



Computational science in the COVID-19 pandemic



Opening - Center for Artificial Intelligence in Medicine (CAIM)
Bern, 19 March 2021

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Image: Nextstrain

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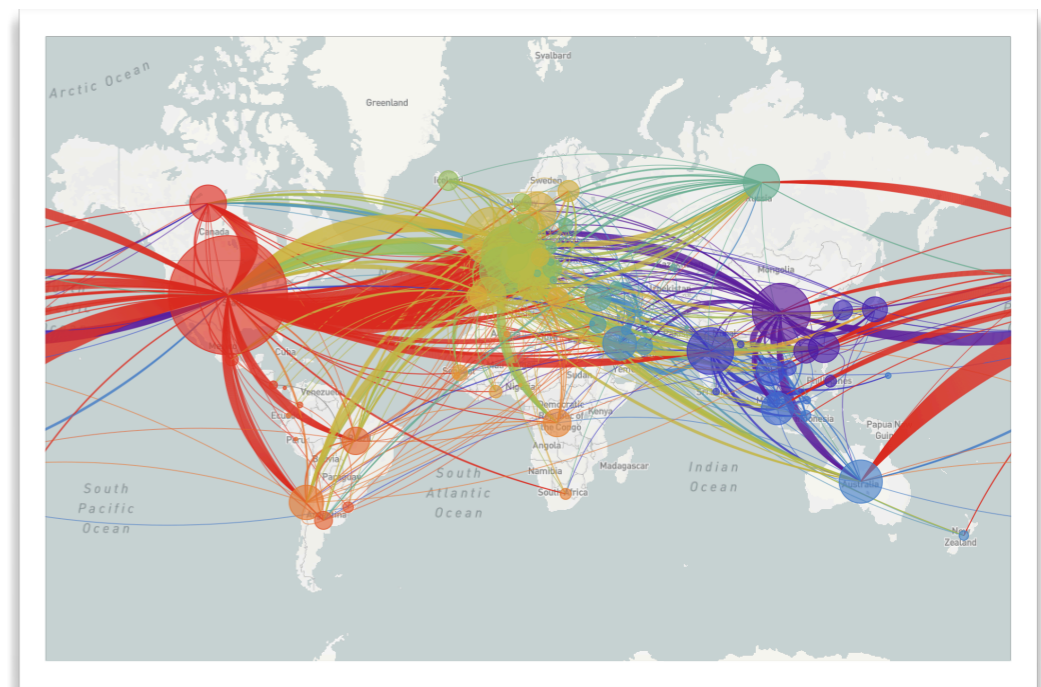
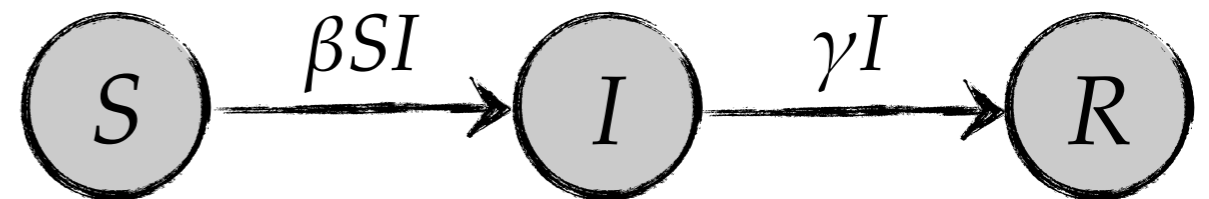
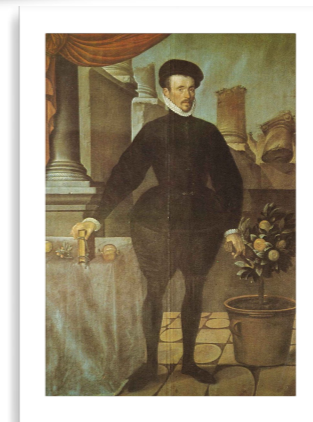
Quantitative understanding of epidemics: History

- 1610/1611: **Felix Platter** writes 'Pestbericht' in Basel
- 1766: **Daniel Bernoulli** uses differential calculus to study impact of variolation against small pox
- 1927: **Kermack & McKendrick** develop basic SIR model
- Since 2000: Global Epidemic and Mobility Model (**GLEAMviz**) and genomic epidemiology (**Nextstrain**)

'A Su^a Sūmarū

Tfür die ganze Sal. Jern so im sterbende zu Basel

In den Vorstetten	—	Starbē	1146	Aufkä	574
In der Großen St. St.	—	—	1913	—	1077
In andern Basst	—	—	724	—	315
Im Spital	—	—	185	—	474
			<hr/>		
			St. 3968	Auf. 2440	
			Und sindt brant glesen		6408.



Early January 2020



Image: The New York Times

Simulating early outbreak trajectories in Wuhan (Hubei, China)

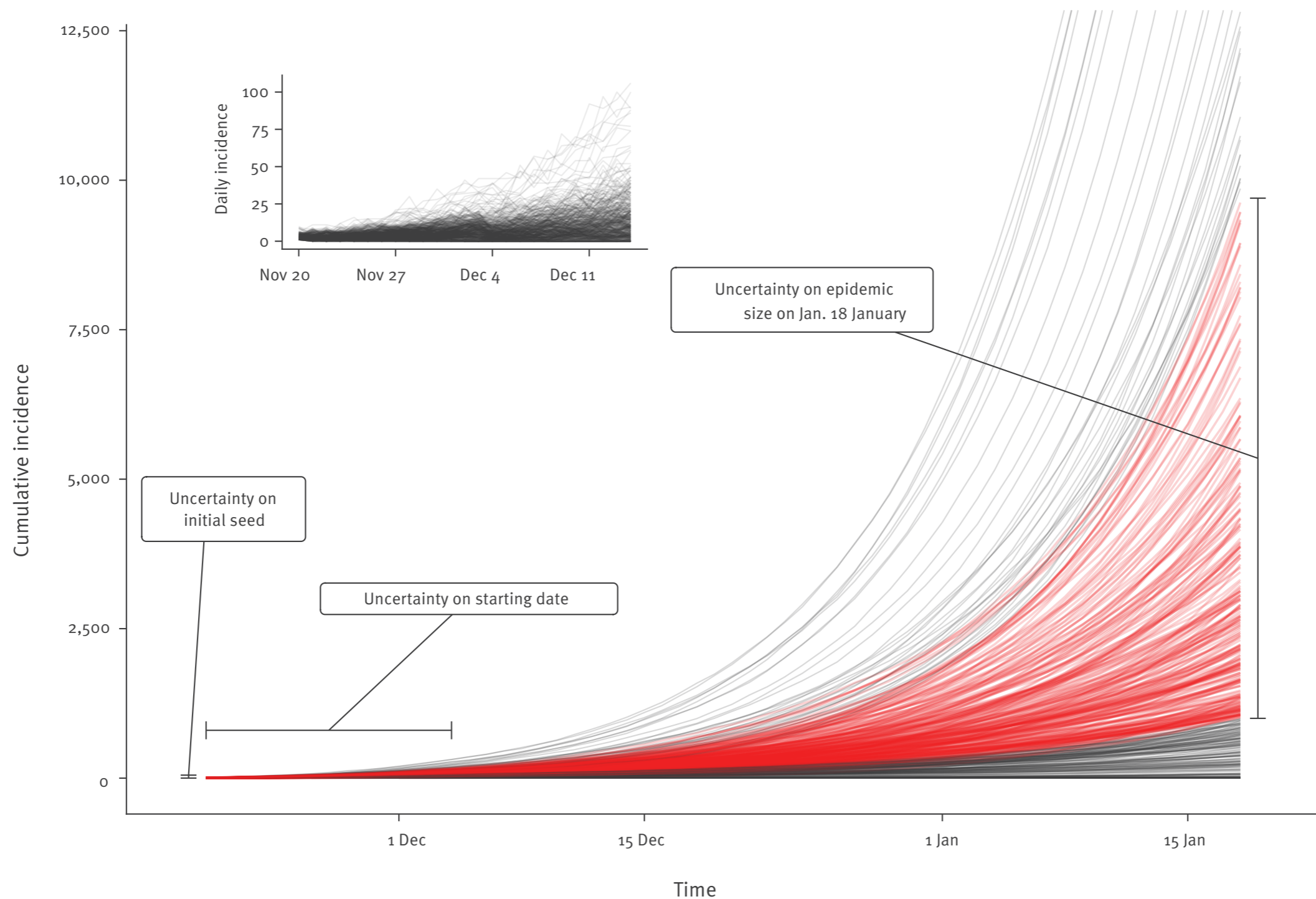


Figure: Riou & Althaus (2020, Euro Surveill)

Comparison to MERS, SARS and influenza

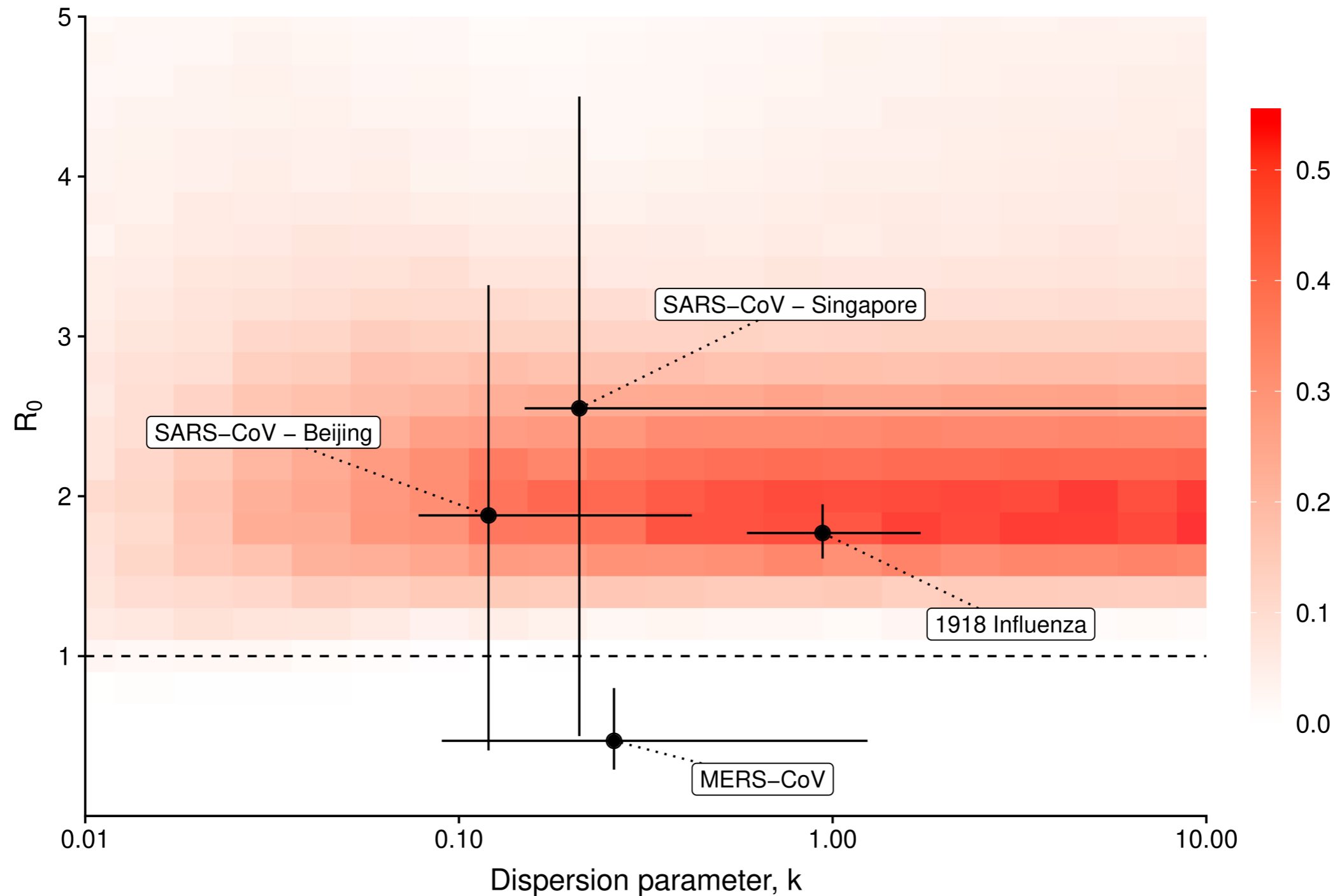


Figure: Riou & Althaus (2020, Euro Surveill)

Rapid communication

Open Access

Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020 |

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Julien Riou¹, Christian L. Althaus¹

“Transmission characteristics appear to be of similar magnitude to severe acute respiratory syndrome-related coronavirus (SARS-CoV) and pandemic influenza, indicating a risk of global spread.”



The World Health Organization (WHO) declared the novel coronavirus outbreak a public health emergency of international concern (PHEIC) on 30 January 2020.

Picture: Fabrice Coffrini

Digital contact tracing: D3-PT (Decentralized Privacy-Preserving Proximity Tracing)

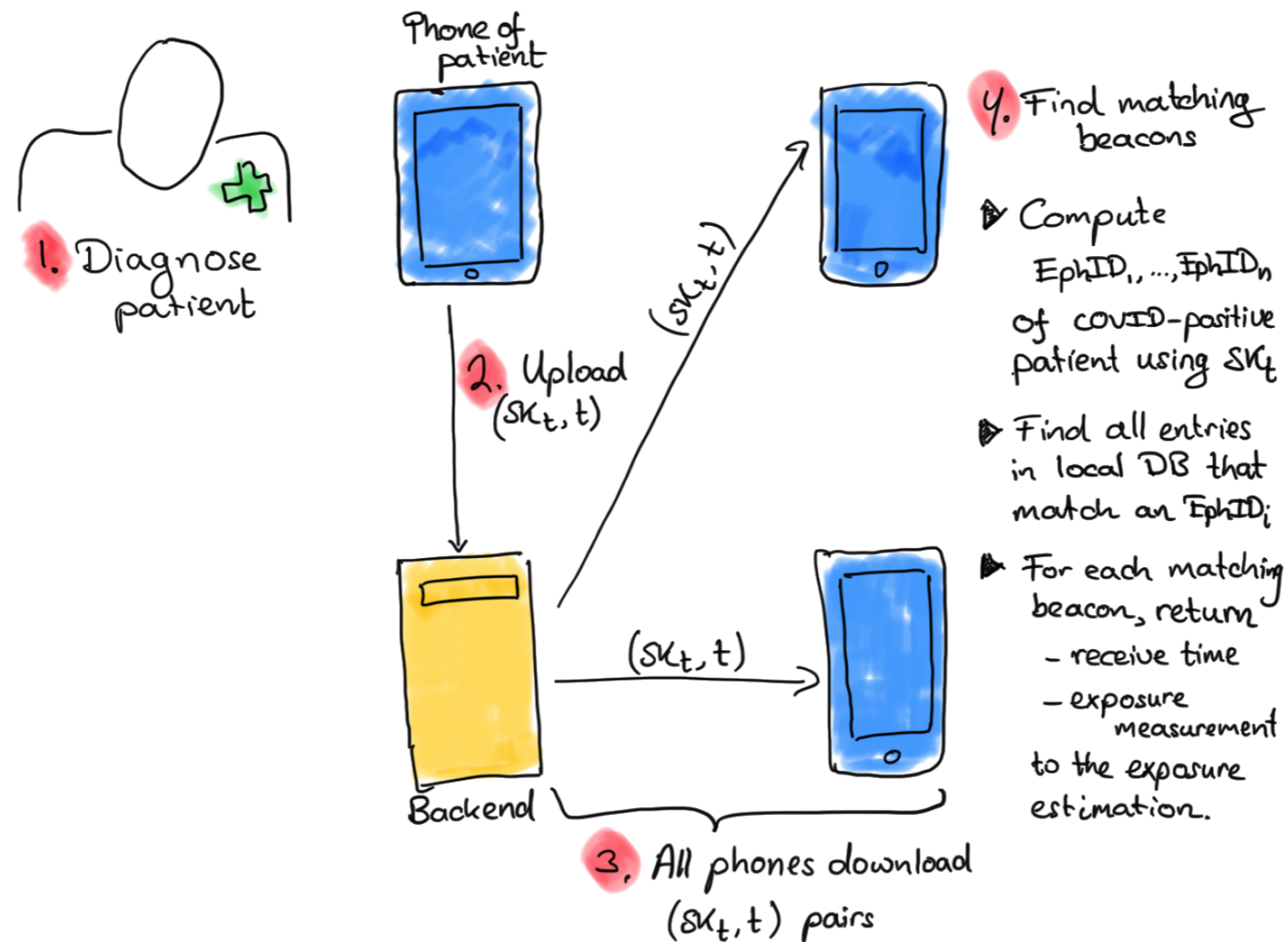
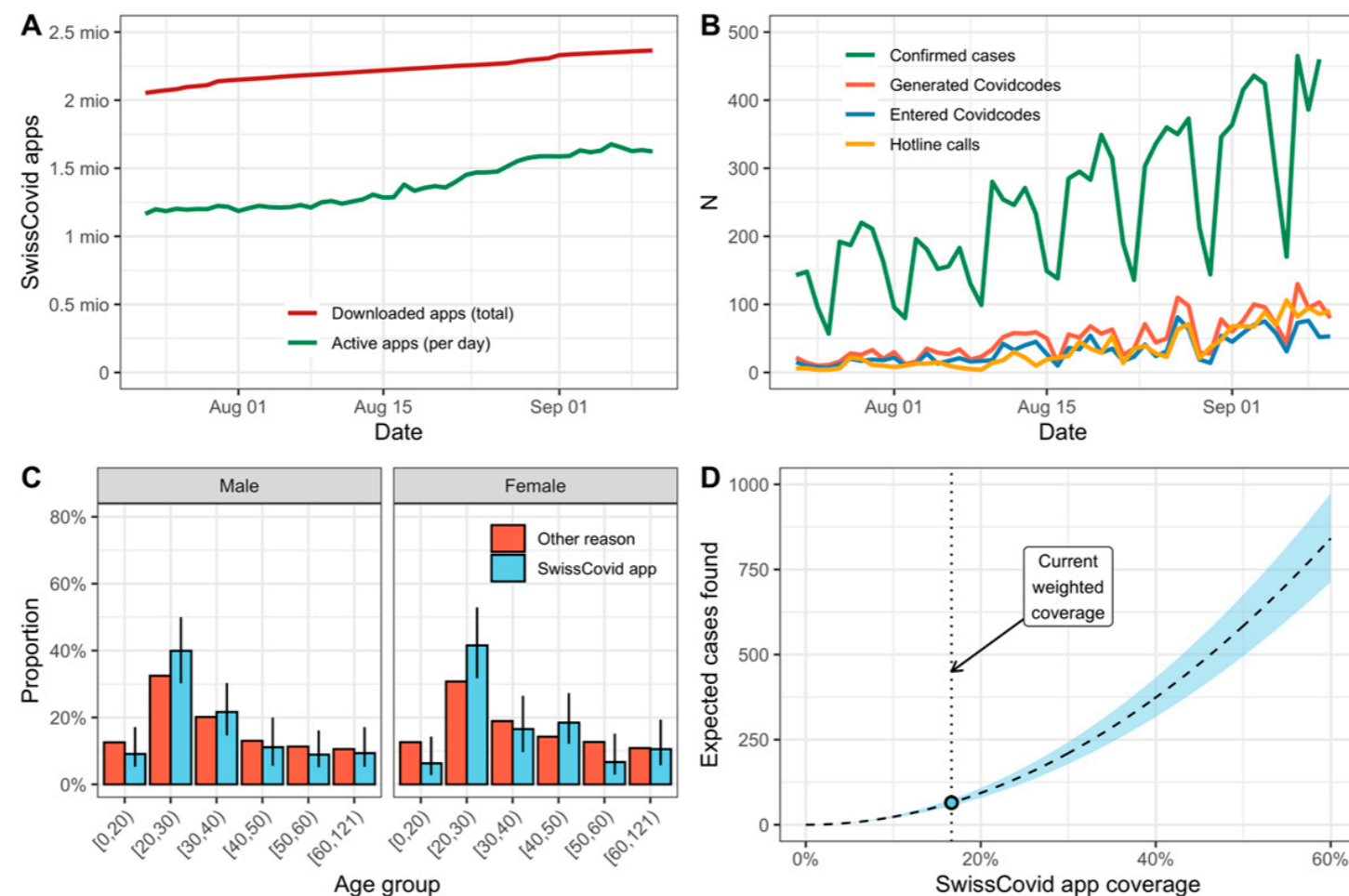


Figure PT: proximity tracing process.

A similar protocol was later implemented into the Google/Apple Exposure Notification (GAEN) system.

Effectiveness of digital contact tracing for SARS-CoV-2 in Switzerland

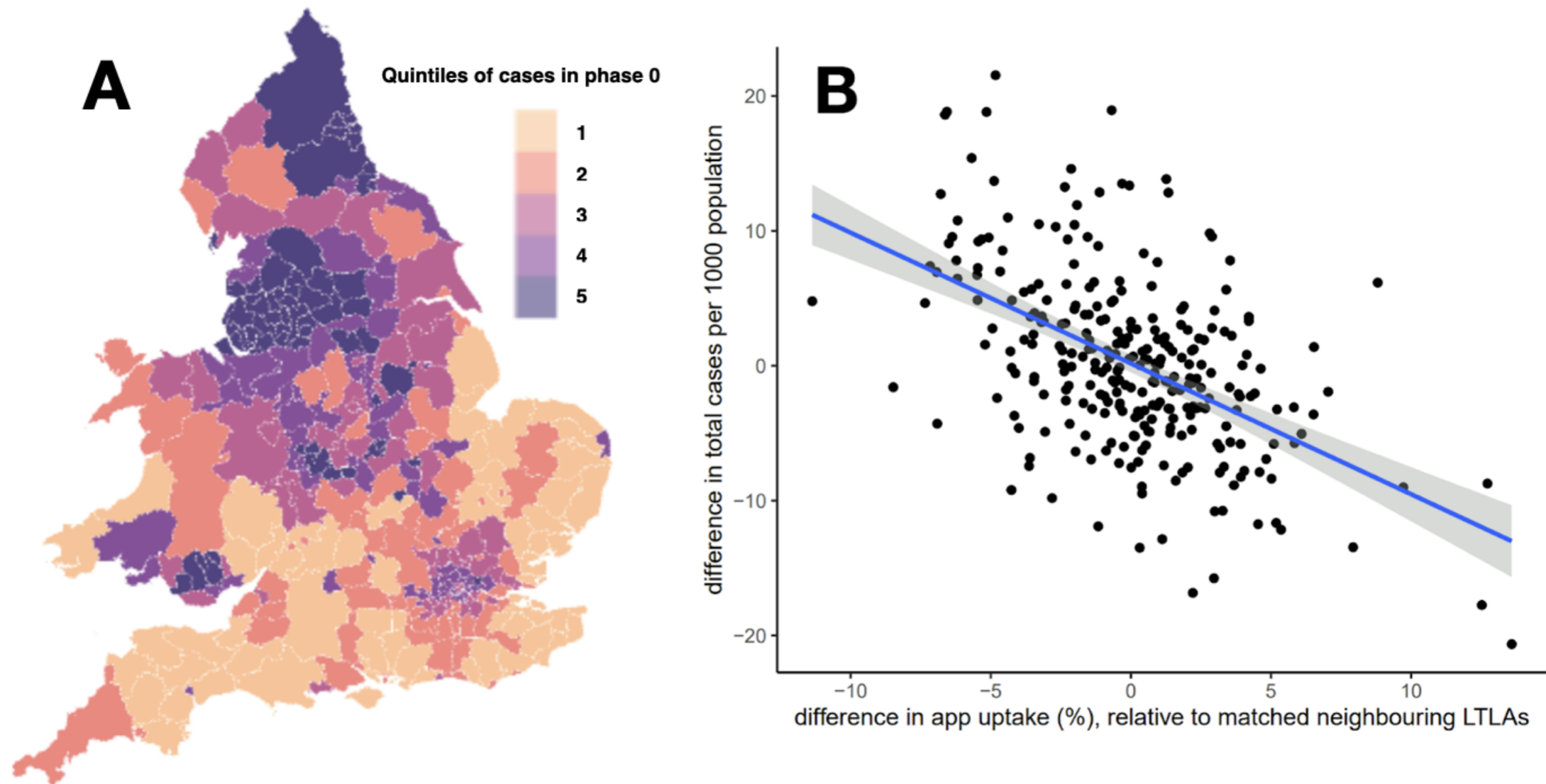
From 23 July to 10 September 2020, 65 (imputed) of 12,456 cases (0.5%) reported the SwissCovid app as the reason for the test, corresponding to around 3,000 cases during second wave.



Provided that both the index case and the exposed contacts use the app, we estimate 0.24 (95% CI: 0.20-0.27) identified positive contacts per index case.

Figure: Salathé et al. (2020, Swiss Medical Wkly)

Epidemiological impact of digital contact tracing in the UK



“We estimated that for every 1% increase in app users, the number of infections can be reduced by 0.8% (from modelling) or 2.3% (from statistical analysis).”

Figure: Wymant et al. (2021, https://github.com/BDI-pathogens/covid-19_instant_tracing)

- Collaboration between Institute for Social and Preventive Medicine (ISPM) and the Center for Space and Habitability (CSH)
- Aim: Development and application of computational methods in epidemiology, medicine and the natural sciences
- Synergies with ARTORG, IDSC, CAIM, and the newly founded multidisciplinary center for research into infectious diseases and immunity

⇒ “Planetary Health”

