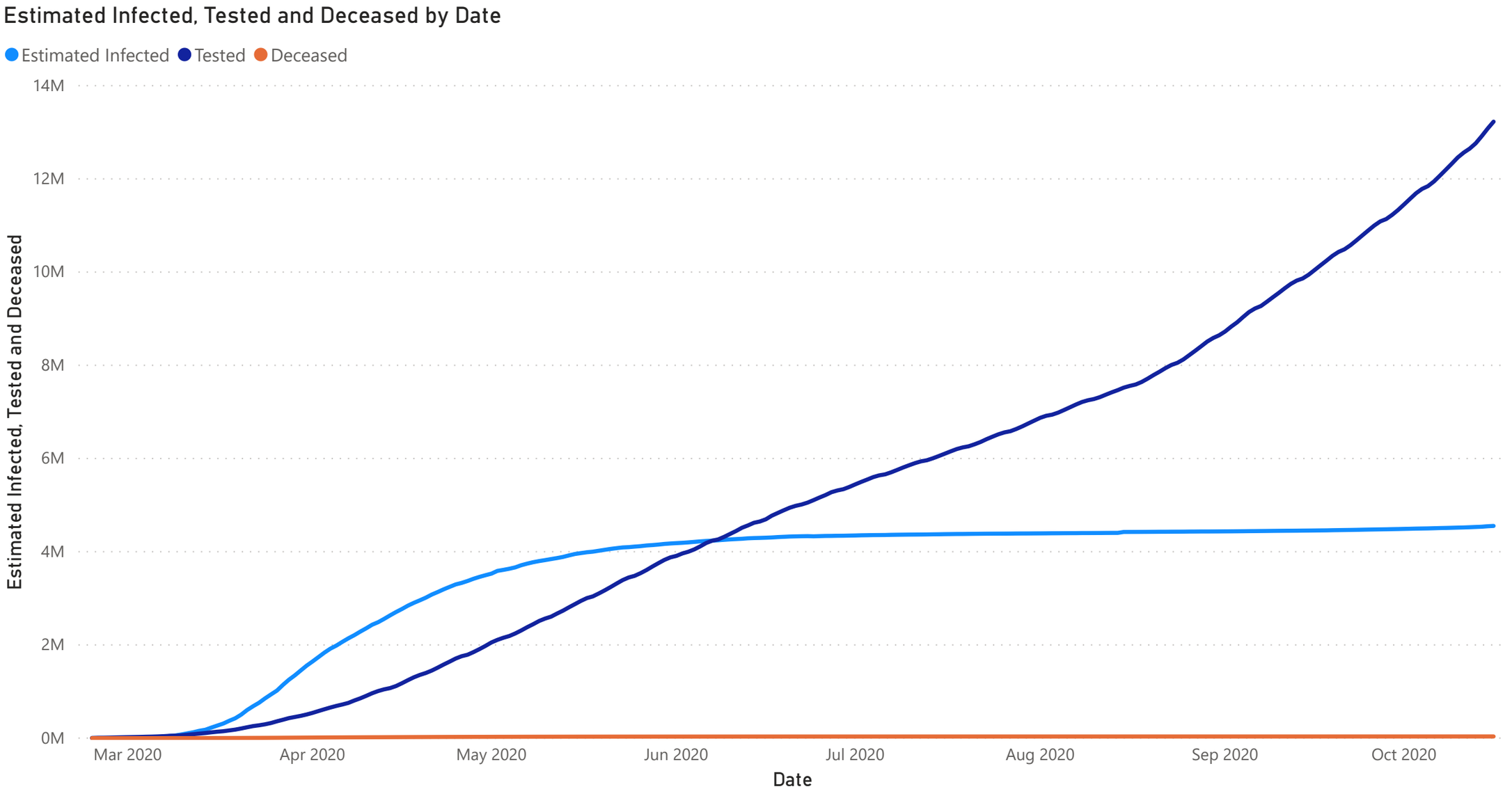


By shifting in time the data we can see the infections spreading in days so we can better compare the trajectories of the deaths for each country
We can see how in Italia the number of deaths is climbing way faster than in others countries

By changing the death_rate we can have an estimation of how many infected people are needed to get the the number of deaths we see

Death Rate

- [ ] 0.001
- [ ] 0.002
- [ ] 0.003
- [ ] 0.004
- [ ] 0.005
- [ ] 0.006
- [ ] 0.007
- [x] 0.008
- [ ] 0.009
- [ ] 0.010
- [ ] 0.011
- [ ] 0.012
- [ ] 0.013
- [ ] 0.014
- [ ] 0.015



Death rate in Italia is way higher than in China. This can be caused by a lot of factors: overall age of people, Italy counts every deaths in which covid19 is involved as a death by covid19 even if previous disease were present in the patient (99% of death in Italia happen to people having others diseases. More info about this here)
More information on wikipedia: "As of 20 March 2020, the rate of deaths per number of diagnosed cases is 4.1%; however, it ranges from 0.2% to 15% according to age group and other health problems"