

There is no ‘number-answer’¹

Numbers are very much in need, and expected from science. This appears to be the case also in the present COVID-19 pandemic.

According The New York Times [1] the report which purportedly “jarred the U.S. and the U.K. to Action”, from the Imperial College in London [2], warned about the possibility of 510,000 deaths in Britain and 2.2 million in the US. How could such a two-digits precision be obtained in a situation where known uncertainties include the prevalence of the virus in the population; the number of asymptomatic cases and their infectiveness; the behaviour and resilience of acquired immunity; the way the flue will react to the oncoming summer and to the next winter; the time needed to make a vaccine globally available; and how individuals will adapt their behaviour to the new situation and containment measures.

The report from the Imperial College explains that the calculation come from a model described in a Nature paper [3] and associated online supplementary information [4]. Here we see that the uncertainty in the prediction was assessed moving one uncertain factor at a time, a strategy bound to grossly underestimate the uncertainty when the model is nonlinear and nonadditive [5][6], as is likely the case for epidemiological models, due to the exponential term(s) in the solution.

As noted by Anthony Fauci in his reply to a politician insisting for a number of deaths, “There is no ‘number-answer’ to your question” [7].

- [1] M. Landler and S. Castle, “Behind the Virus Report That Jarred the U.S. and the U.K. to Action - The New York Times,” *The New York Times*, 17-Mar-2020.
- [2] Neil M.Ferguson *et al.*, “Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand,” *Imperial College London*, 2020. [Online]. Available: <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf>.
- [3] N. M. Ferguson, D. A. T. Cummings, C. Fraser, J. C. Cajka, P. C. Cooley, and D. S. Burke, “Strategies for mitigating an influenza pandemic,” *Nature*, vol. 442, no. 7101, pp. 448–452, Jul. 2006.
- [4] N. M. Ferguson, D. A. T. Cummings, C. Fraser, J. C. Cajka, P. C. Cooley, and D. S. Burke, “Strategies for mitigating an influenza pandemic - SUPPLEMENTARY INFORMATION,” *Nature*, 2006.
- [5] A. Saltelli and P. Annoni, “How to avoid a perfunctory sensitivity analysis,” *Environ. Model. Softw.*, vol. 25, no. 12, pp. 1508–1517, Dec. 2010.
- [6] A. Saltelli *et al.*, “Why so many published sensitivity analyses are false: A systematic review of sensitivity analysis practices,” *Environ. Model. Softw.*, vol. 114, pp. 29–39, Apr. 2019.
- [7] A. Fauci, “There is no number-answer,” *Twitter*, 2020. [Online]. Available: <https://twitter.com/marioricciard18/status/1237778247011663872>.

¹ Andrea Saltelli, Centre for the Study of the Sciences and the Humanities (SVT) - University of Bergen (UIB, Norway), and Open Evidence Research, Universitat Oberta de Catalunya (UOC), Barcelona
March 25, 2020.

