

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

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

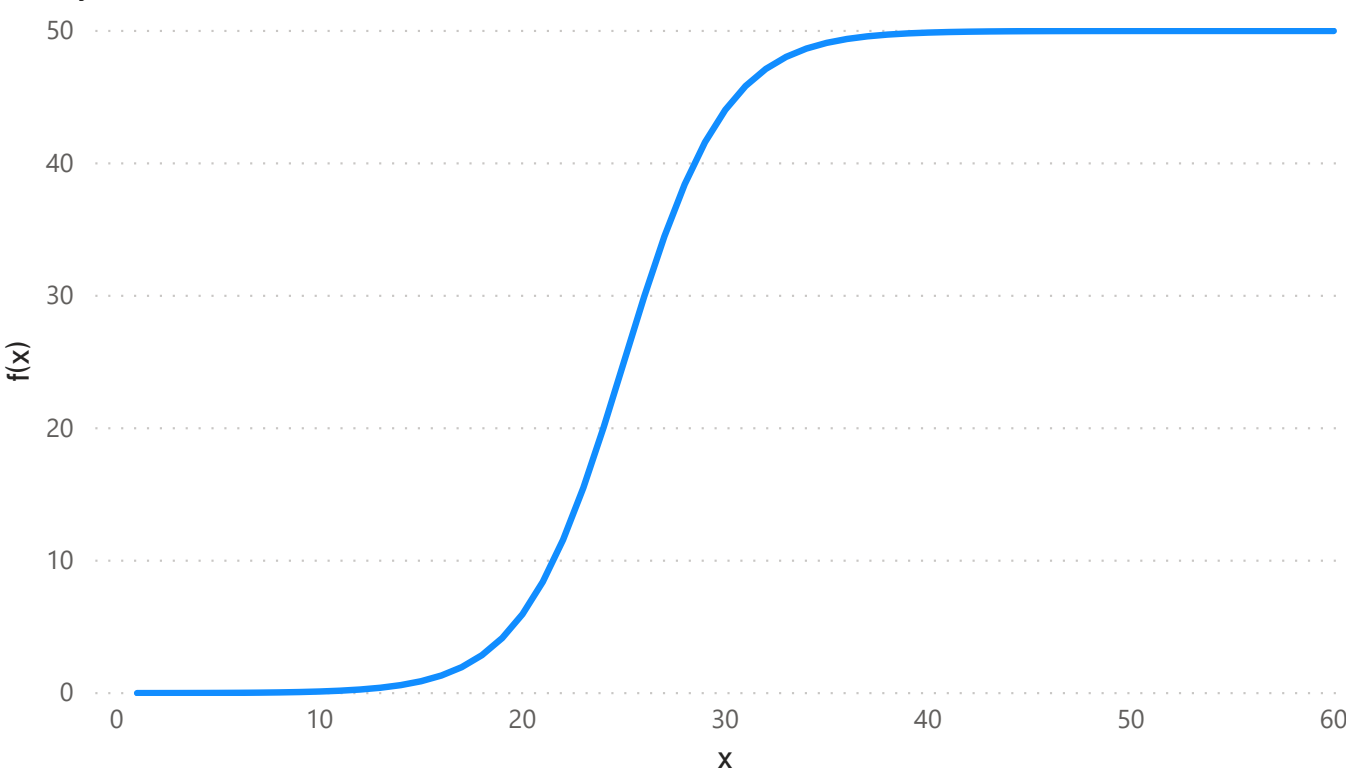
where

- 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]

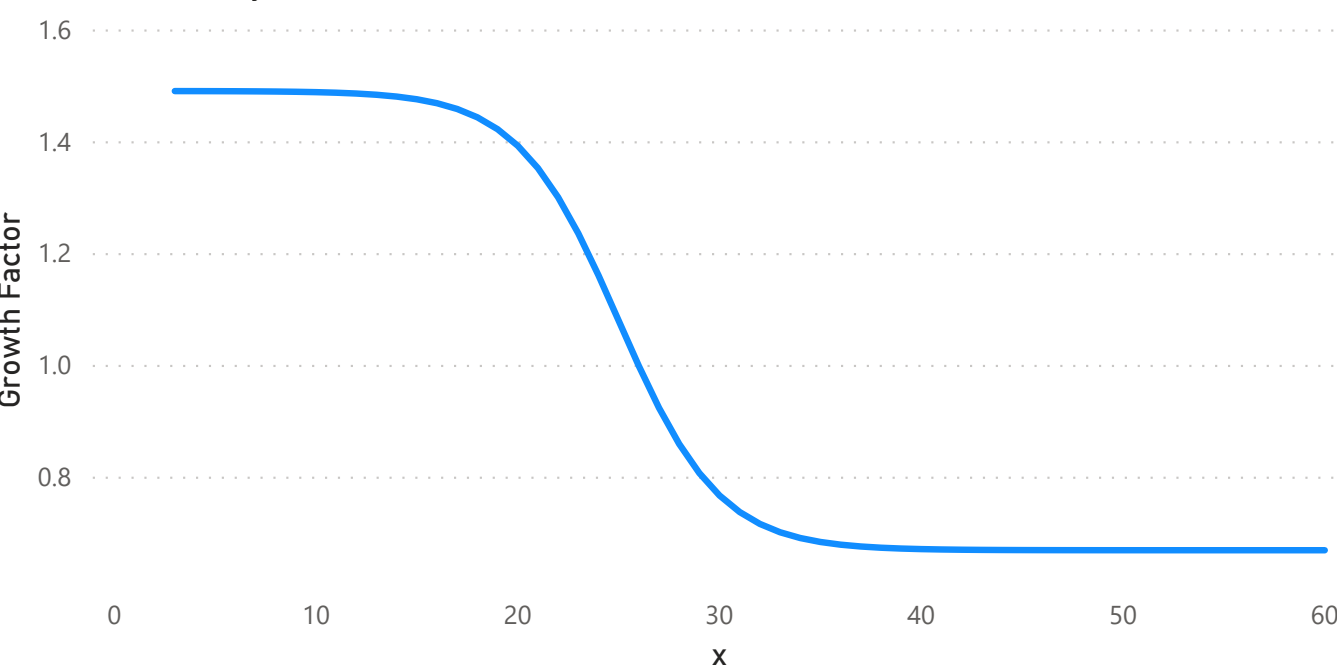
More information on [wikipedia](#)

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

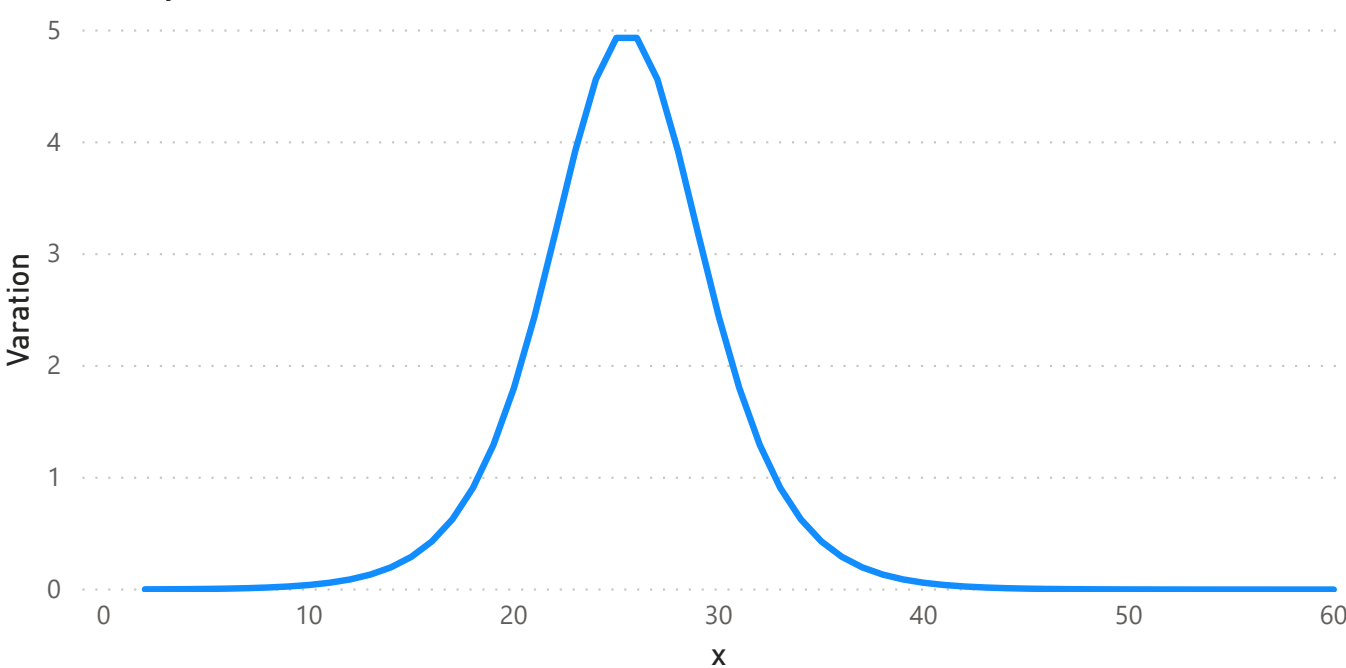
f(x) by x



Growth Factor by x

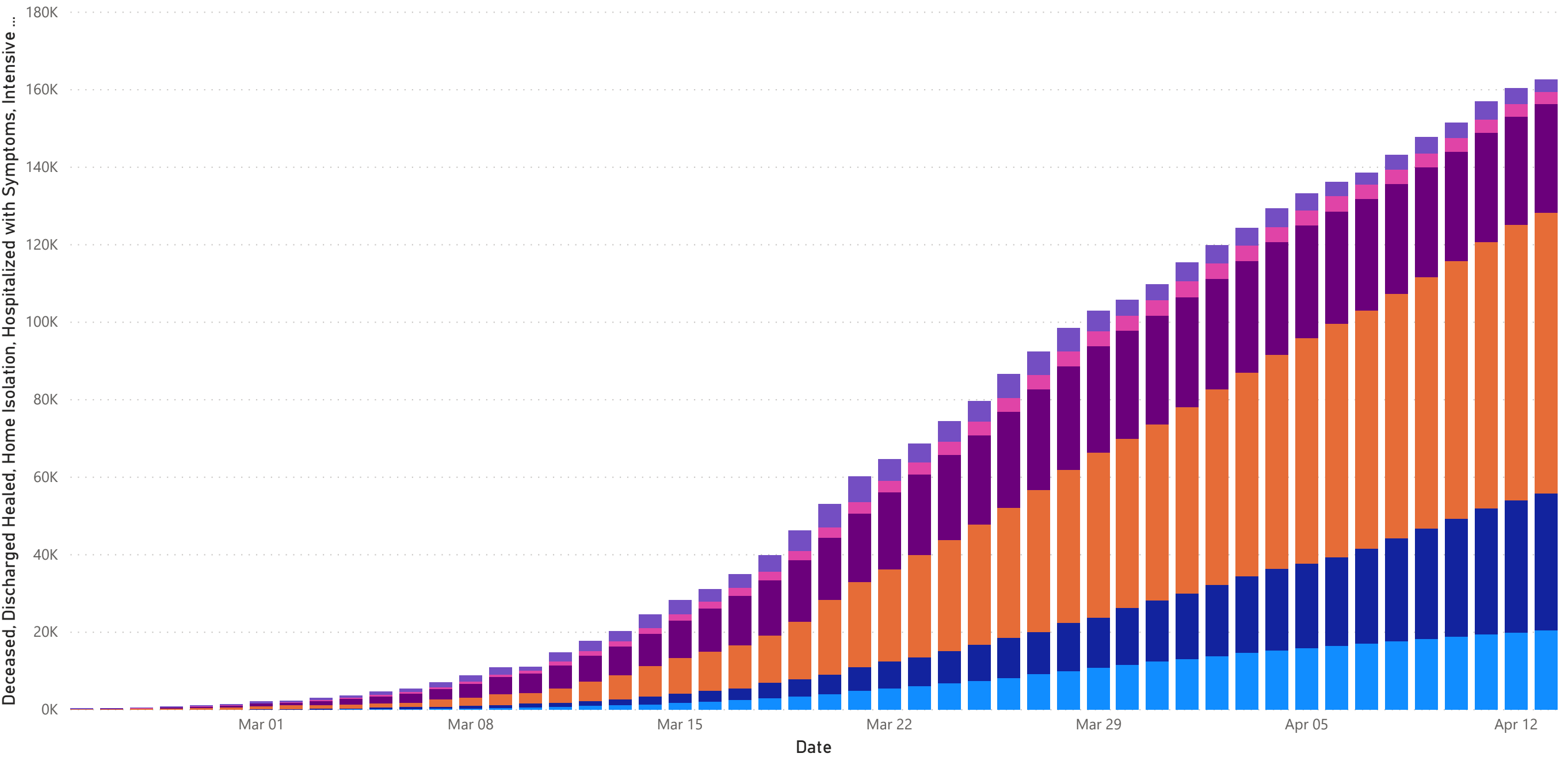


Variation by x



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

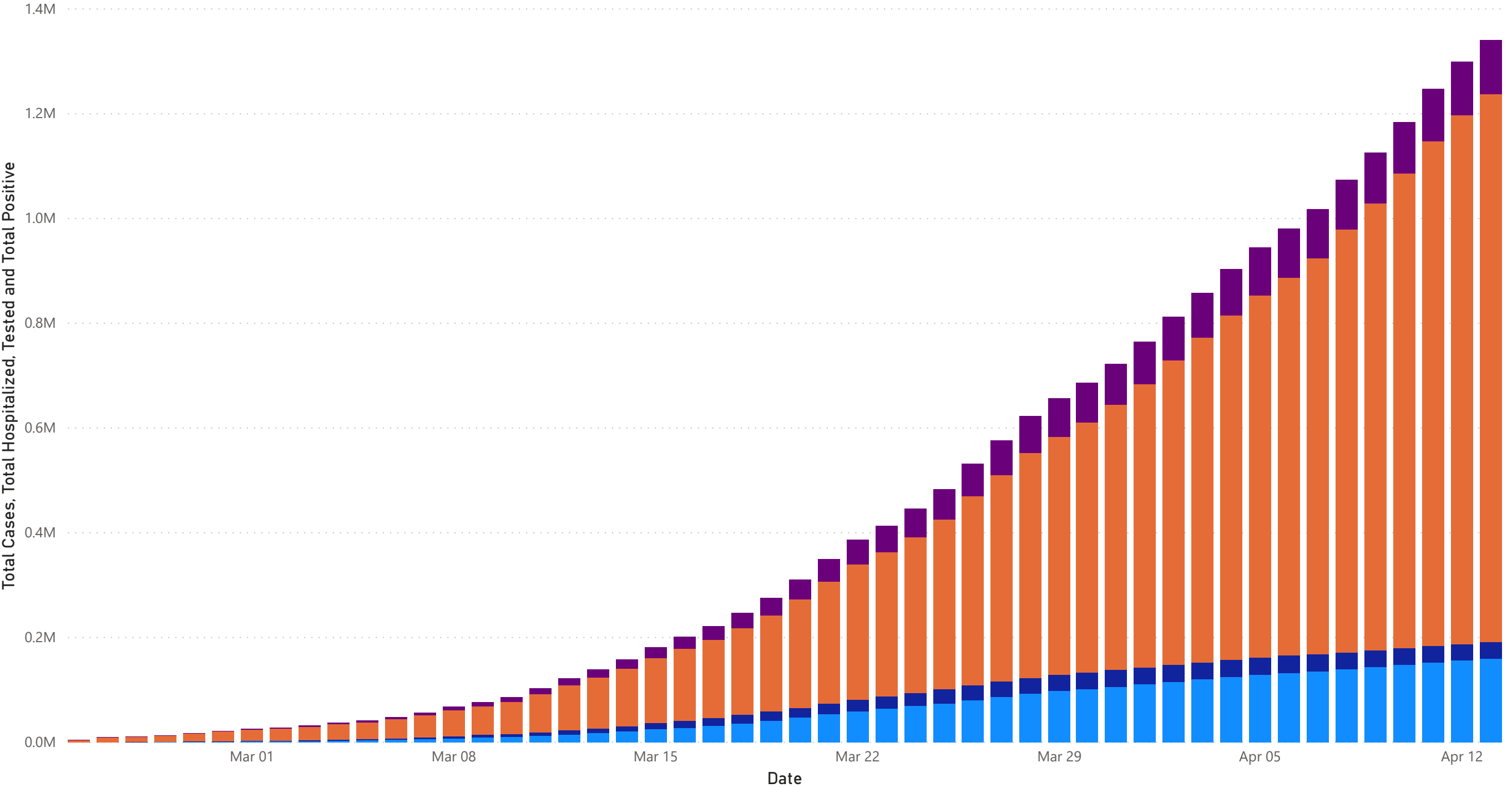
Deceased Discharged Healed Home Isolation Hospitalized with Symptoms Intensive Care New Positive



Data from [Protezione Civile](#)

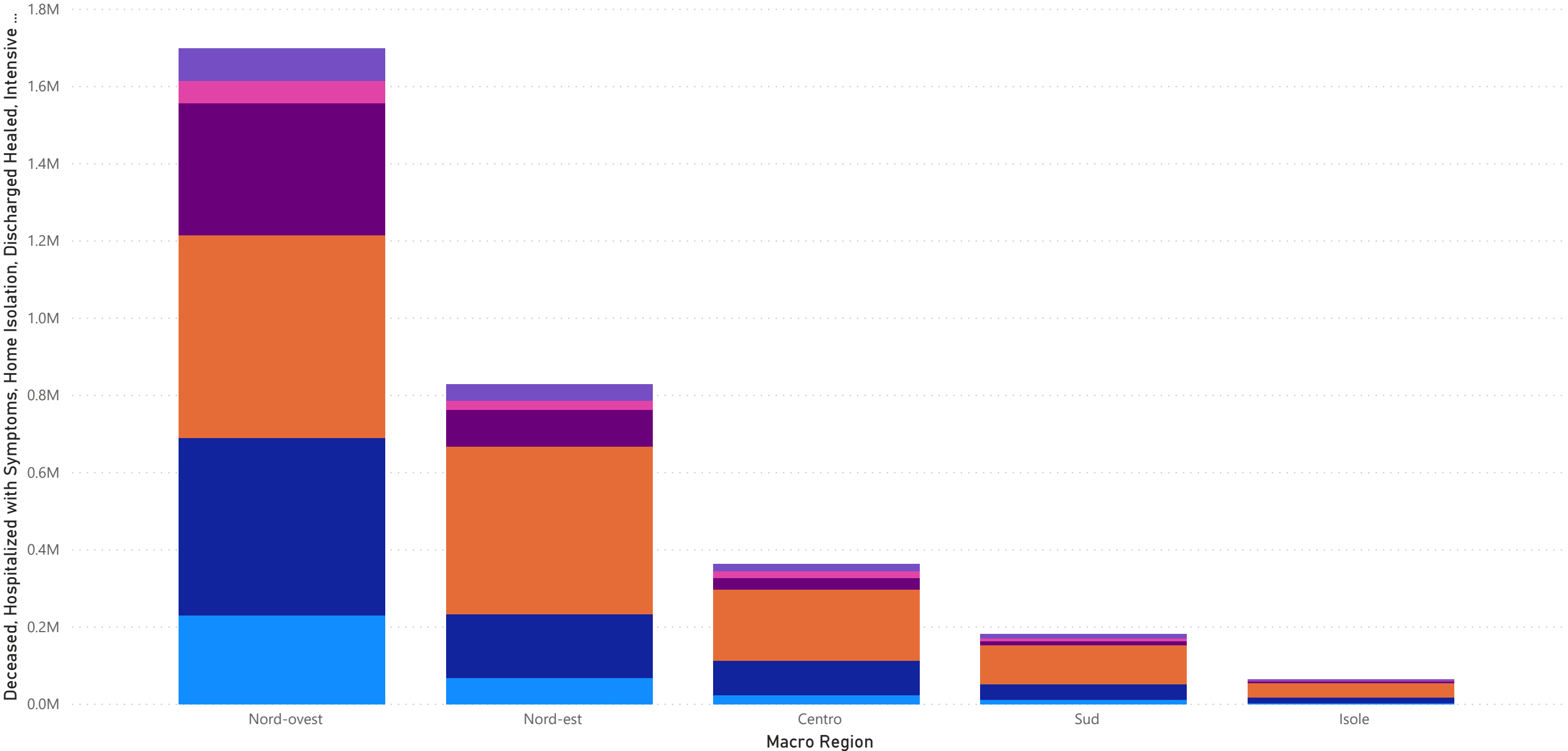
Total Cases, Total Hospitalized, Tested and Total Positive by Date

Total Cases Total Hospitalized Tested Total Positive



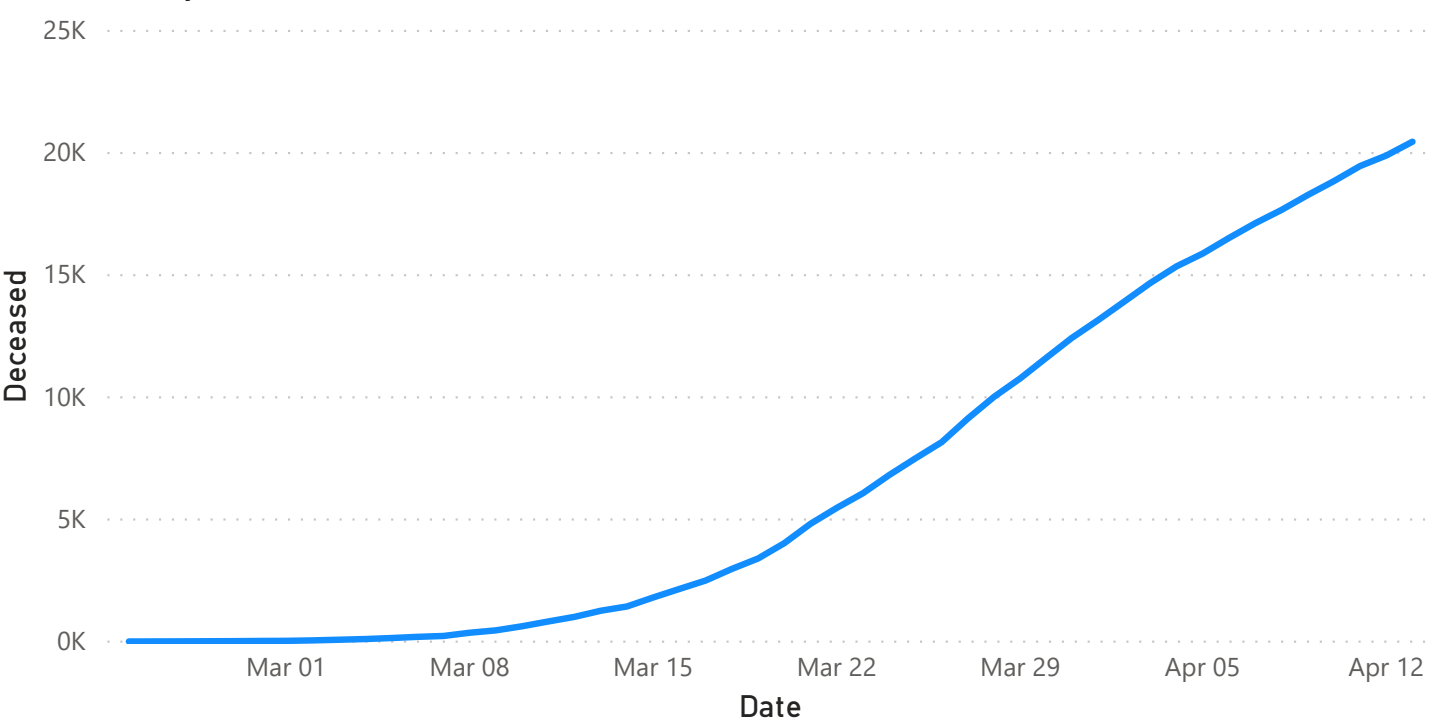
Deceased, Hospitalized with Symptoms, Home Isolation, Discharged Healed, Intensive Care and New Positive by Macro Region

Deceased Hospitalized with Symptoms Home Isolation Discharged Healed Intensive Care New Positive

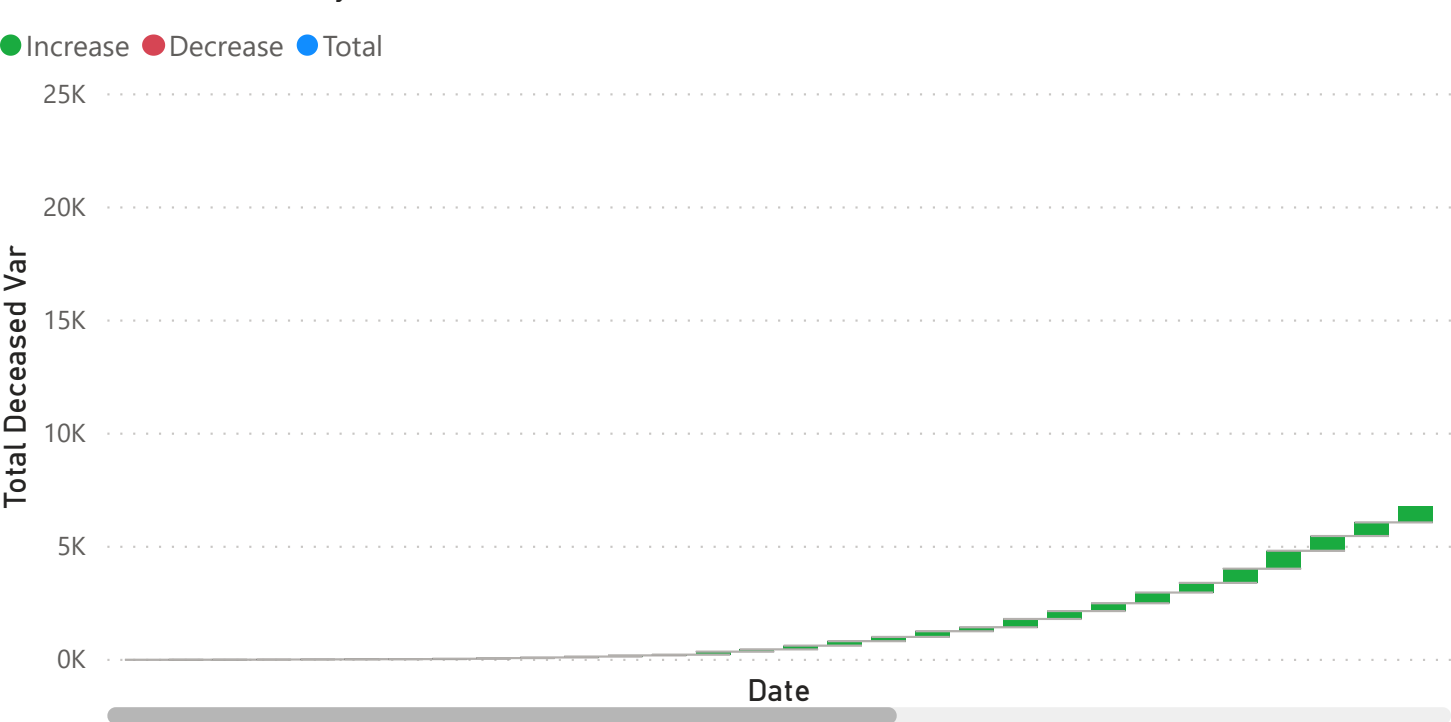


The virus started spreading in North Italia especially in Lombardia

Deceased by Date



Total Deceased Var by Date

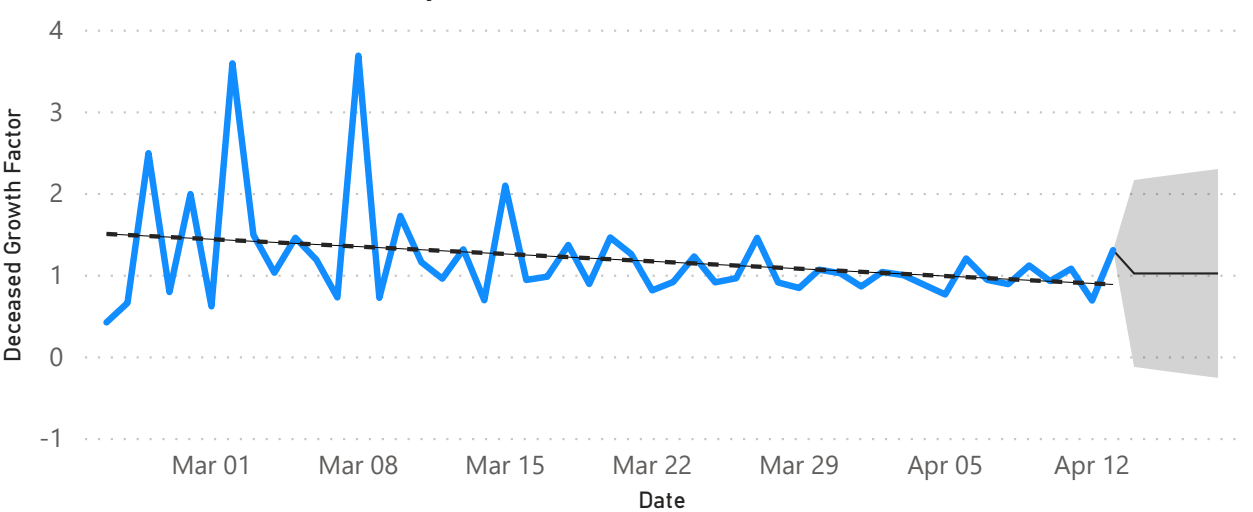


Because it is not possible to test all the population everyday to get the real number of infected people let's consider the number of deaths as starting point for our analysis

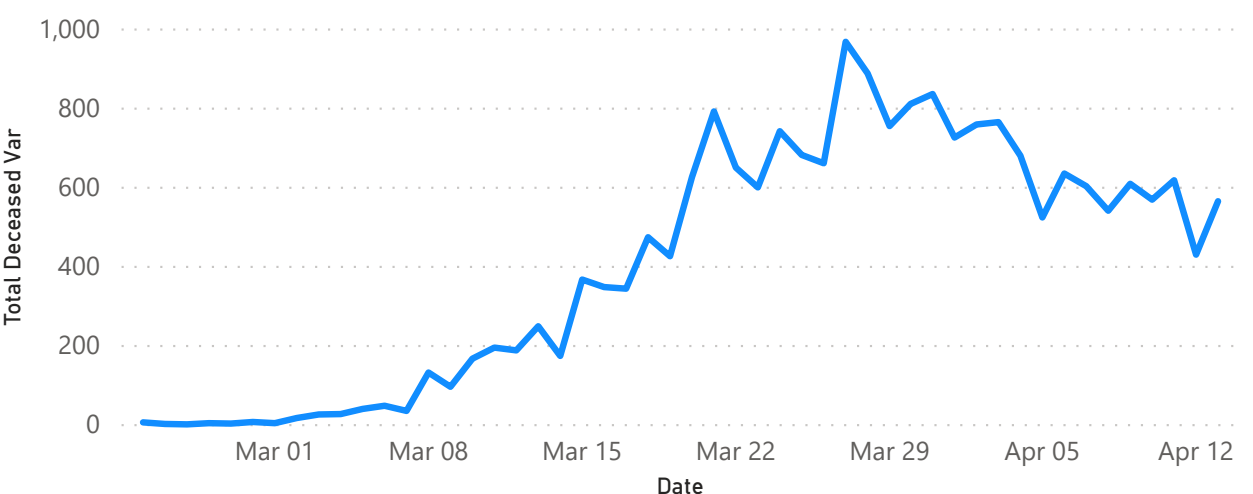
How many infected people are needed to get the the deaths we see? Of course to compute this we need to know the death_rate of the disease

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

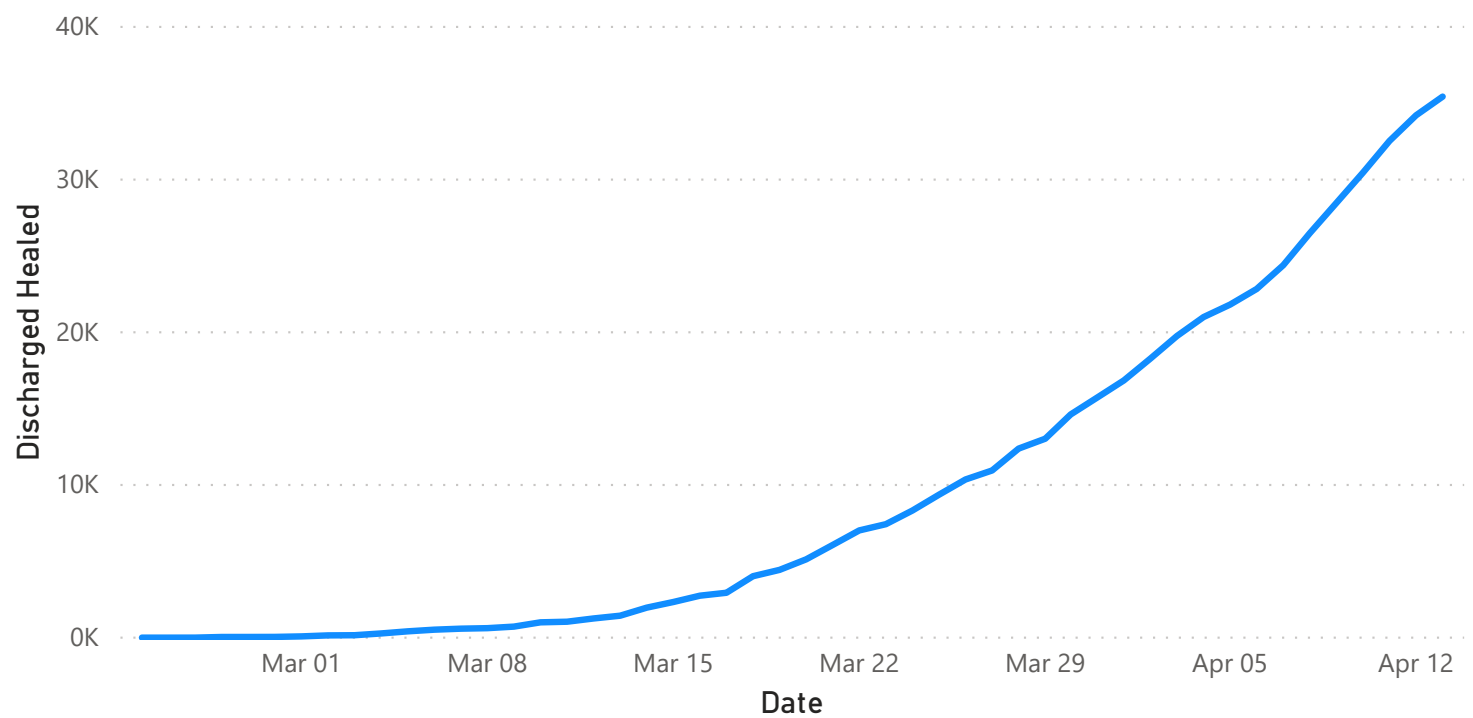
Deceased Growth Factor by Date



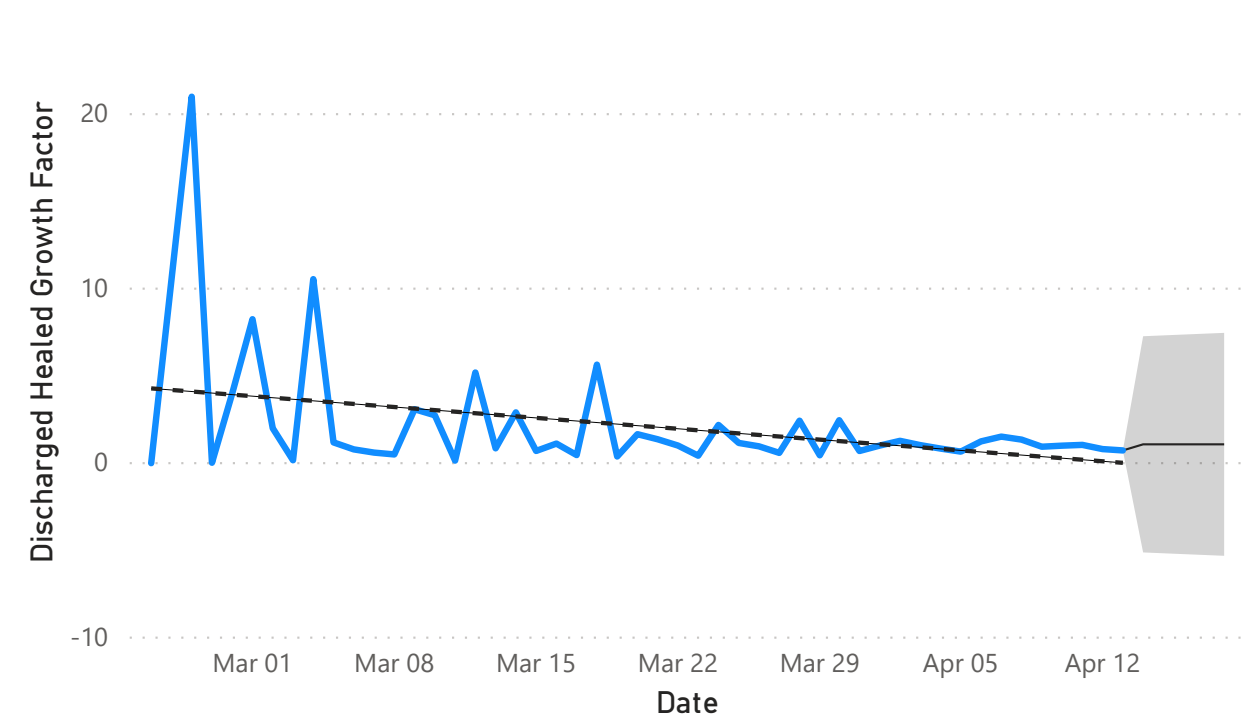
Total Deceased Var by Date



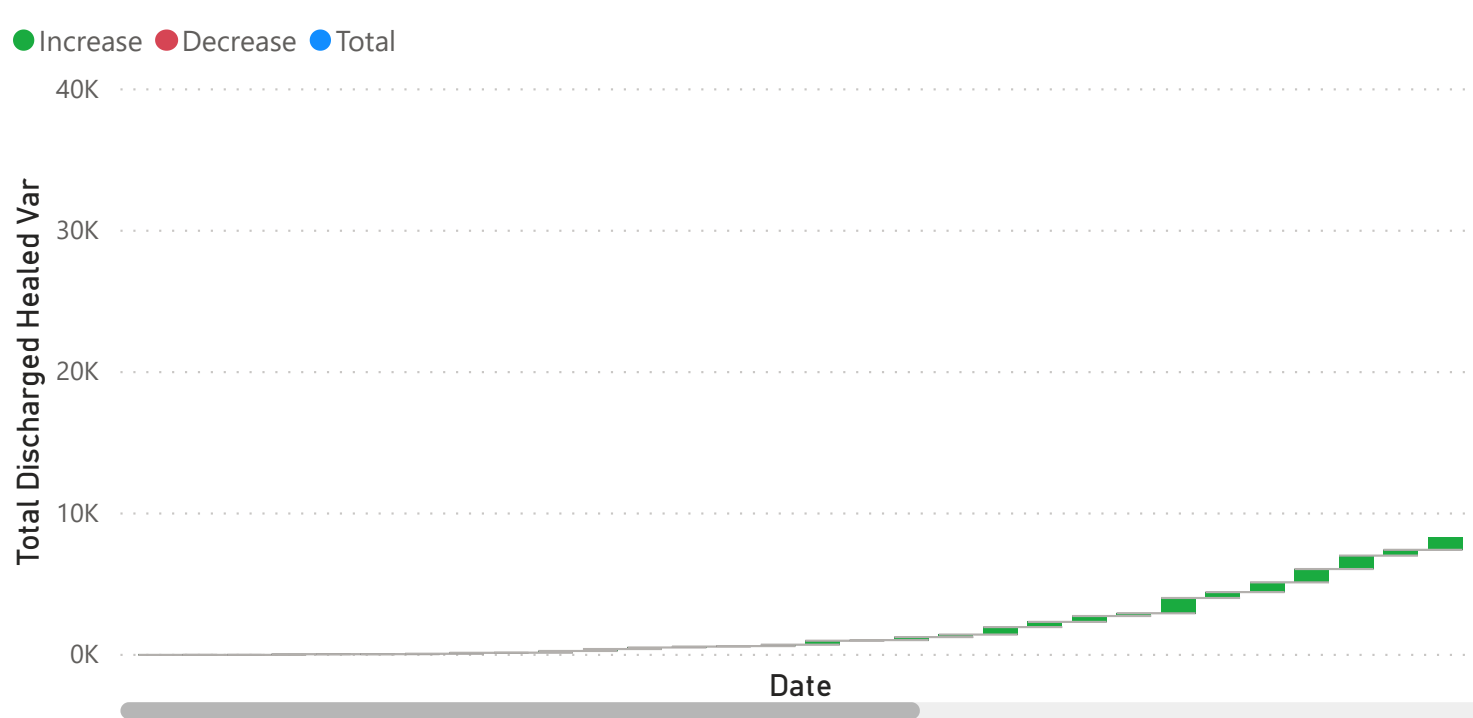
Discharged Healed by Date



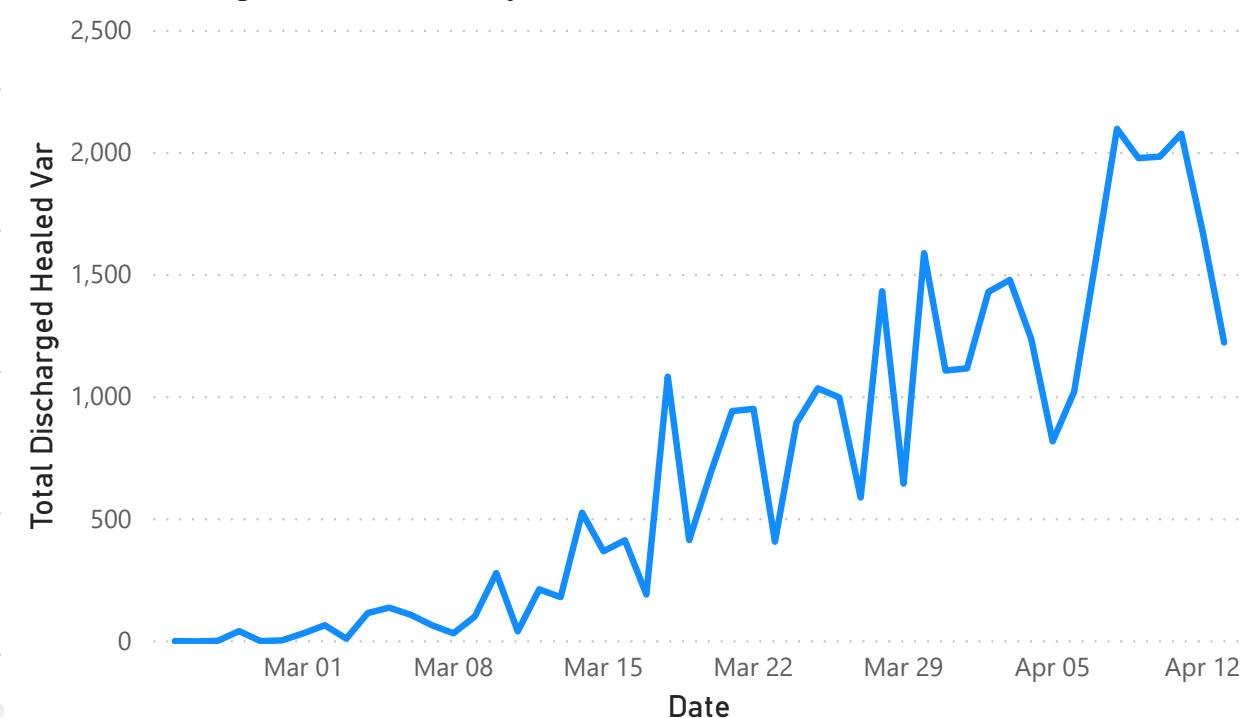
Discharged Healed Growth Factor by Date



Total Discharged Healed Var by Date

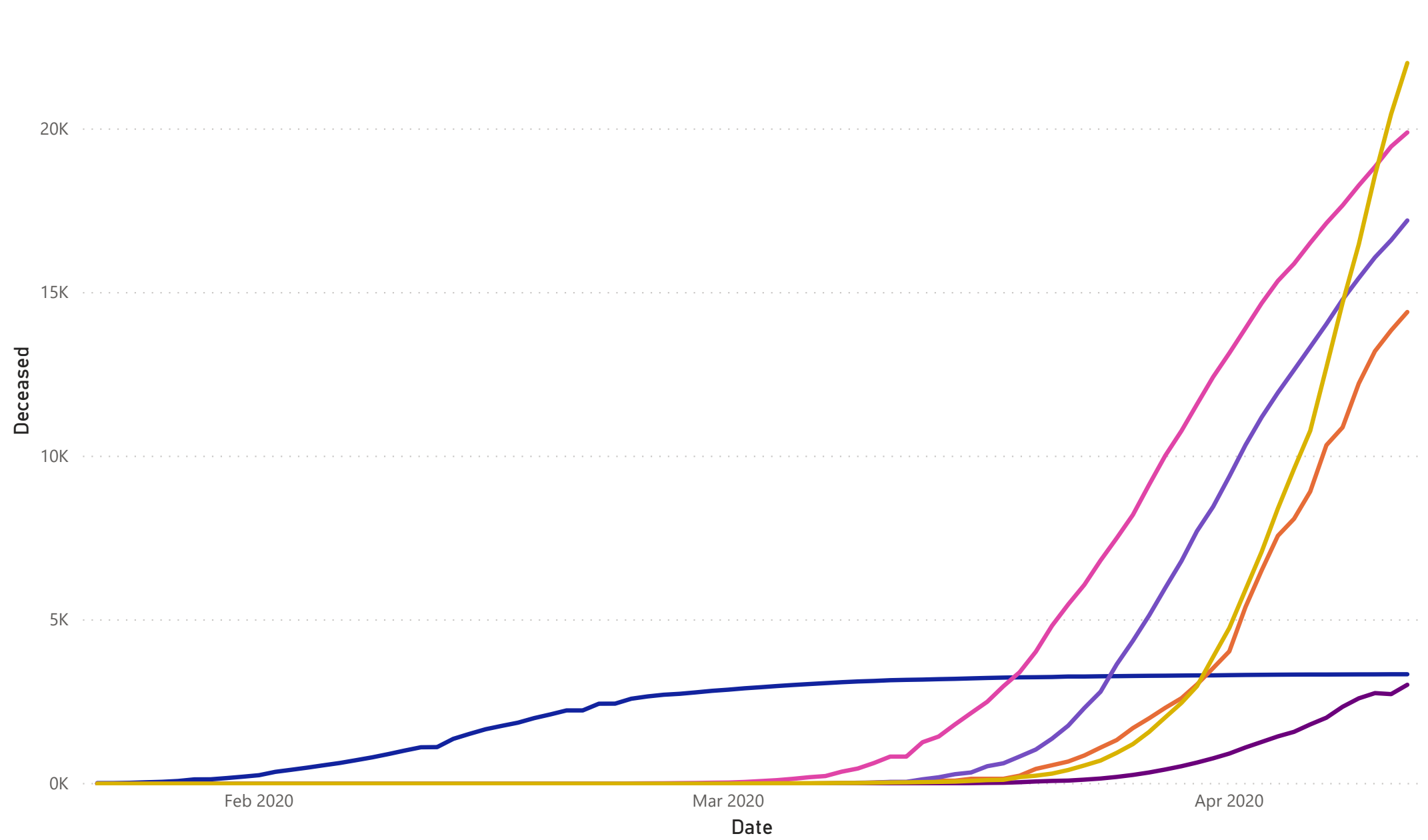


Total Discharged Healed Var by Date



Deceased by Date and State

State ● China ● France ● Germany ● Italia ● Spain ● US



Data from data.humdata.org.

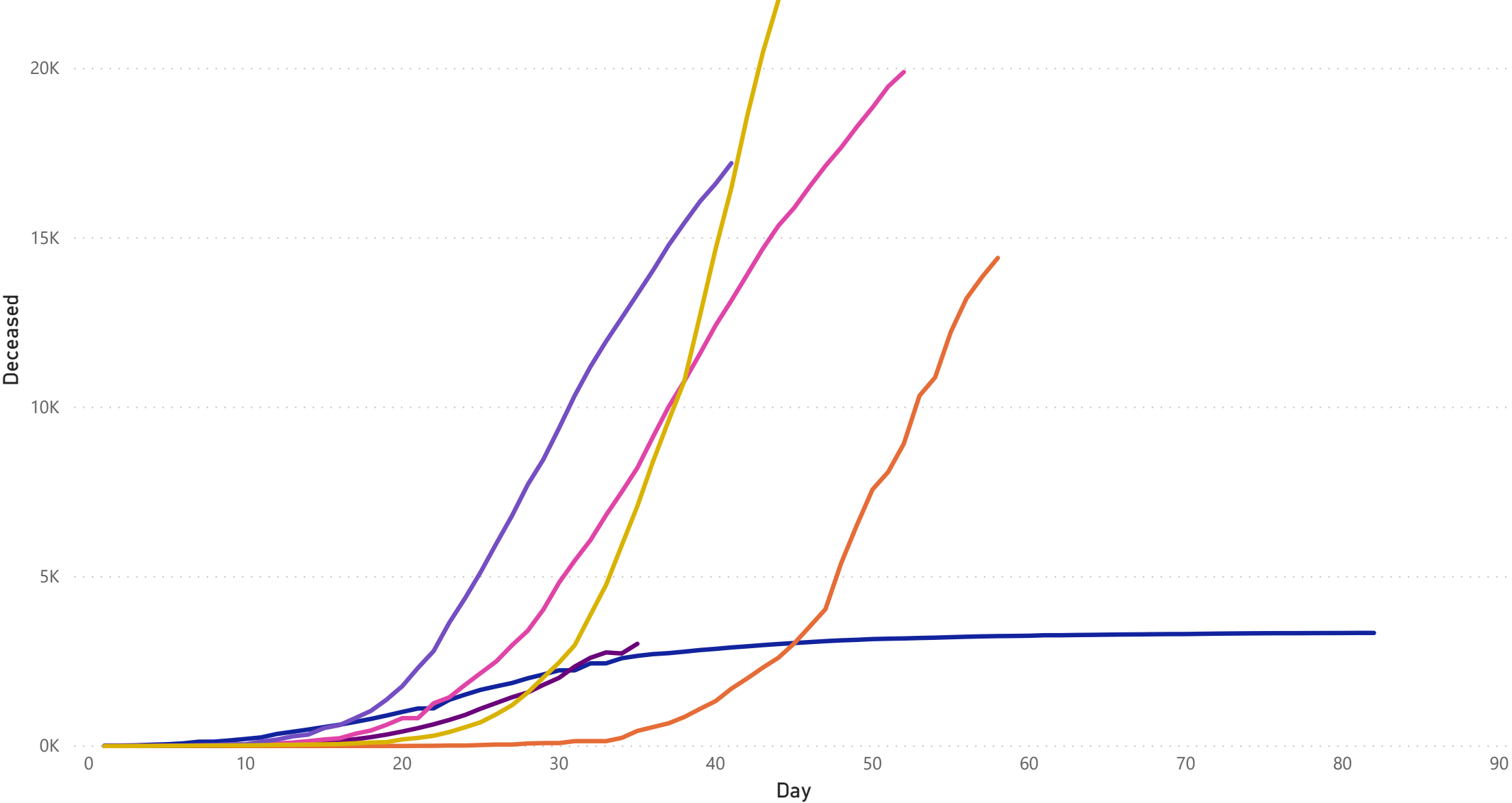
We can see the delay in time needed to covid-19 to reach the others countries from China and the spreading phase

- State
- ☐ 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
 - ☐ Brazil
 - ☐ Brunei
 - ☐ Bulgaria
 - ☐ Burkina Faso
 - ☐ Burma
 - ☐ Burundi
 - ☐ Cabo Verde
 - ☐ Cambodia
 - ☐ Cameroon
 - ☐ Canada
 - ☐ Central African Republic
 - ☐ Chad
 - ☐ Chile
 - ☐ China
 - ☐ Colombia
 - ☐ Costa Rica
 - ☐ Czechia
 - ☐ Denmark
 - ☐ Dominican Republic
 - ☐ Ecuador
 - ☐ Egypt
 - ☐ El Salvador
 - ☐ Estonia
 - ☐ Ethiopia
 - ☐ Finland
 - ☐ France
 - ☐ Germany
 - ☐ Greece
 - ☐ Guatemala
 - ☐ Guinea
 - ☐ Guinea-Bissau
 - ☐ Haiti
 - ☐ Honduras
 - ☐ Hungary
 - ☐ Iceland
 - ☐ India
 - ☐ Indonesia
 - ☐ Iran
 - ☐ Iraq
 - ☐ Ireland
 - ☐ Israel
 - ☐ Italy
 - ☐ Jamaica
 - ☐ Japan
 - ☐ Jordan
 - ☐ Kazakhstan
 - ☐ Kenya
 - ☐ Korea
 - ☐ Kuwait
 - ☐ Kyrgyzstan
 - ☐ Laos
 - ☐ Latvia
 - ☐ Lebanon
 - ☐ Lesotho
 - ☐ Liberia
 - ☐ Lithuania
 - ☐ Luxembourg
 - ☐ Madagascar
 - ☐ Malawi
 - ☐ Malaysia
 - ☐ Maldives
 - ☐ Mali
 - ☐ Malta
 - ☐ Mexico
 - ☐ Micronesia
 - ☐ Moldova
 - ☐ Monaco
 - ☐ Mongolia
 - ☐ Montenegro
 - ☐ Morocco
 - ☐ Mozambique
 - ☐ Myanmar
 - ☐ Namibia
 - ☐ Nepal
 - ☐ Netherlands
 - ☐ New Zealand
 - ☐ Nicaragua
 - ☐ Niger
 - ☐ Nigeria
 - ☐ North Macedonia
 - ☐ Norway
 - ☐ Oman
 - ☐ Pakistan
 - ☐ Panama
 - ☐ Paraguay
 - ☐ Peru
 - ☐ Philippines
 - ☐ Poland
 - ☐ Portugal
 - ☐ Qatar
 - ☐ Romania
 - ☐ Russia
 - ☐ Rwanda
 - ☐ Saudi Arabia
 - ☐ Senegal
 - ☐ Serbia
 - ☐ Singapore
 - ☐ Slovakia
 - ☐ Slovenia
 - ☐ South Africa
 - ☐ South Korea
 - ☐ Spain
 - ☐ Sri Lanka
 - ☐ Sweden
 - ☐ Switzerland
 - ☐ Taiwan
 - ☐ Tajikistan
 - ☐ Tanzania
 - ☐ Thailand
 - ☐ Timor-Leste
 - ☐ Togo
 - ☐ Tonga
 - ☐ Trinidad and Tobago
 - ☐ Tunisia
 - ☐ Turkey
 - ☐ Turkmenistan
 - ☐ Uganda
 - ☐ Ukraine
 - ☐ United Arab Emirates
 - ☐ United Kingdom
 - ☐ United States
 - ☐ Uruguay
 - ☐ Uzbekistan
 - ☐ Venezuela
 - ☐ Vietnam
 - ☐ Wales
 - ☐ Yemen
 - ☐ Zambia
 - ☐ Zimbabwe



Deceased by Day and State

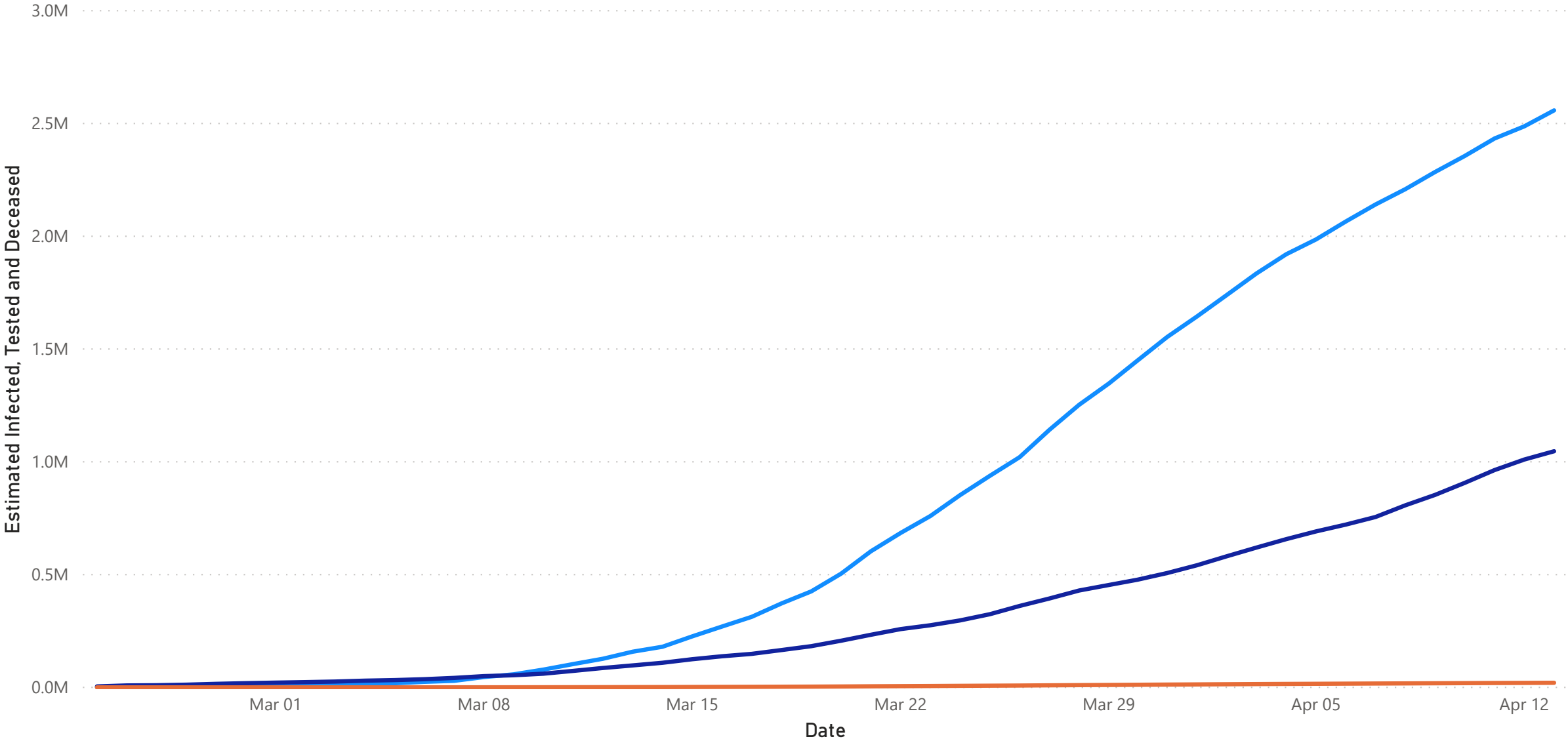
State ● China ● France ● Germany ● Italia ● Spain ● US



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

Estimated Infected, Tested and Deceased by Date

Estimated Infected Tested Deceased



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

0.008

0.009

0.010

0.011

0.012

0.013

0.014

0.015

Death rate in Italy 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 Italy 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"