

# “COVID-19. Where are we now and where will be in the future?”

## Current epidemiological situation related to COVID-19 in selected countries

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# 1 Introduction

As there are numerous fake information about actual status of COVID-19 outbreak among the world, this brief communication is dedicated to show actual epidemic situation and possible progression of epidemic spread in selected countries. Selection of countries analysed in some details in this report is based on my current cooperates citizenship or country of their actual stay.

## 2 Materials and methods

Data on cases in Poland were taken from official Polish Ministry of Health [twitter](#) (last updated 22/03/20, CET: 12:19:00), incidence data for other countries as well as fatalities number were taken from [Johns Hopkins University \(JHU\)](#) Global Cases by the Center for Systems Science and Engineering (CSSE) (last updated at 22/3/2020, CET:12:13:25). Data on current population size in each country were taken from [Worldometers](#) web site.

Two models were used: classic epidemiological exponential model for first stage of epidemy, as well as compartmental [SIR model](#) assuming acquisition of immunity in the population. For stable epidemy future stage logistic growth model was assumed.

R-studio<sup>1</sup> as well as Microsoft Excel<sup>2</sup> were used for all calculations and visualisations.

## 3 Results

### 3.1 Current COVID-19 situation

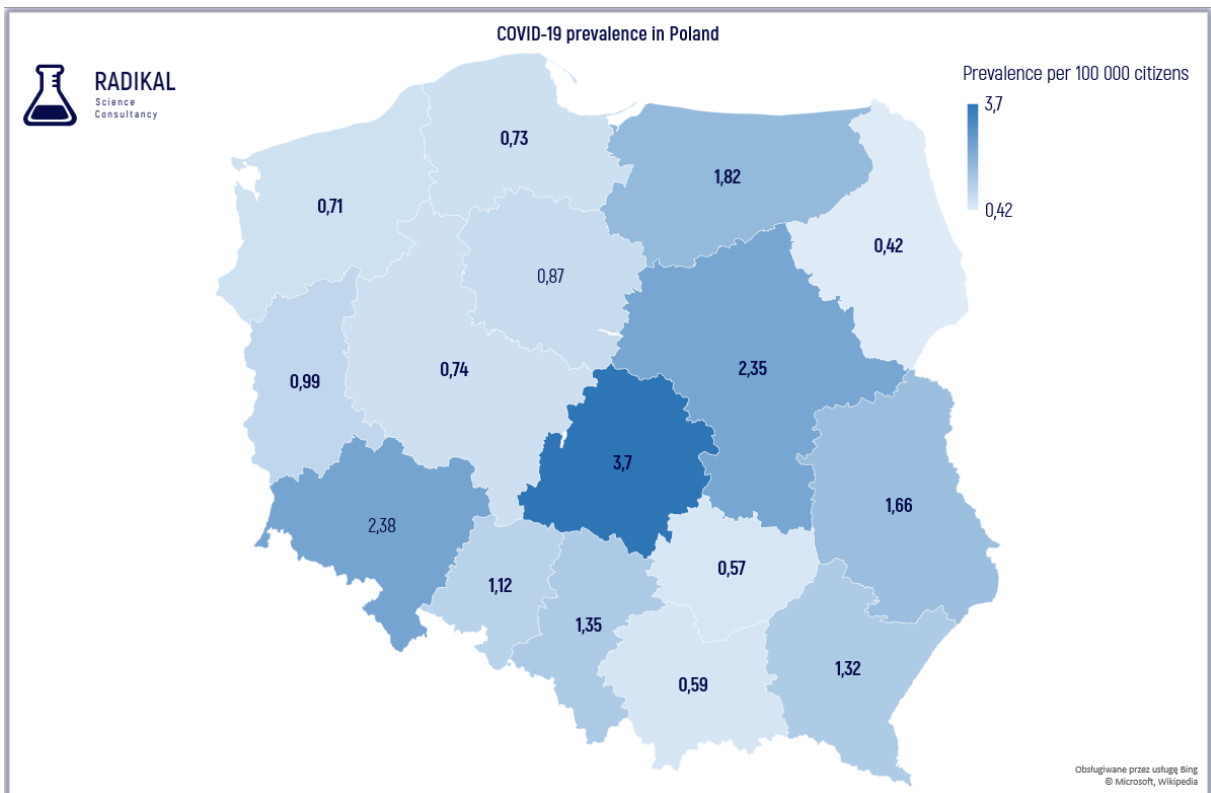
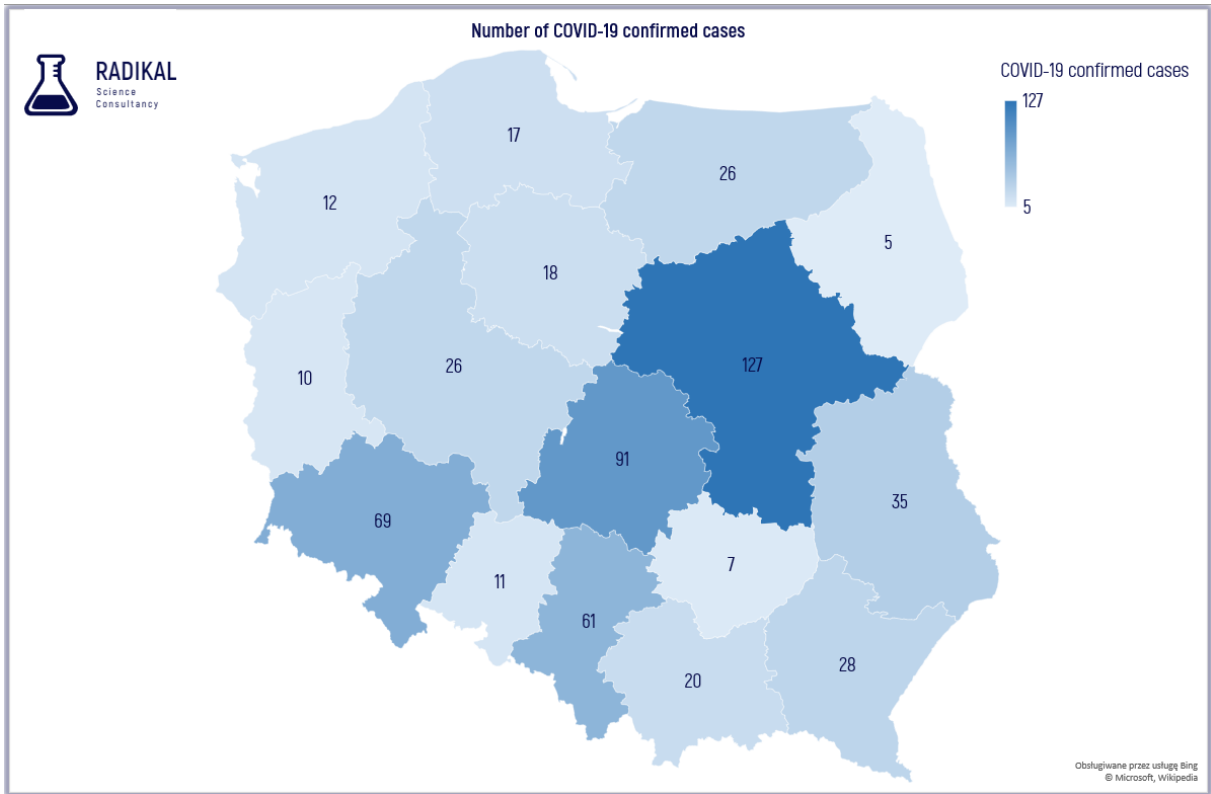
#### 3.1.1 COVID-19 cases

Sole comparisons of single cases data among countries do not have epidemiological sense, as they do not include population density in these regions. As an illustration of that phenomena let me provide Polish current situation in voivodeships on these two graphs. First one present number of cases in each voivodeship second one prevalence in the same region. From first graph Mazovia voivodship seems to be in worst situation, but actually this is not true... The centre of mass of a distribution of confirmed COVID-19 cases is currently in Lodzkie voivodship.

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<sup>1</sup> RStudio Team (2019). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL <http://www.rstudio.com/>

<sup>2</sup> Microsoft Excel Professional Plus (2019)



### 3.1.2 COVID-19 fatality rate

COVID-19 is fatal, with overall fatality rate approximately 4% this is fact. But on other hand it is not as much fatal as previous epidemics like smallpox (10-30%)<sup>3</sup>, SARS (13.2-43.3%)<sup>4</sup> or legionellosis (5.6-35%)<sup>5</sup>.

Country	Fatality rate [%]
Poland	1.31
India	1.20
Spain	5.42
Finland	0.17
China	4.01
World	4.30

As far as incidence data may be explained by different factors like population densities, social habits' or demographic society structure it must be admitted that overestimation of fatalities in selected countries like Italy – 9%, Iran – 7.8% is caused by assignment COVID-19 as a cause of death for each COVID-19 positive patient without taking into account possible worsening for numerous coexisting diseases. On the other hand underestimation in some countries is rather caused by very initial stage of epidemic situation than better medical care or just luck.

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<sup>3</sup> USAMRIID Blue Book, Eighth Edition, September 2014:

<https://www.usamriid.army.mil/education/bluebookpdf/USAMRIID%20BlueBook%208th%20Edition%20-%20Sep%202014.pdf>

<sup>4</sup> Christl A Donnelly, Azra C Ghani, Gabriel M Leung, Anthony J Hedley, Christophe Fraser, Steven Riley, Laith J Abu-Raddad, Lai-Ming Ho, Thuan-Quoc Thach, Patsy Chau, King-Pan Chan, Tai-Hing Lam, Lai-Yin Tse, Thomas Tsang, Shao-Haei Liu, James H B Kong, Edith M C Lau, Neil M Ferguson, Roy M Anderson, Epidemiological determinants of spread of causal agent of severe acute respiratory syndrome in Hong Kong, <https://www.thelancet.com/pb-assets/Lancet/extras/03art4453web.pdf>

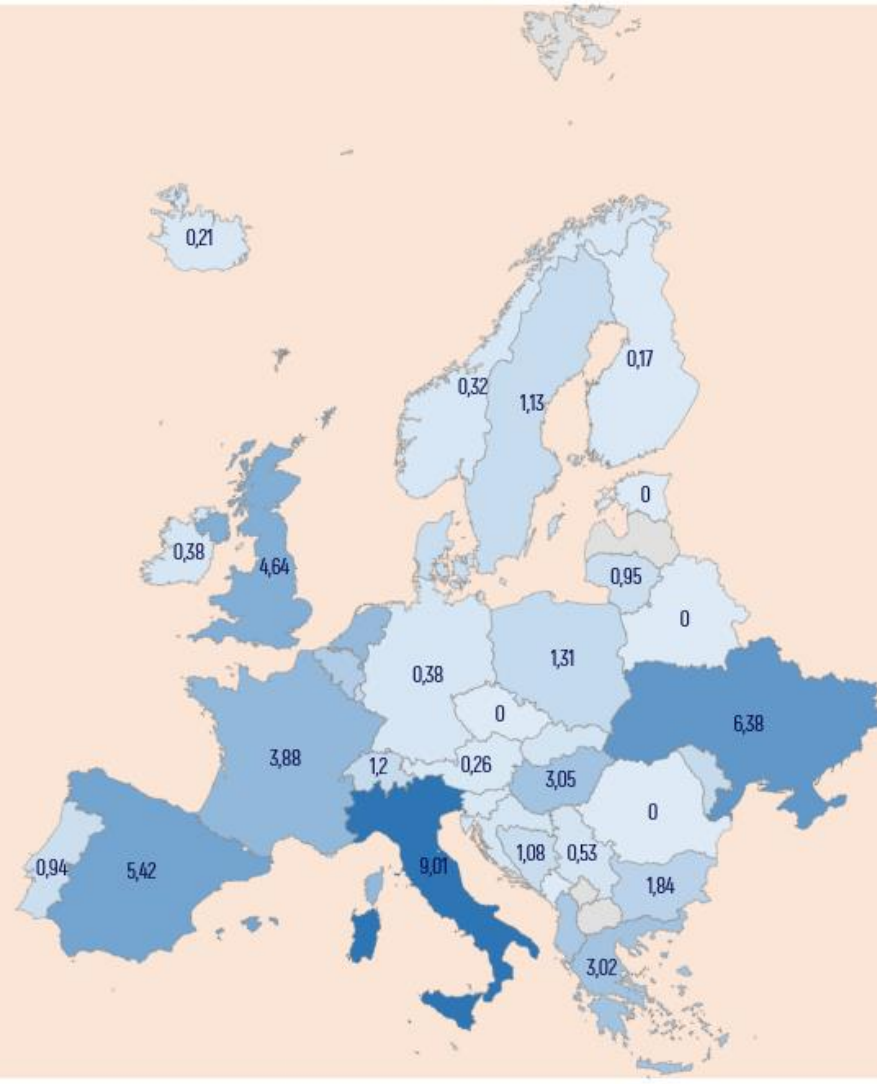
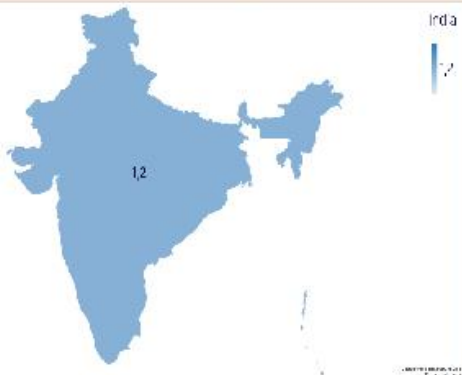
<sup>5</sup> Dominguez A, Alvarez J, Sabria M, Carmona G, Torner N, Oviedo M, Cayla J, Minguell S, Barrabeig I, Sala M, Godoy P, Camps N., Factors influencing the case-fatality rate of Legionnaires' disease. *Int J Tuberc Lung Dis.* 2009 Mar;13(3):407-12.



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### COVID-19 fatality rate in selected countries

Status: 3/22/2020, 12:13:25 (CET)

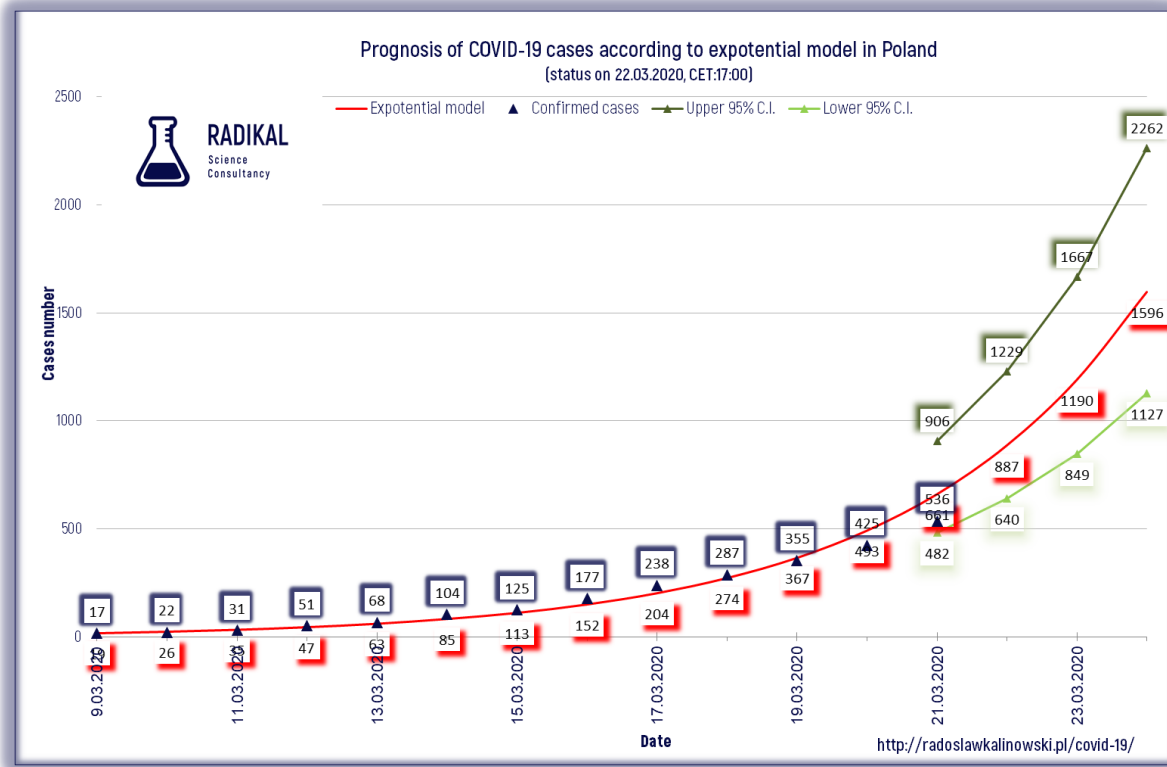


Obsługiwane przez usługę Bing  
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## 3.2 Modelling of COVID-19 epidemic

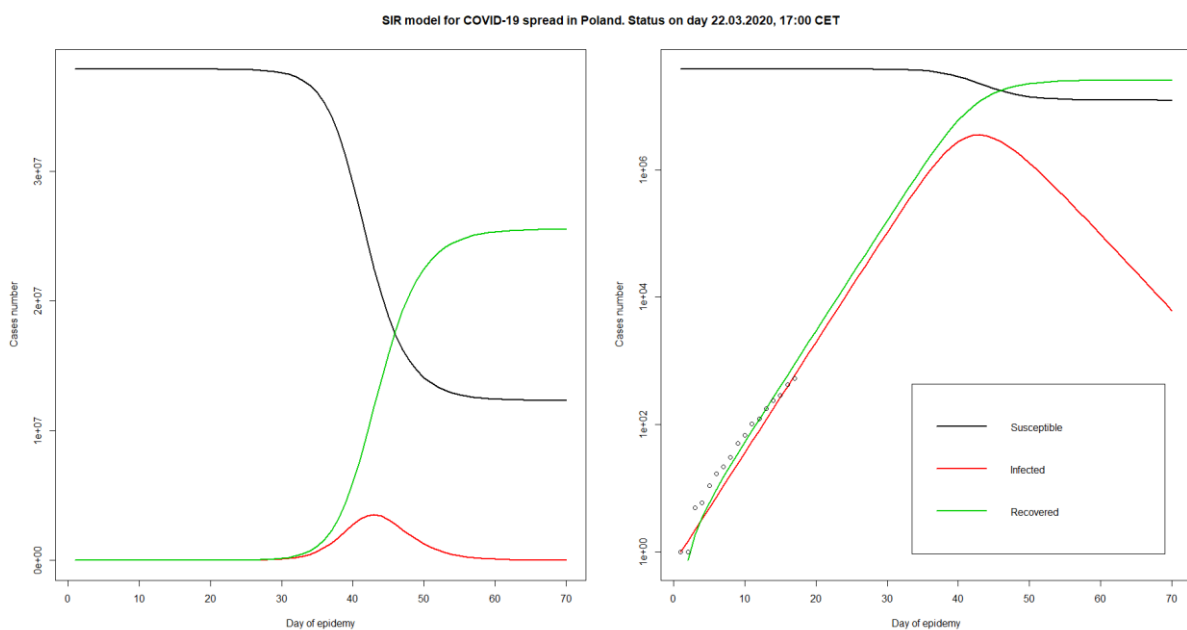
### 3.2.1 Poland

#### 3.2.1.1 Exponential model for growth of epidemic in Poland



Based on exponential model number of cases in Poland on 24<sup>th</sup> of March will be 1596 [95% C.I. 1127-2262].

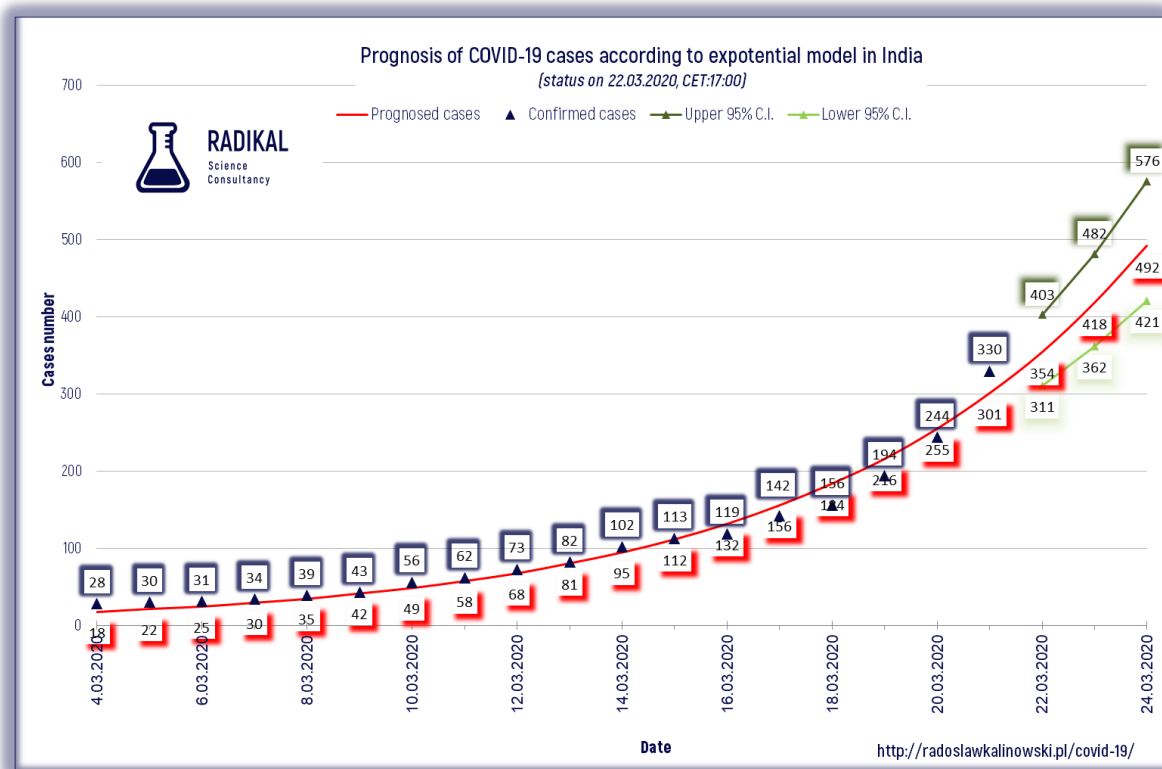
#### 3.2.1.2 SIR model of epidemic in Poland



From SIR model maximal incidence will occur at 16<sup>th</sup> of April 2020, with 3 519 479 of infected and 43 759 of fatalities, based on actual fatality rate in Poland.

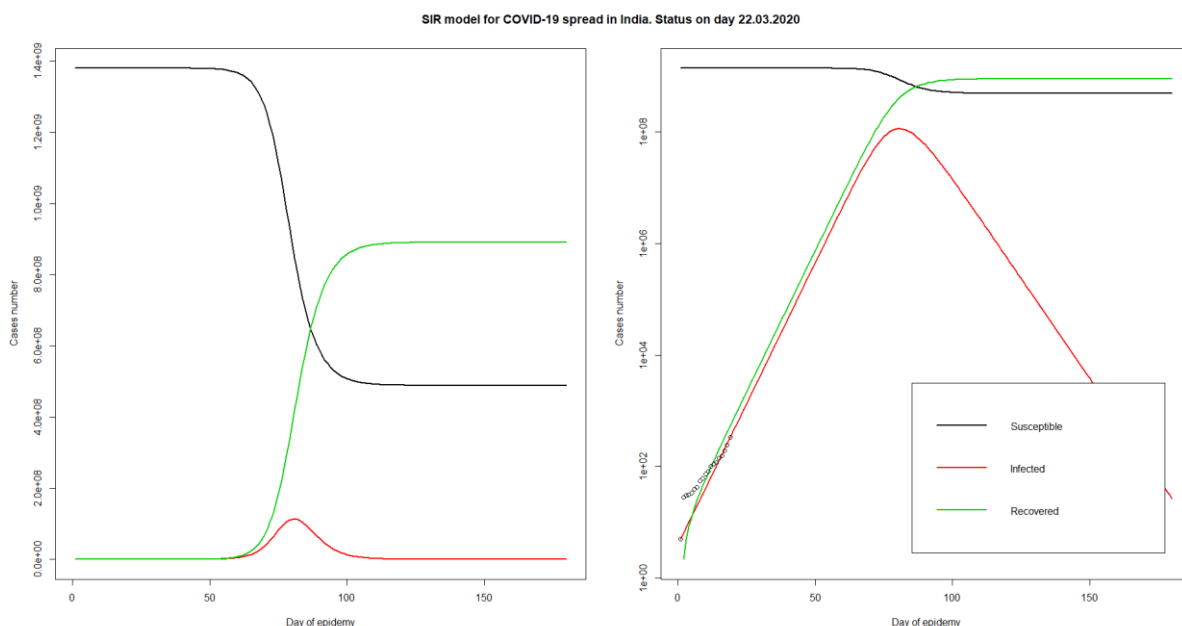
### 3.2.2 India

#### 3.2.2.1 Exponential model for growth of epidemy in India



Based on exponential model number of cases in India on 24<sup>th</sup> of March will be 492 [95% C.I. 421-576].

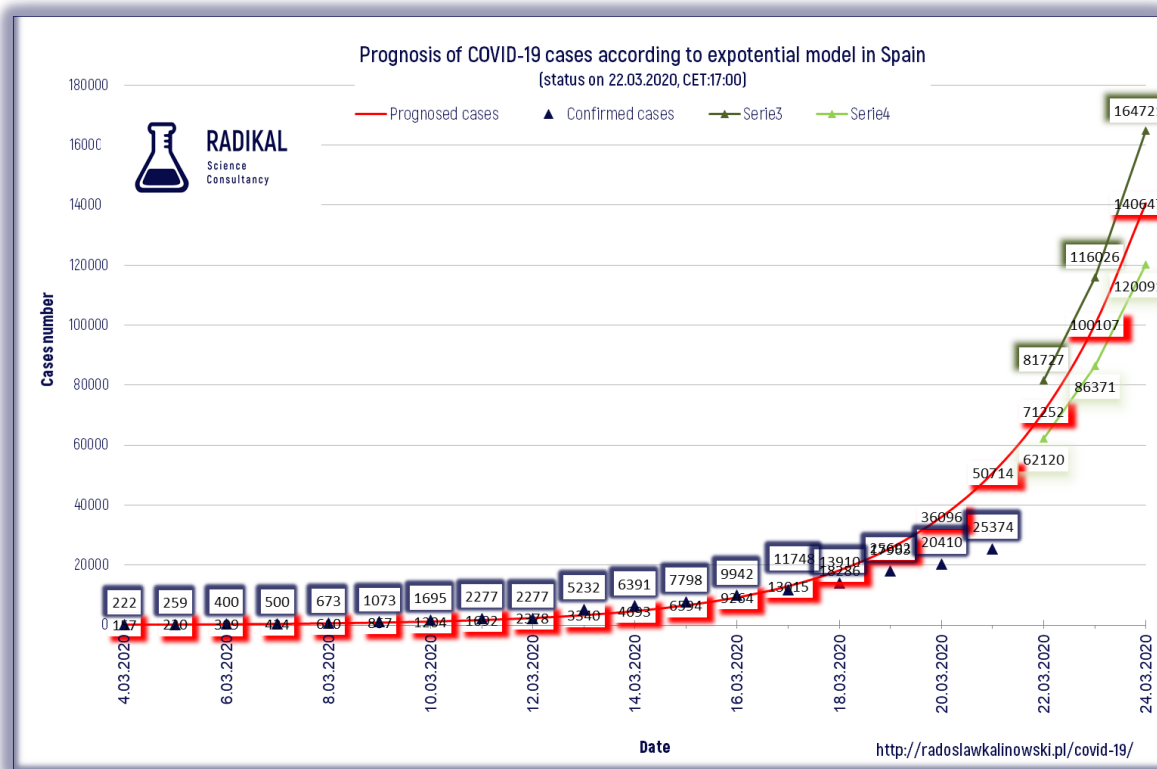
#### 3.2.2.2 SIR model of epidemy in India



From SIR model maximal incidence will occur at 23<sup>rd</sup> of May 2020, with 113 8105 68 of infected and 1 371 212 of fatalities, based on actual fatality rate in India.

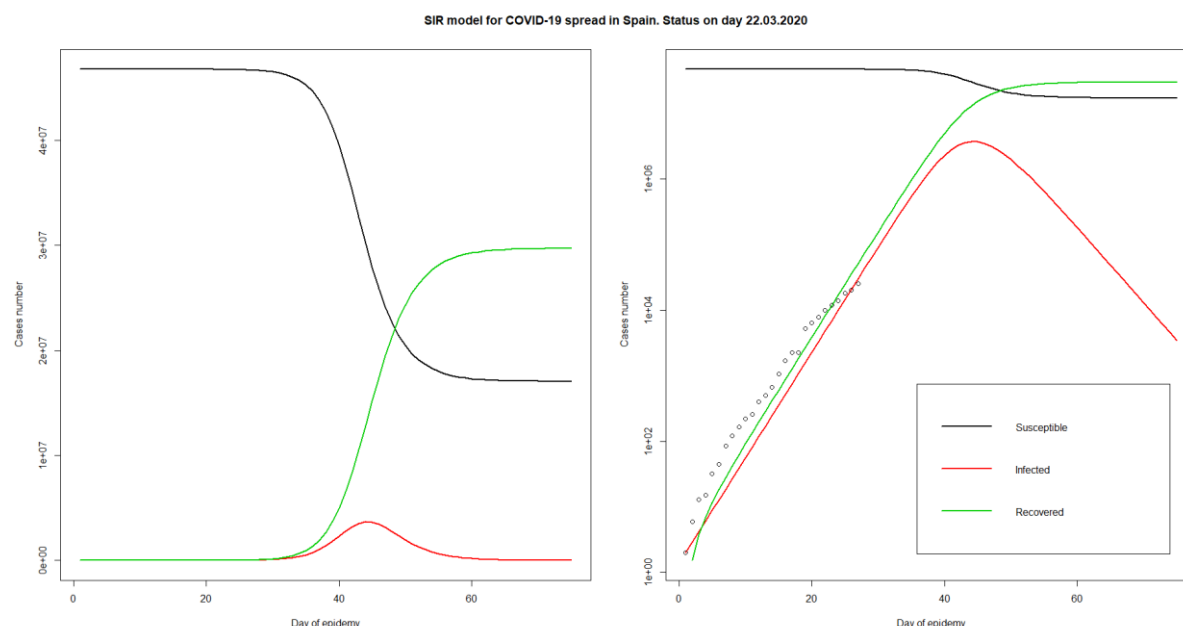
### 3.2.3 Spain

#### 3.2.3.1 Exponential model for growth of epidemy in Spain



Based on exponential model number of cases in Spain on 24<sup>th</sup> of March will be 140 647 [95% C.I. 120 091-164 721].

#### 3.2.3.2 SIR model of epidemy in Spain

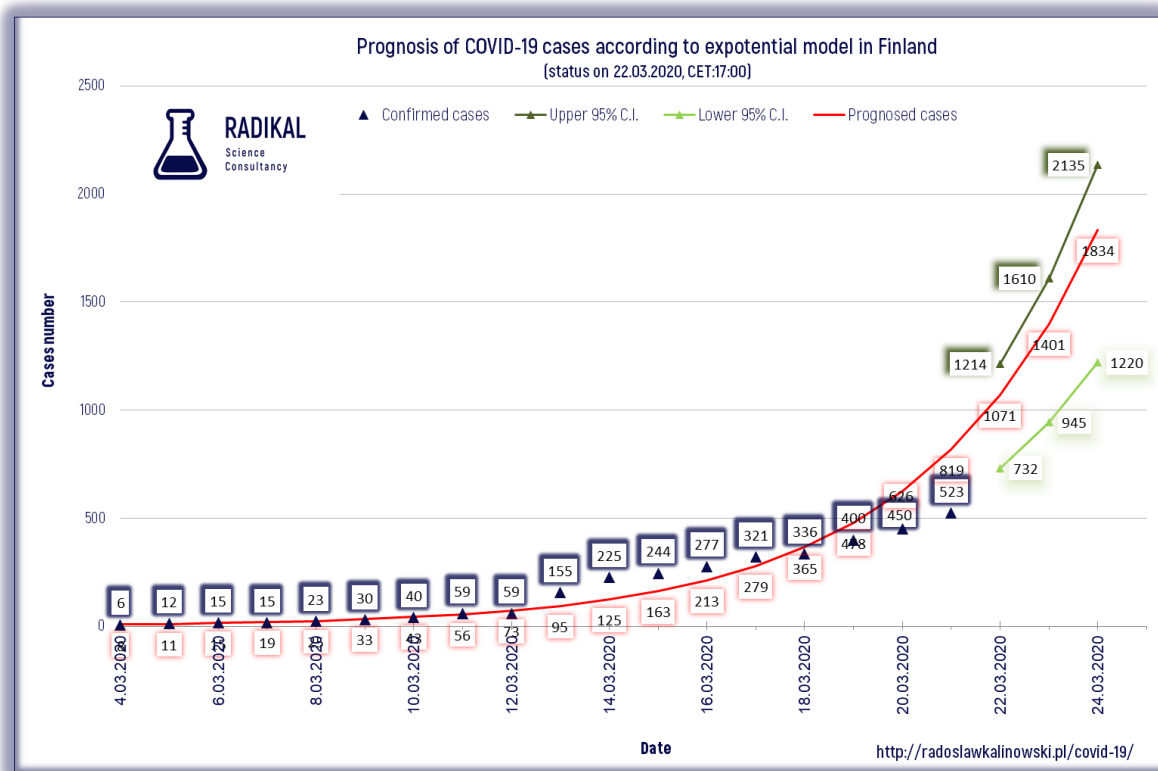




From SIR model maximal incidence will occur at 8<sup>th</sup> of April 2020, with 3 685 221 of infected and 221 845 of fatalities, based on actual fatality rate in Spain.

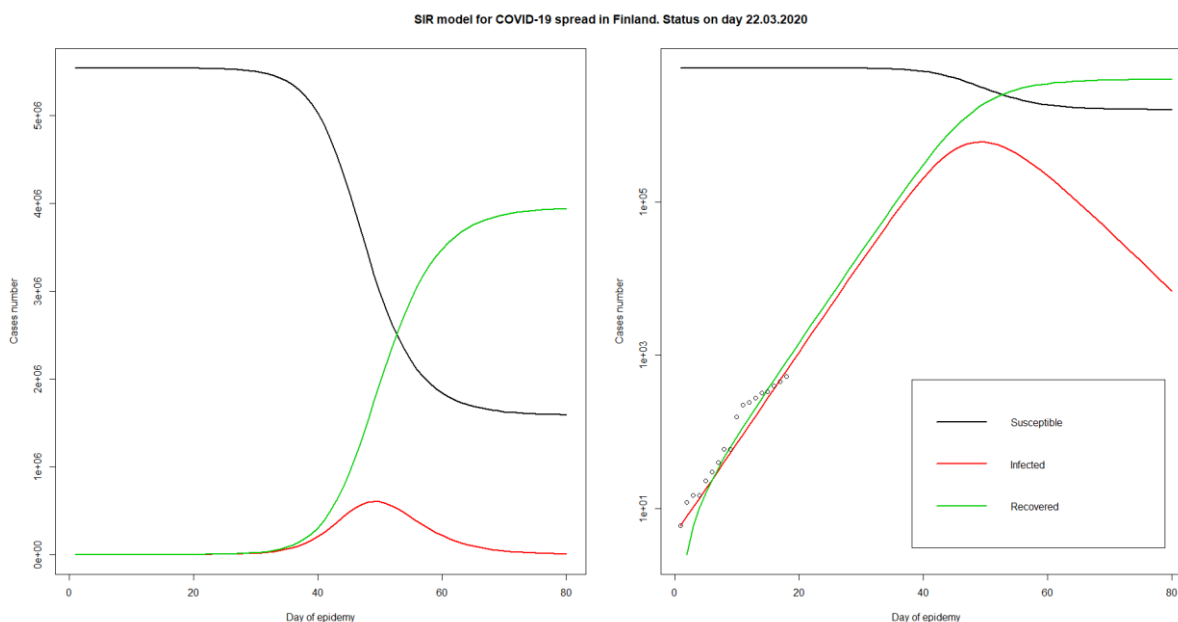
### 3.2.4 Finland

#### 3.2.4.1 Exponential model for growth of epidemy in Finland



Based on exponential model number of cases in Finland on 24<sup>th</sup> of March will be 3258 [95% C.I. 2538-4183].

#### 3.2.4.2 SIR model of epidemy in Finland



From SIR model maximal incidence will occur at 16th of April 2020, with 605 352 of infected and 1019 of fatalities, based on actual fatality rate in Finland.

## 4 Summary

Analysis indicate that different epidemiological situation related to COVID-19 outbreak occurs among countries.

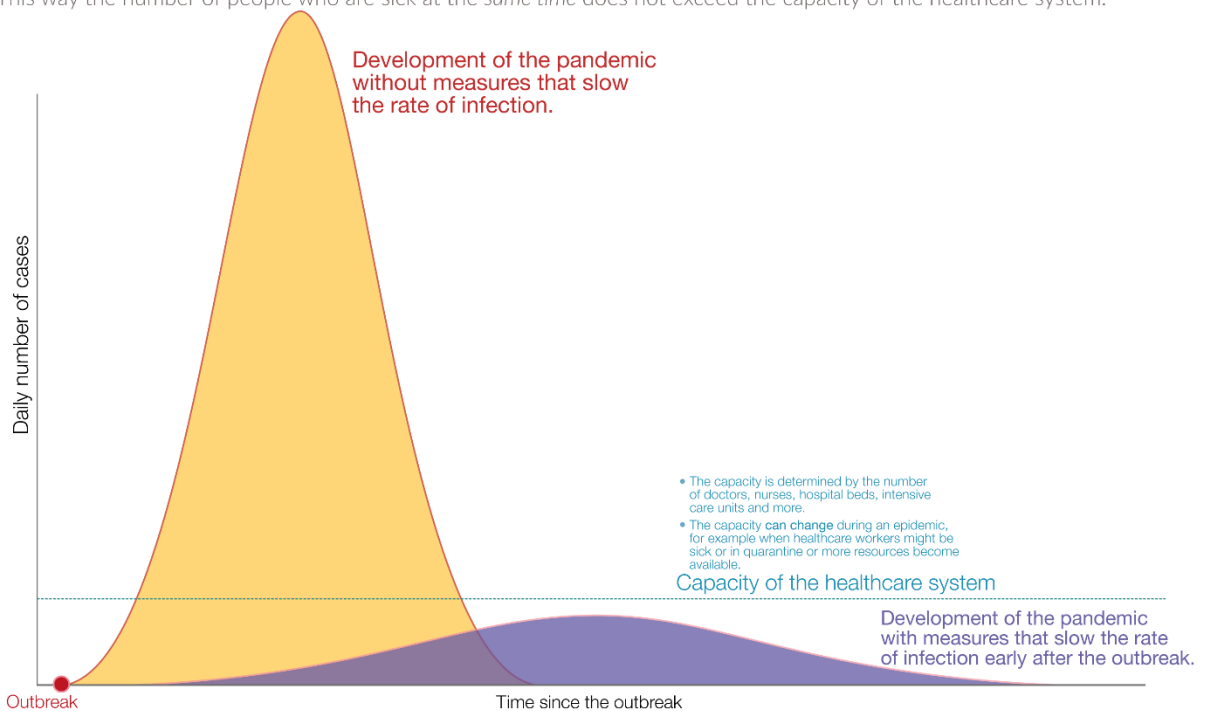
Country	Epidemy doubling time [days]
Poland	2.36
India	4.21
Spain	2.04
Finland	2.58

Currently worst situation seems to be in Spain (highest mortality and lowest doubling time) and best is in India (highest doubling time – causing flattening of pandemic curve).

### In the outbreak of an epidemic *early* counter measures are important



Their intention is to 'flatten the curve': to lower the rate of infection to spread out the epidemic. This way the number of people who are sick at the *same time* does not exceed the capacity of the healthcare system.



Based on the Centers for Disease Control and Prevention  
OurWorldinData.org · Research and data to make progress against the world's largest problems.

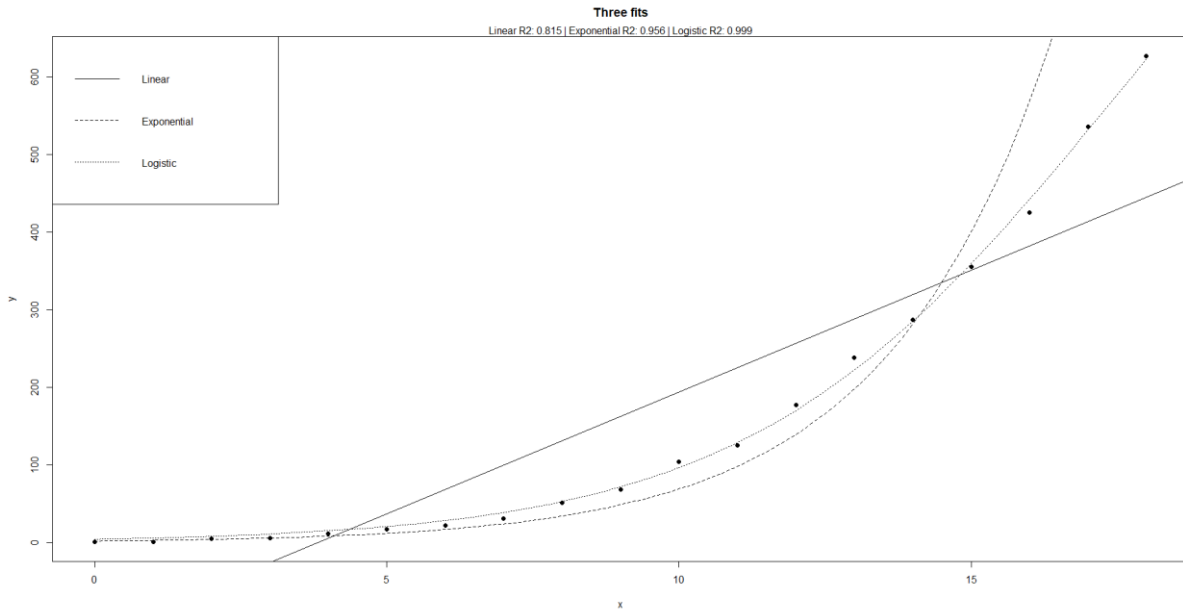
Licensed under CC BY by the author Max Roser

Source: [Our World in Data](https://ourworldindata.org)

Presented models are well established approximations for first, beginning periods of epidemy. They indicate that we all may face higher increase of cases, and fatalities with mean World's fatality rate approx. 4.3%. It was not my intention to scare anyone, just to point out that uncontrolled COVID-19 spread can be serious danger. But as new data will be available everything may change... in both directions.

## 5 Future of COVID-19

It must be noted that on such early stage of epidemic most models (even linear with  $R^2=0.815$ ) give quite good approximation of daily cases data i.e. for Polish data:



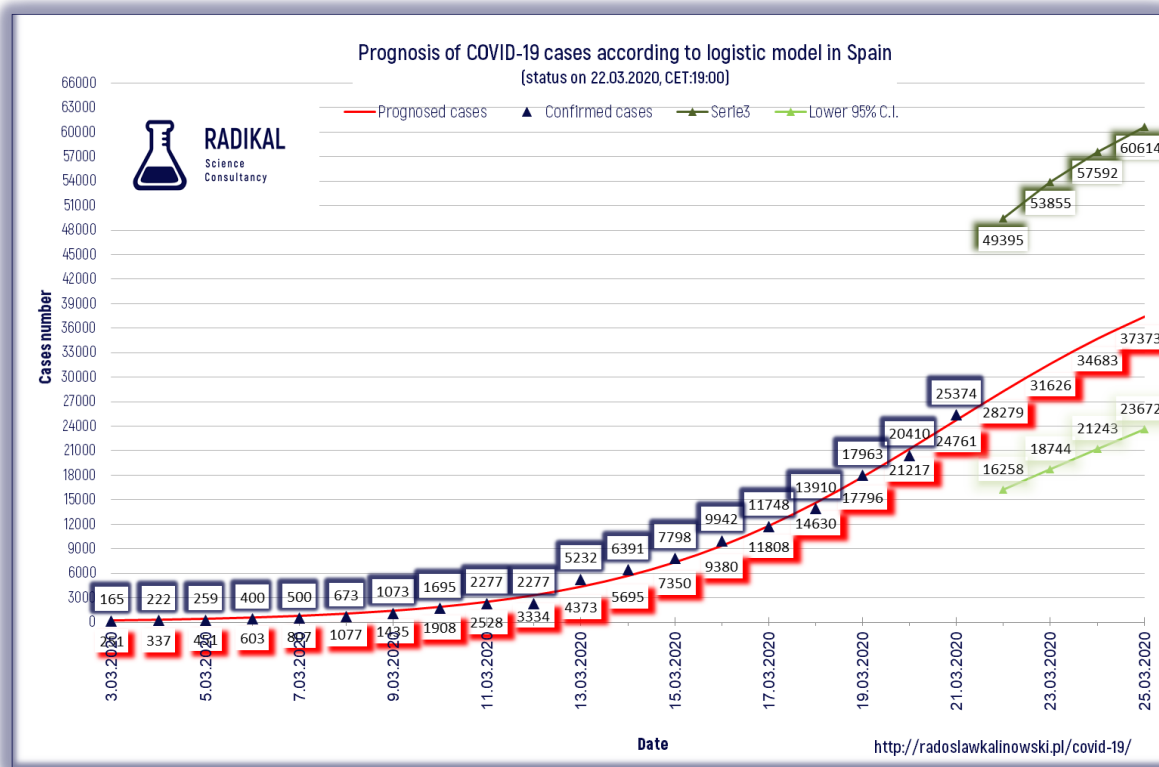
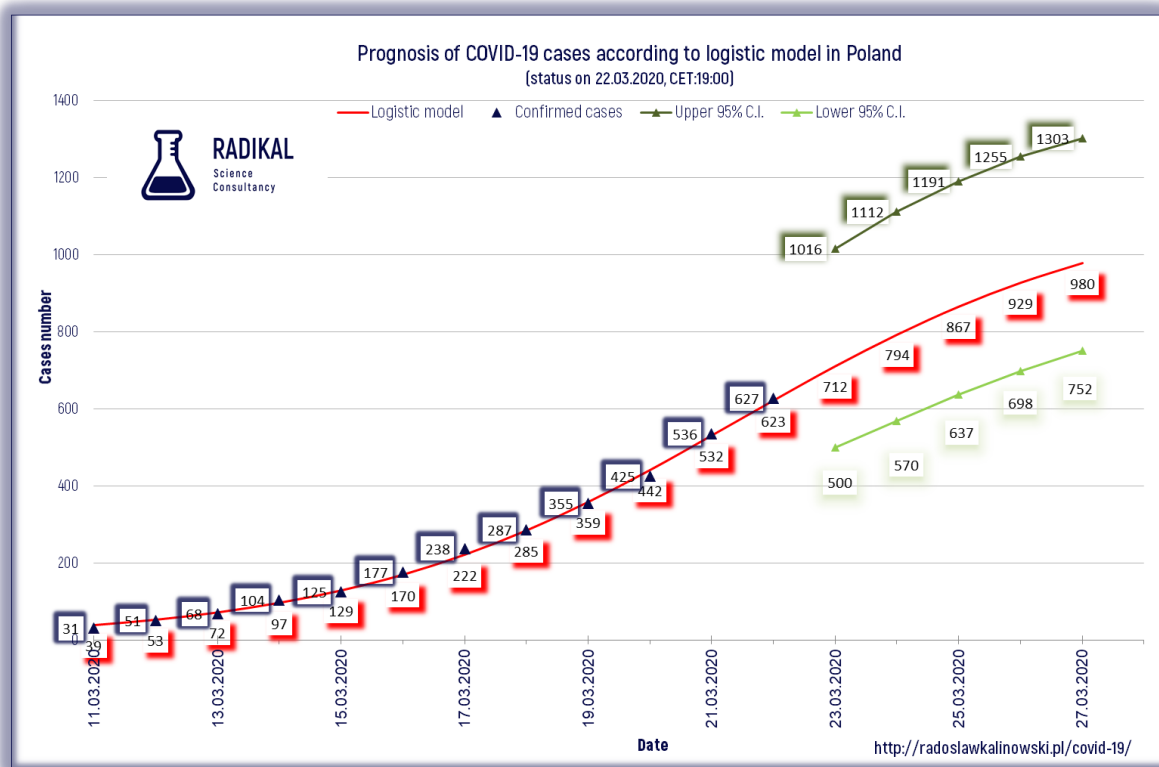
As mentioned earlier exponential and SIR models provide estimation in case of undisturbed growth of disease (without or with society induced immunity). Hopefully numerous anti-epidemic actions are taken both by authorities and responsible society.

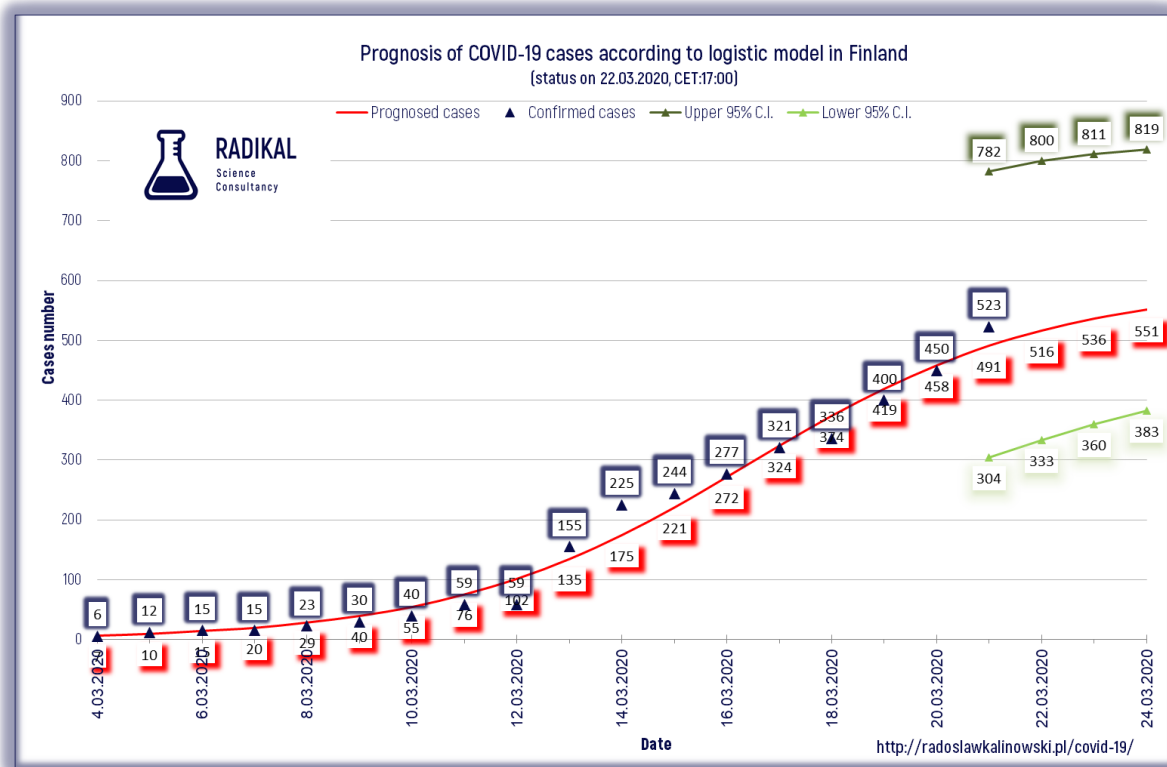
Due to that fact it seems that in case of some countries we are or (hopefully soon) will be able to switch from J-shaped exponential curves into S-shaped logistic functions. The point of such decision is reaching of so called disease inflection point. Based on actual incidence data inflection points were calculated for all countries.

Country	Estimated epidemic inflection date
Poland	22 <sup>nd</sup> – 24 <sup>th</sup> of March 2020
India	N/A <sup>1)</sup>
Spain	11 <sup>th</sup> – 16 <sup>th</sup> of April 2020
Finland	19 <sup>th</sup> – 23 <sup>rd</sup> of April 2020

<sup>1)</sup> To early stage of epidemic, logistic model do not fit

So lets' have a hope that soon for each of you such curves will better show what is going on in virus's world.





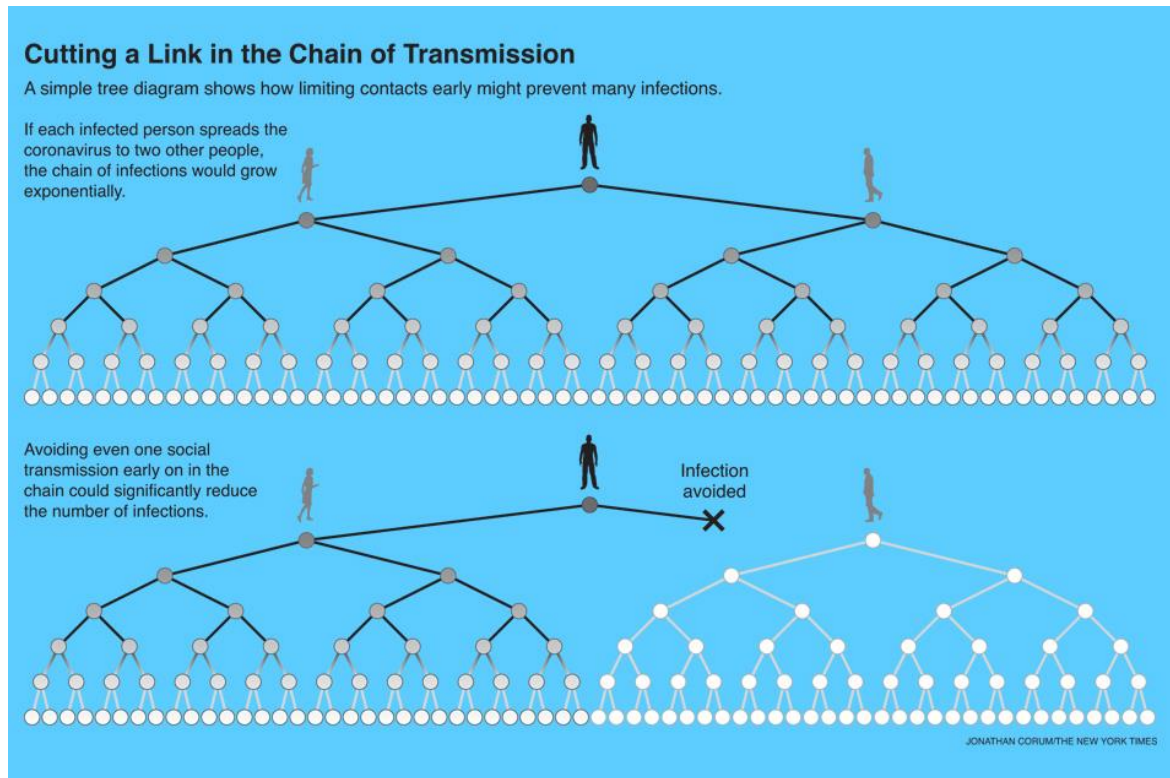
## 6 Comparison of models outputs

Will be provided in next update.

## 7 Messages to be taken

- As there are no vaccine for COVID-19 disease (YET!) the only thing we may do right now is to brake epidemic chain by cutting transmission routes via proper hand washing and keeping 1.5-2 m distance one to another.

And this will be the result:



Source: [ABC-CBN News](#)

- As there were information about mass euthanasia of pets it must be clearly stated that there are **no scientific evidence that** our **cats** or **dogs** may **transmit** the virus.



By the way... How could they?

- Use only confirmed information provided by your domestic authorities or from [WHO](#) and [EMA](#).

- Do not panic! 1000 toilet paper rolls is definitely not what you need right now.
- Additional information (mostly in Polish language) are available on my [website](#).

#StayHome

#TakeCareOfYourself

## 8 About the author

As far as you probably know, I am an experimental Ecotoxicologist since 2003, currently plant protection products regulatory affairs specialist, formerly GLP certified Test Facility Manager at [Institute of Environmental Protection – National Research Institute \(Poland\)](#), but what you rather do not know I am also (due to my previous employment at [Military Institute of Hygiene and Epidemiology](#)) graduated at 2014 Specialist in Epidemiology. And finally yes, statistical analysis and modelling of research data are also one of my scientific interests.