

Consequences from COVID-19 Simulations

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model basis

Modellierung von Beispielszenarien der SARS-CoV-2-Epidemie 2020 in Deutschland

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FG 34 für HIV/AIDS und andere sexuell oder
durch Blut übertragbare Infektionen

<http://dx.doi.org/10.25646/6571.2>

23.03.2020



detailed Information on COVID-19 (German)

podcast:

NDR Corona-Update

Prof. Dr. Christian Drosten, Robert Koch-Institut, Berlin

<https://www.ndr.de/nachrichten/info/podcast4684.html>

influence of basic reproduction number R_0

Generation	$R_0 = 3$	$R_0 = 2$	$R_0 = 1$	$R_0 = 0.5$	$R_0 = 0.1$	$R_0 = 0$
Start	1000	1000	1000	1000	1000	1000
1	3000	2000	1000	500	100	0
2	9000	4000	1000	250	10	0
3	27000	8000	1000	125	1	0
4	81000	16000	1000	62.5	0.1	0
5	243000	32000	1000	31.25	0.01	0

reproduction number

reproduction number = number of contacts x probability of infection

R_0 , basic reproduction number: without counter measures

R_{eff} effective reproduction number: with counter measures

average over all contacts in a society

model basis

day	infective	symptoms	hospital	intensive care	death
23			recovered ↑		
22			75% ↑		
21					
20				recovered ↑	
19				50% ↑ 50%	→
18					
17					
16					
15					
14		recovered ↑			
13		95.5% ↑			
12	0.05 R_0				
11	0.05 R_0				
10	0.05 R_0			25% →	
9	0.05 R_0	4.5%	→		
8	0.05 R_0				
7	0.05 R_0				
6	0.10 R_0				
5	0.10 R_0				
4	0.20 R_0				
3	0.30 R_0				
2					
1					

model extensions:

age dependence of mortality:

The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) - China, 2020
Zijian Feng et al., Chinese Center for Disease Control and Prevention, CCDC Weekly 2020, 2(8), 113-122
<https://doi.org/10.3760/cma.j.issn.0254-6450.2020.02.003>

Likelihood of survival of coronavirus disease 2019

S. Ruan, The Lancets, Infectious Diseases, March 30, 2020
[https://doi.org/10.1016/S1473-3099\(20\)30257-7](https://doi.org/10.1016/S1473-3099(20)30257-7)

time dependence of infectivity:

Temporal dynamics in viral shedding and transmissibility of COVID-19

X. He et al., preprint server www.medrxiv.org, 18.03.2020
<https://doi.org/10.1101/2020.03.15.20036707>



7



spatially resolved models

J Biol Phys (2011) 37:133–140
DOI 10.1007/s10867-010-9204-6

ORIGINAL PAPER

Reinfection induced disease in a spatial SIRI model

Li-Peng Song · Zhen Jin · Gui-Quan Sun

Statistical Methods in Medical Research 1995; **4**: 160–183

Spatial heterogeneity, nonlinear dynamics and chaos in infectious diseases

BT Grenfell Zoology Department, **A Kleczkowski**, **CA Gilligan** Department of Plant Sciences, Cambridge University, Cambridge, UK and **BM Bolker** Department of Ecology and Evolutionary Biology, Princeton University, Princeton, New Jersey, USA



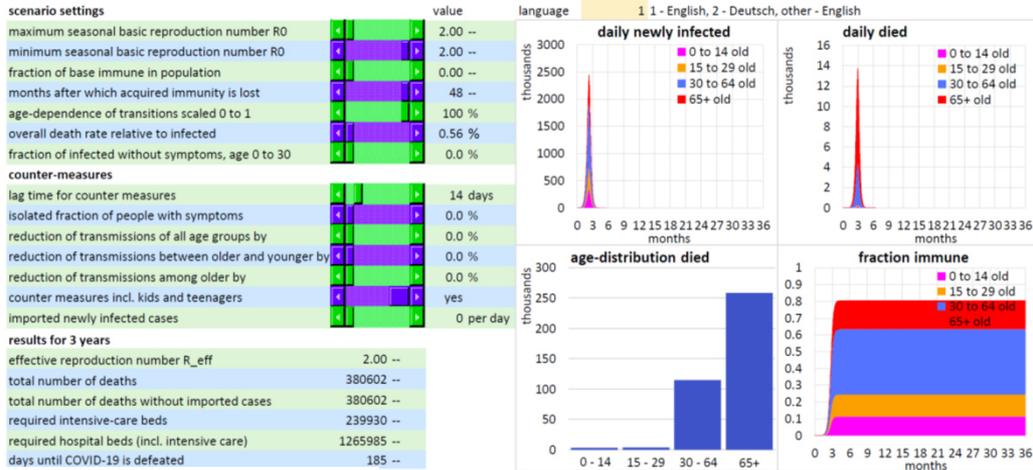
8



COVID-19 simulator - see disclaimer

COVID-19 Simulator

Version 1.00 Author: Andreas Pfennig, Details and disclaimer see here.



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9



reproduction number

reproduction number = number of contacts x probability of infection

R_0 , basic reproduction number: without counter measures

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average over all contacts in a society



10



from an interview with working parents

Question:

Are parents permitted to bring the kids to their grandparents even though that increases the grandparents' risk for infection with severe outcome?

Answer:

Everyone has to decide that for him or herself.

ethically acceptable?

individual freedom ↔ societal consequences ↔ individual obligations

conclusions 1

- measures 'only' to ensure that hospitals can manage the demand:
 - correspond to reaching herd immunity
 - always leads to many deaths
 - ⇒ unacceptable & eradication with little further increased effort
- reduce chances for transmission as much as possible
- isolating elderly:
 - does not avoid death of middle aged
 - but slows down spreading of virus - if not compensated by more other contacts
 - ⇒ in real life presumably of limited effect
- isolating kids and teenagers essential, but unknown, if not infected or only less symptoms
- scientists design processes - not only facts for policymakers

conclusions 2

■ past:

- delay to start with counter measures increased number of deaths

■ now, phase 1, R_{eff} as low as possible:

- reduce transmissions as much as possible for maximum reduction of virus in shortest time, only after that relaxation of measures with still $R_{\text{eff}} < 1$

■ future, phase 2, R_{eff} reliably below 1:

- keep transmissions low
- isolate people with symptoms.
- mass meetings: concerts, cinema, theater?
- face/breathing mask mandatory, no competition with professional masks, not own protection, dry/wash at 60°C
- is that enough for school, university, public transport, etc.?
- why not also for ordinary cold and flue?

filtration efficiency self-made masks, single layer

	bacterium 1 μm	Corona virus 0.16 μm	virus MS2 0.023 μm
100% cotton T-shirt	69.4%		50.9%
tea towel	83.2%		72.5%
pillowcase	61.3%		57.1%
surgical mask, class I	96.3%		89.5%
professional mask, FFP3	99% (0.6 μm)		

Quelle:

A. Davies, K.-A. Thompson, K. Giri, G. Kafatos, J. Walker, A. Bennett

Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic?

Disaster Medicine and Public Health Preparedness, 7(4), August 2013, 413-418

<https://doi.org/10.1017/dmp.2013.43>

conclusions 3

- COVID-19 and climate change & renewable-energy transition
 - less environmental damage for some months
 - economic power for renewable-energy transition lost by shutdown but required for renewable-energy transition
 - new view on interaction individual freedom - consequences for society

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