

The post-lockdown society: challenges of social and mathematical predictions

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19 May 2020

Do you know who this is?



- Prof. Neil Ferguson
 - Mathematical epidemiologist at Imperial College London
 - Scientific Advisor to UK Government


16 March 2020

Imperial College COVID-19 Response Team

Report 9: Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand

Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani, Natsuko Imai, Kylie Ainslie, Marc Baguelin, Sangeeta Bhatia, Adhiratha Boonyasiri, Zulma Cucunubá, Gina Cuomo-Dannenburg, Amy Dighe, Iliaria Dorigatti, Han Fu, Katy Gaythorpe, Will Green, Arran Hamlet, Wes Hinsley, Lucy C Okell, Sabine van Elsland, Hayley Thompson, Robert Verity, Erik Volz, Haowei Wang, Yuanrong Wang, Patrick GT Walker, Caroline Walters, Peter Winskill, Charles Whittaker, Christl A Donnelly, Steven Riley, Azra C Ghani.

Prediction: based upon mathematical models

No action taken  500.000 deaths in UK!

MATHEMATICS

exponential growth

R_0

moving averages

flattening the curve

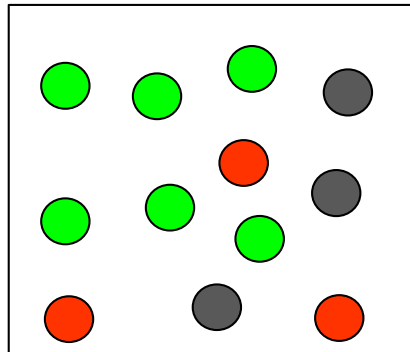
the R-number

Underlying basic principles



- Two modelling approaches

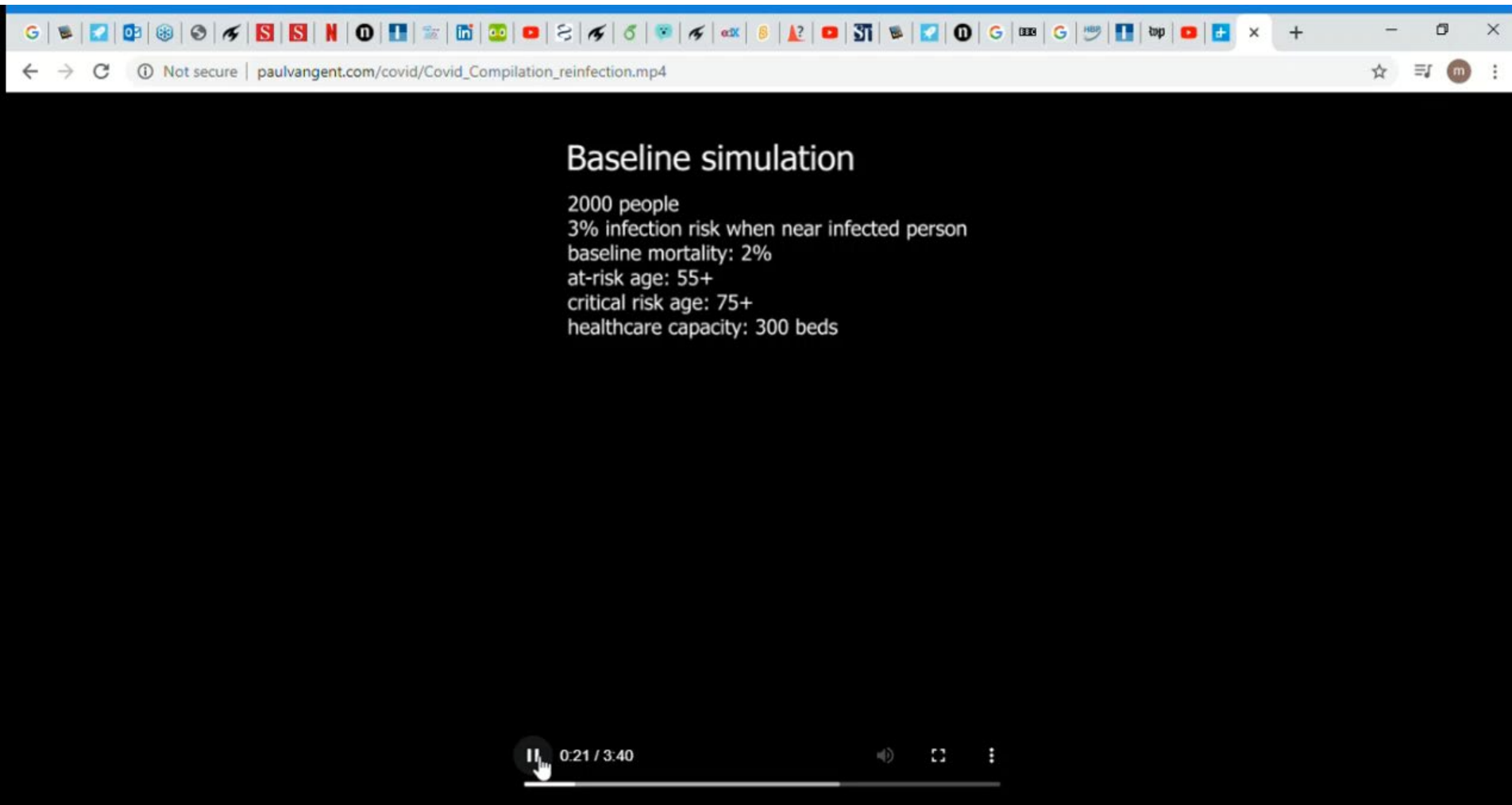
- Agent based



- Equation based

$$\begin{aligned}\frac{dS}{dt} &= -\beta SI \\ \frac{dI}{dt} &= \beta SI - \gamma I \\ \frac{dR}{dt} &= \gamma I\end{aligned}$$

Some cool simulators: agent based



Baseline simulation

- 2000 people
- 3% infection risk when near infected person
- baseline mortality: 2%
- at-risk age: 55+
- critical risk age: 75+
- healthcare capacity: 300 beds

0:21 / 3:40

The screenshot shows a web browser window with a video player. The video player is paused at 0:21 / 3:40. The browser's address bar shows the URL 'paulvangent.com/covid/Covid_Compilation_reinfection.mp4'. The video player interface includes a play/pause button, a progress bar, and volume controls.



neil.jpg neil.jpg GoToWebinar Ope...exe 1.1 Doolhof Start -....sb3 1.1 Doolhof Start -....sb3 Show all X

The screenshot shows a Windows taskbar with several open applications. From left to right, the visible taskbar items are: 'neil.jpg', 'neil.jpg', 'GoToWebinar Ope...exe', '1.1 Doolhof Start -....sb3', and '1.1 Doolhof Start -....sb3'. There is also a 'Show all' button and a close button 'X' on the right.



- **Paul van Gent:** post-doc at Faculty of CiTG
https://github.com/paulvangentcom/python_corona_simulation



Some cool simulators: equation based

On average, each ●...

Infects 1 ● per 4 days
(at the start of the epidemic)

Takes 10 days to go from ● to ●

Simulate 1.0 years in 10 seconds

▶ Start

Reset All

● Susceptible: 99.999%

● Infectious: 0.001%

● Recovered: 0.000%

jan 2020 | apr 2020 | jul 2020 | oct 2020

And *that's* where that famous curve comes from! It's not a bell

neil.jpg | neil.jpg | GoToWebinar Ope...exe | 1.1 Doolhof Start -....sb3 | 1.1 Doolhof Start -....sb3 | Show all



<https://ncase.me/covid-19/>



Equation based approach on networks



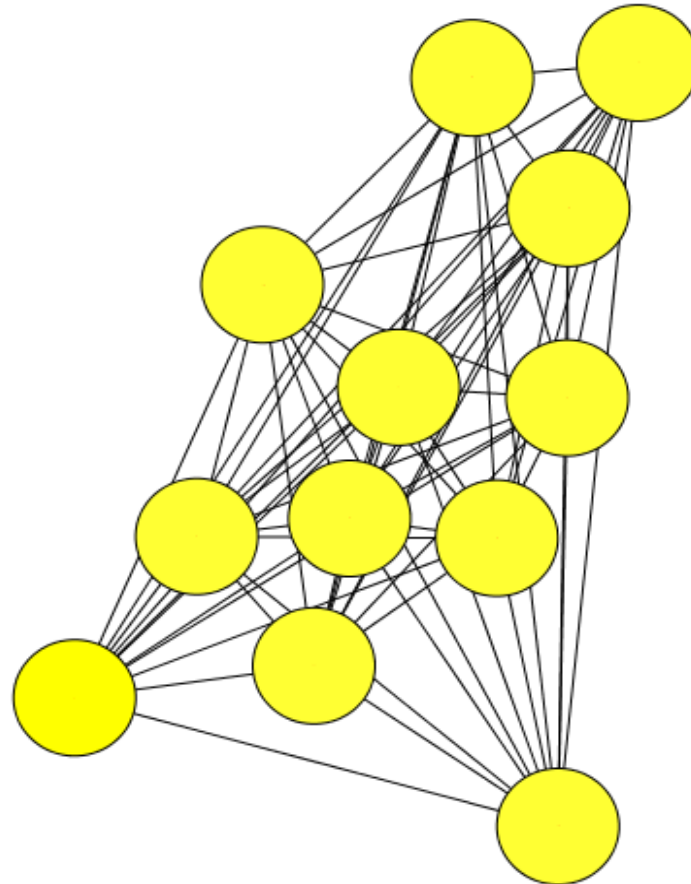
4th May 2020

Imperial College COVID-19 Response Team

Report 20: Using mobility to estimate the transmission intensity of COVID-19 in Italy: A subnational analysis with future scenarios

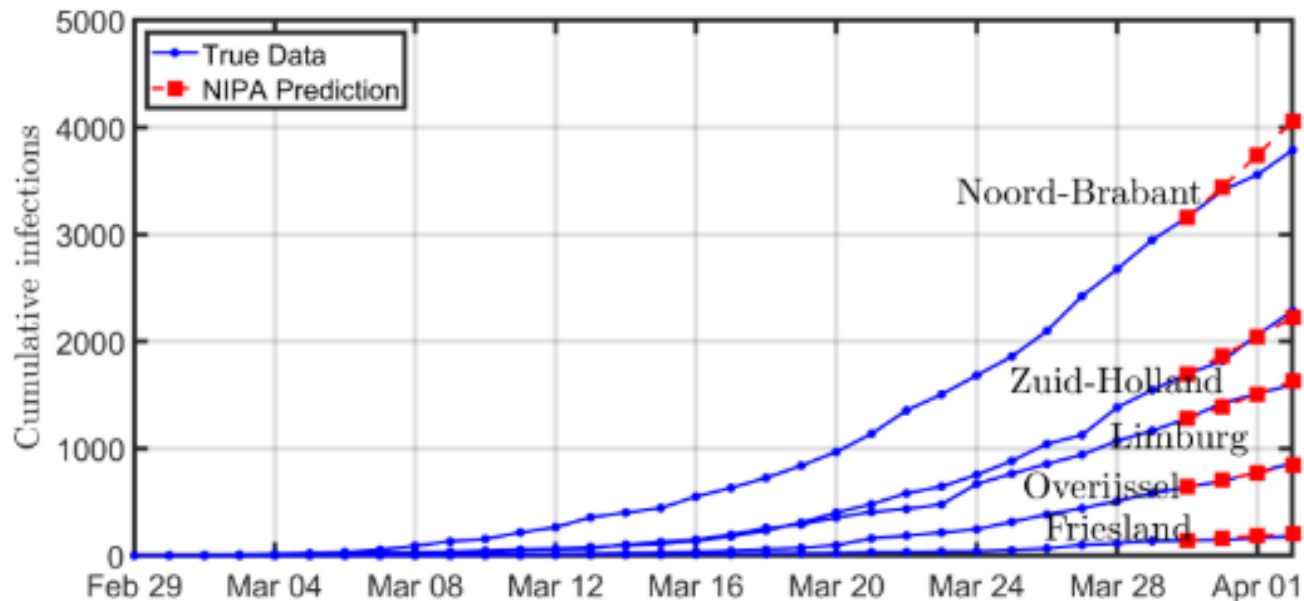
occur, the number of deaths averted is likely to be considerably lower in both scenarios. It should be noted that in our model we do not account for cross-region movement, which, given increased mobility, is likely to increase infections and subsequently deaths, in regions not experiencing major epidemics.

Equation based approach on networks



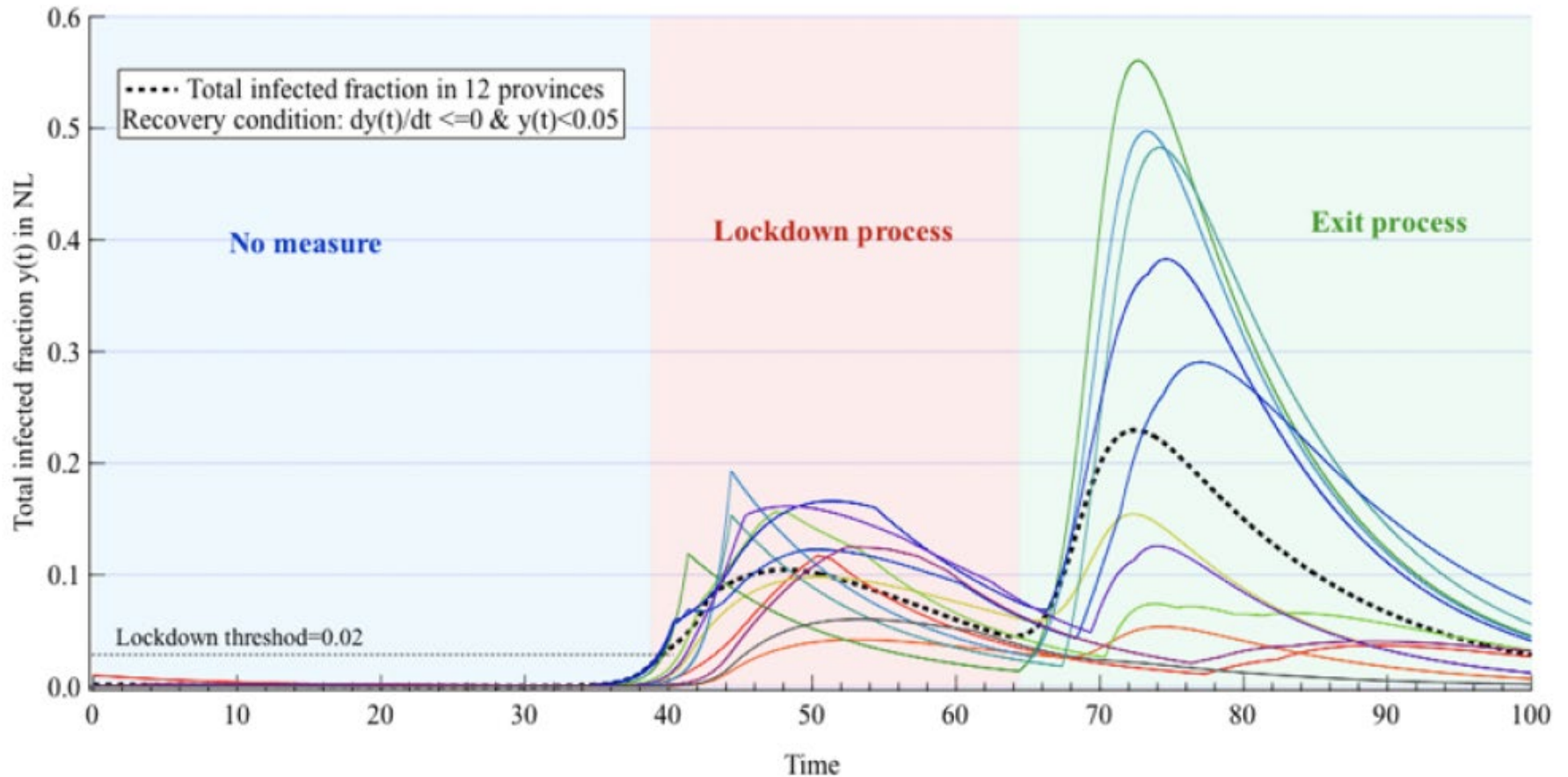
Equation based approach on networks

- NIPA = Network Inference-based Prediction Algorithm



- Apply NIPA to evaluate Exit Strategies

Equation based approach on networks



Exit Strategies

- Relaxation of measures post-lockdown
 - public gatherings
 - school closures
 - social distancing
 - mobility restrictions
 - case-based measures
- Exit Strategy is combination of
 - Which measures?
 - When?
 - Where?
 - For whom?

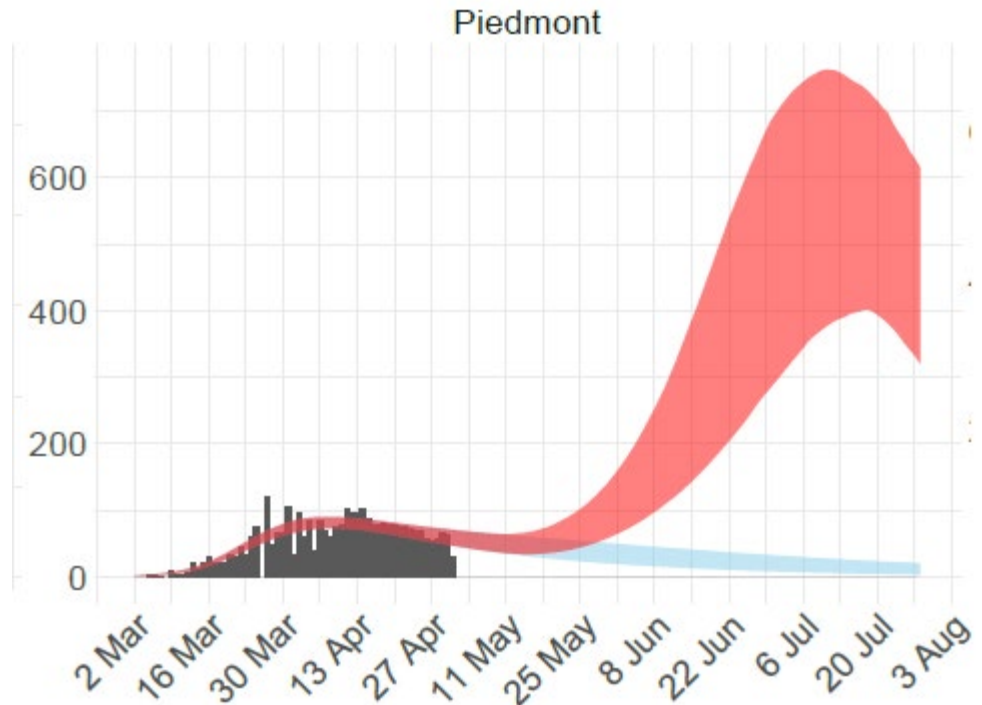
Analysis Exit Strategies: uncertainty

- Availability and quality of data
- Duration immunity
- Seasonal variation
- Undetected cases
- Human mobility
- Adherence to post-lockdown measures

Analysis Exit Strategies: uncertainty



4 May 2020



■ Mobility held constant ■ Increased mobility: 40% return to pre-lockdown level

Analysis Exit Strategies: uncertainty



Virus spreading in public transport networks: the alarming consequences of the business as usual scenario

Published on April 30, 2020



Panchamy Krishnan
Postdoctoral Researcher at TU Delft

1 article

✓ Following

Panchamy Krishnakumari and Oded Cats, Dittlab | SmartPTLab, TU Delft

- Pre-corona demand:
 - 3 infectious travelers infect 55% of all travelers in 20 days

Analysis Exit strategies



dr. Tina Comes

ESCAPE: Exit Strategies - Combining Approaches from Population behavior, mobility and Epidemiology

NIPA

