



JOURNAL OF THE ROYAL SOCIETY INTERFACE

 Open Access

Research articles

Beyond R_0 : heterogeneity in secondary infections and probabilistic epidemic forecasting

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Message #3 : we need to look beyond R_0 for overdispersed infectious diseases like COVID-19

- negative binomial distribution for secondary cases

$$G_1(x) = \left[1 + \frac{R_0(x-1)}{\gamma} \right]^{-\gamma}$$

shows the great impact overdispersion (small γ) has on the spreading dynamics

- in other words, if $R_0 > 1$, our attention should not be focused on whether R_0 equals 2.5 or 3.5, but rather be focused on figuring out how much heterogeneity there is behind it (what is γ ?)

smallpox (1958–1973)

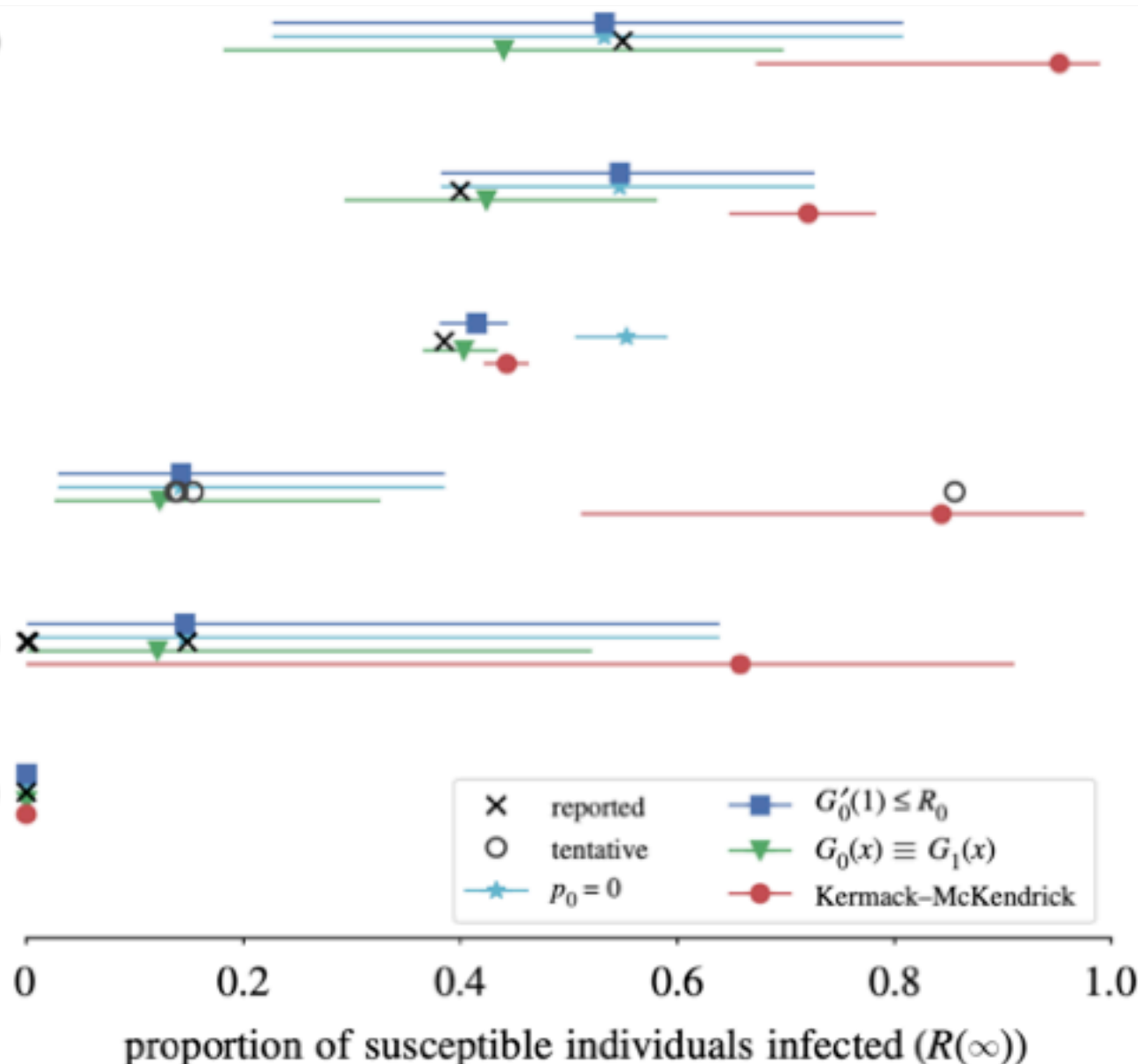
influenza (1918)

influenza (2009)

COVID-19 (2020)

SARS (2003)

MERS (2013)



Message #4 : COVID-19 is particularly overdispersed

- plans prepared with pandemic Influenza in mind might fall short to contain the spread of COVID-19

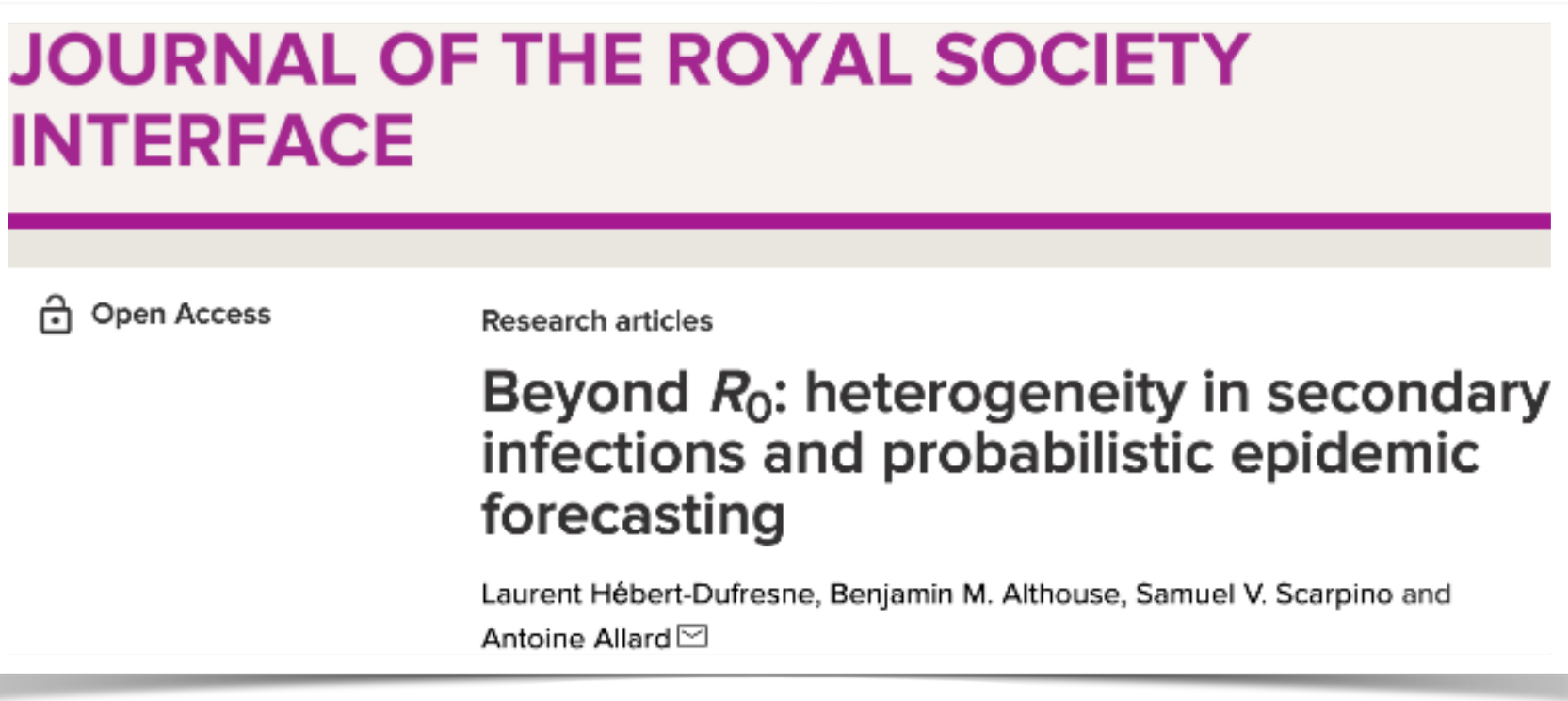
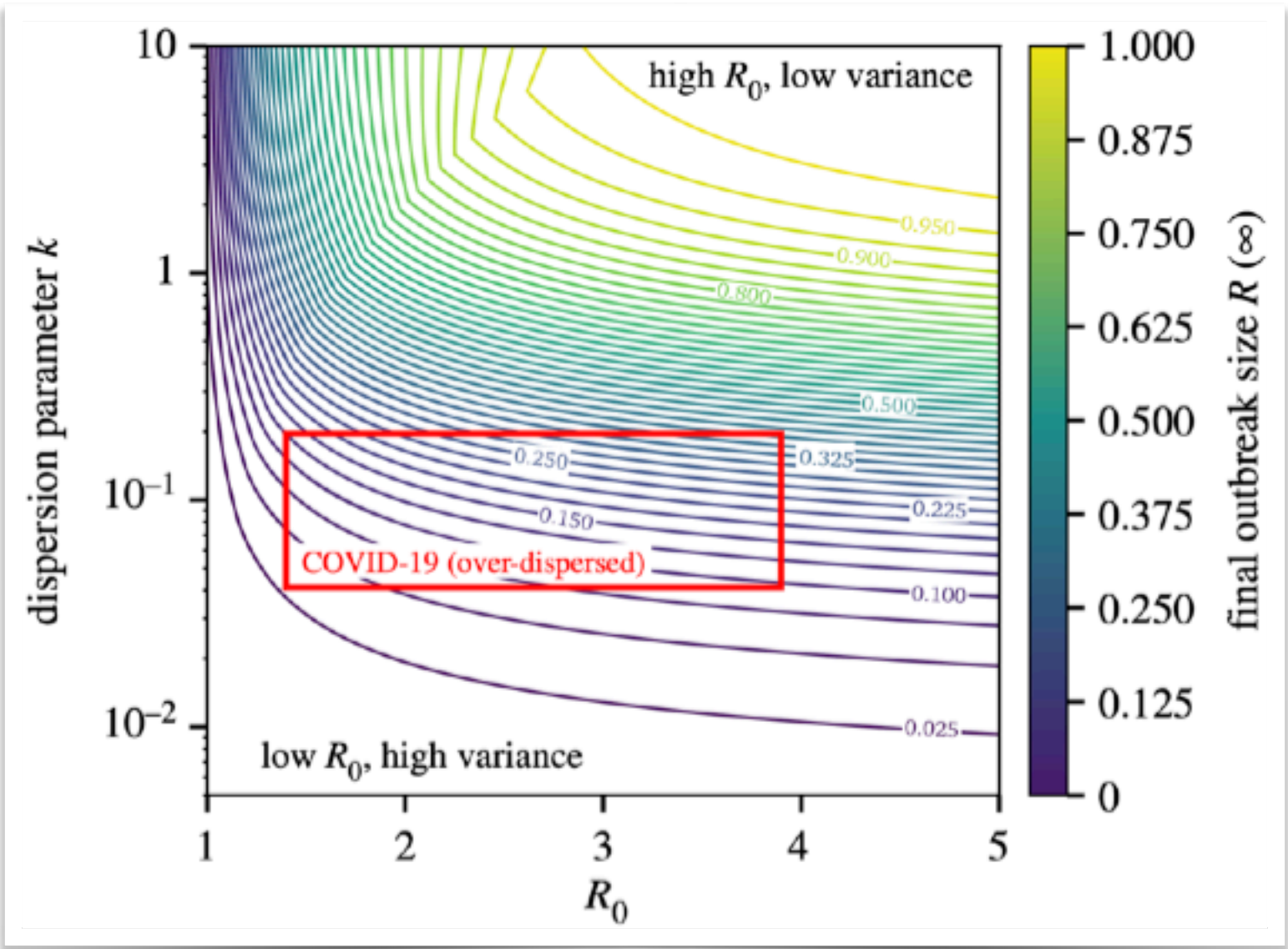
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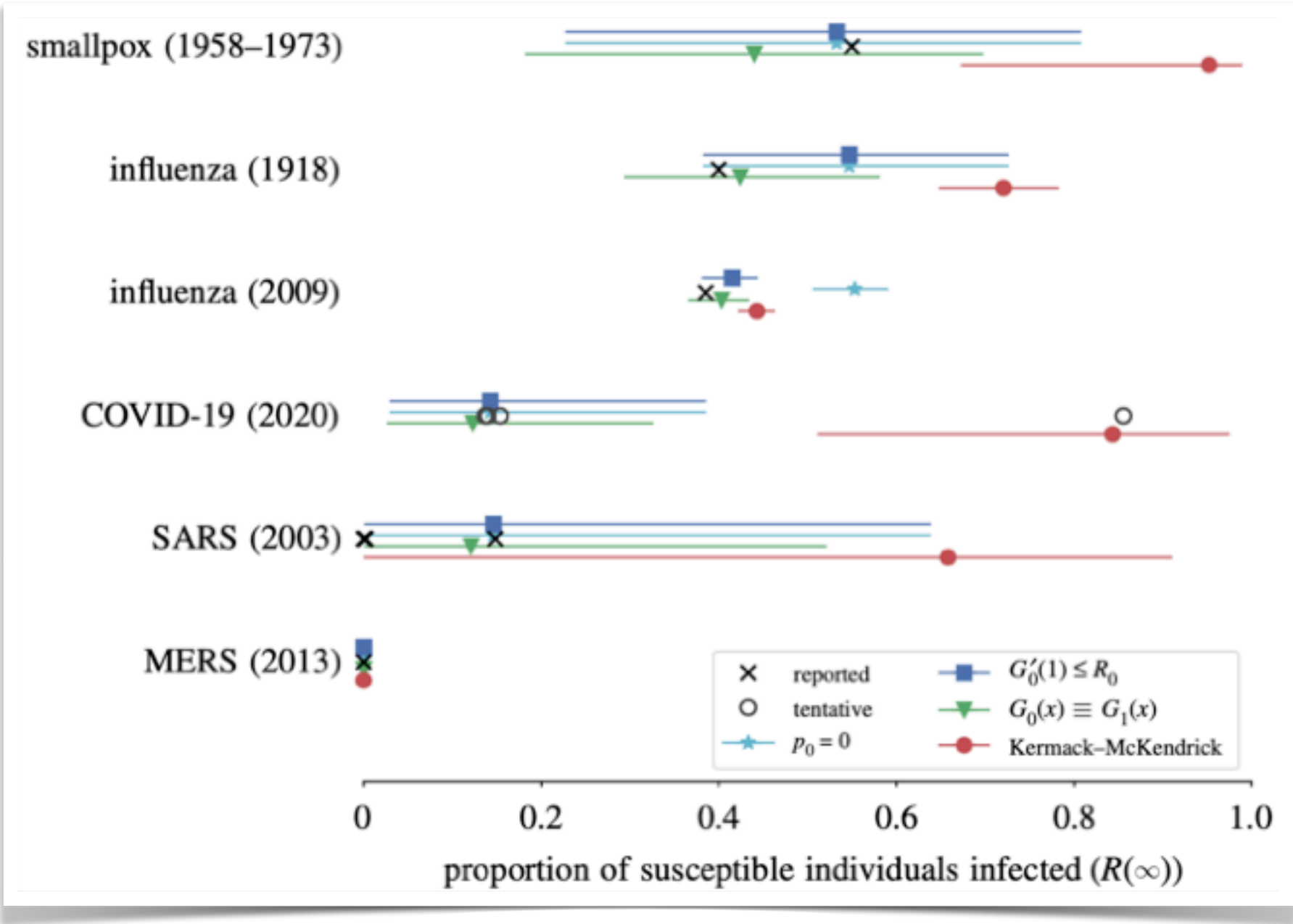
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And then came an email...

[...] As you can see, the stochastic simulations reach the same size as predicted from the classic final size equation. k doesn't seem to play a role at all. [...]

RAPID COMMUNICATION

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

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Citation style for this article:
Riou Julien, Althaus Christian L. . Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. Euro Surveill. 2020;25(4):pii=2000058. <https://doi.org/10.2807/1560-7917.ES.2020.25.4.2000058>

Article submitted on 24 Jan 2020 / accepted on 30 Jan 2020 / published on 30 Jan 2020

