



MRC Centre for
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Module 2 of the UK Covid-19 Public Inquiry
Request for Evidence under Rule 9 of the Inquiry Rules 2006
Reference for Request - M2/SAGE/01/NI

Dear Mr Suter,

Thank you for your letter of 2 September on behalf of Baroness Hallett, Chair of the UK Covid 19 Inquiry. Taking the questions in turn:

1. A brief overview of your qualifications, career history, professional expertise and major publications.

I hold a PhD in quantitative epidemiology from the University Pierre et Marie Curie Paris VI (France) which I defended in 2010. I then moved to the Department of Infectious Disease Epidemiology at Imperial College London, where I was a postdoctoral researcher from 2010 to 2018, a lecturer from 2018 to 2022, and now a senior lecturer in infectious disease modelling since September 2022.

My expertise lies in the mathematical and statistical modelling of infectious diseases transmission. I have worked across a number of pathogens including influenza, Ebola, HIV, SARS-CoV-1 and SARS CoV-2. In the last 10 years, my work has focused on real-time analysis of epidemic data to assess the transmissibility, severity and potential control strategies of ongoing outbreaks, notably of Ebola and SARS-CoV-1. I have also developed several software packages to facilitate those real-time analyses.

A full list of my publications is available here (please see question 5 for publications on or related to COVID-19): <https://www.imperial.ac.uk/people/a.cori/publications.html>

2. A list of the groups (i.e. SAGE and/or any of its sub-groups) in which you have been a participant, and the relevant time periods.

I joined SPI-M-O in autumn 2020 after returning from my maternity leave, which started in February 2020 and ended in October 2020. I was then actively engaged in SPI-M-O until late 2021.

3. An overview of your involvement with those groups between January 2020 and February 2022, including:

a. When and how you came to be a participant;

Given my experience in real-time outbreak analysis, upon returning from maternity leave I joined our departmental COVID-19 real-time modelling team, and rapidly joined SPI-M-O to present and discuss our work and hear about work from other institutions.

b. The number of meetings you attended, and your contributions to

those meetings;

I mostly attended SPI-M-O submeetings focused on modelling the roadmap out of lockdown, between Autumn 2020 and Autumn 2021. To the best of my knowledge there were about 20 such meetings. In addition, I attended a handful of the main SPI-M-O meetings in that time interval.

c. Your role in providing research, information and advice.

Our research group rapidly developed a mathematical model of SARS-CoV-2 transmission in the UK, which was updated in real-time during the epidemic. When I returned from maternity leave, promising vaccine trial results were emerging, and the Alpha variant emerged soon after. I expanded the model developed by my colleagues to add vaccination and variants. We used this model to

- Quantify plausible epidemic trajectories associated with different paces of relaxation of non-pharmaceutical interventions in parallel to the vaccination campaign
 - Reevaluate this in real-time, in particular as variants of concern emerged •
- Quantify the plausible impact of delaying the last step of the roadmap after the emergence of the Delta variant

Results of these analyses were compared with those from other modelling groups and discussed in SPI-M-O submeetings focused on the roadmap modelling. They were also presented at the main SPI-M-O meetings, and summarised in reports shared with SPI-M-O on a regular basis. Consensus documents summarising results from different academic groups were drafted by the SPI M secretariat and approved by each contributing group.

4. A summary of any documents to which you contributed for the purpose of advising SAGE and/or its related subgroups on the Covid-19 pandemic. Please include links to those documents where possible.

I list below all publicly available documents authored by the Centre and which I was involved in, which were formally considered by SAGE.

1. Early “Modelling inputs” – <https://www.gov.uk/government/collections/scientific-evidence-supporting-the-government-response-to-coronavirus-covid-19#modelling-inputs>
 - o *Reports from Imperial College London* – 8 reports listed on that page
2. Evaluating the roadmap out of lockdown (multiple inputs into SAGE)
 - a. <https://www.gov.uk/government/publications/imperial-college-london-potential-profile-of-the-covid-19-epidemic-in-the-uk-under-different-vaccination-roll-out-strategies-13-january-2021>
 - b. <https://www.gov.uk/government/publications/imperial-college-london-strategies-for-gradually-lifting-npis-in-parallel-to-covid-19-vaccine-roll-out-in-the-uk-4-february-2021>
 - c. <https://www.gov.uk/government/publications/imperial-college-london-unlocking-roadmap-scenarios-for-england-5-february-2021>
 - d. <https://www.gov.uk/government/publications/imperial-college-london-unlocking-roadmap-scenarios-for-england-18-february-2021>
 - e. <https://www.gov.uk/government/publications/imperial-college-london-evaluating-englands-roadmap-out-of-lockdown-30-march-2021>
 - f. <https://www.gov.uk/government/publications/imperial-college-london-evaluating-the-roadmap-out-of-lockdown-step-3-5-may-2021>
 - g. <https://www.gov.uk/government/publications/imperial-college-london-evaluating-the-roadmap-out-of-lockdown-modelling-step-4->

[of-the-roadmap-in-the-context-of-b16172-delta-9-june-2021
h.https://www.gov.uk/government/publications/imperial-college-london-evaluating-the-roadmap-out-of-lockdown-for-england-modelling-the-delayed-step-4-of-the-roadmap-in-the-context-of-the-delta-v](https://www.gov.uk/government/publications/imperial-college-london-evaluating-the-roadmap-out-of-lockdown-for-england-modelling-the-delayed-step-4-of-the-roadmap-in-the-context-of-the-delta-v)

3. Delta (B.1.617.2) transmission in England – risk factors and transmission – [Imperial College London: Delta \(B.1.617.2\) transmission in England – risk factors and transmission advantage, 1 June 2021 - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/imperial-college-london-delta-b16172-transmission-in-england-risk-factors-and-transmission-advantage-1-june-2021)
4. Autumn/Winter 2021/22 scenarios: <https://www.gov.uk/government/publications/imperial-college-london-autumn-and-winter-2021-to-2022-potential-covid-19-epidemic-trajectories-13-october-2021>
5. Report 49, Growth, population distribution and immune escape of Omicron in England – <https://www.gov.uk/government/publications/imperial-college-london-report-49-growth-population-distribution-and-immune-escape-of-omicron-in-england-15-december-2021>
6. Omicron severity and vaccine effectiveness – <https://www.gov.uk/government/publications/imperial-college-london-omicron-severity-and-vaccine-effectiveness-5-january-2022>

Other connected pieces of research, estimates and projections were submitted to SPI-M-O meetings but we have not kept a detailed record of those submissions. However the SPI-M secretariat has an archive of all work submitted to it. We also generated modelling estimates for DHSC/Cabinet Office and NHS at various points in the pandemic; these were generally handled by the SPI-M secretariat also.

5. A summary of any articles you have written, interviews and/or evidence you have given regarding the work of the above-mentioned groups and/or the UK's response to the Covid-19 pandemic. Please include links to those documents where possible.

Below is a list of scientific articles I have published (as pre-prints and/or in peer reviewed scientific journals) on COVID-19 or related to COVID-19:

- Imai N, Rawson T, Knock ES, Sonabend R, Elmaci Y, Perez-Guzman PN, Whittles LK, Thekke Kanapram D, Gaythorpe KAM, Hinsley W, Djaafara BA, Wang H, Fraser K, FitzJohn RG, Hogan AB, Doohan P, Ghani AC, Ferguson NM, Baguelin M, **Cori A** *Quantifying the impact of delaying the second COVID-19 vaccine dose in England: a mathematical modelling study* <https://www.medrxiv.org/content/10.1101/2022.08.08.22278528v2>
- Bhatia S, Wardle J, Nash RK, Nouvellet P, **Cori A**, *A generic method and software to estimate the transmission advantage of pathogen variants in real-time : SARS-CoV-2 as a case-study* <https://www.medrxiv.org/content/10.1101/2021.11.26.21266899v1>
- Bhatia S, Parag KV, Wardle J, Imai N, Van Elsland SL, Lassmann B, Cuomo-Dannenburg G, Jauneikaite E, Unwin HJT, Riley S, Ferguson N, Donnelly CA, **Cori A**, Nouvellet P, *Global predictions of short- to medium-term COVID-19 transmission trends: a retrospective assessment* <https://www.medrxiv.org/content/10.1101/2021.07.19.21260746v1>
- Unwin HJT, **Cori A**, Natsuko Imai, Gaythorpe KAM, Bhatia S, Cattarino L, Donnelly CA, Ferguson NM, Baguelin M *Using next generation matrices to estimate the proportion of cases that are not detected in an outbreak* <https://www.medrxiv.org/content/10.1101/2021.02.24.21252339v1>
- Bosse NI, Abbott S, Bracher J, Hain H, Quilty BJ, Jit M, Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, van Leeuwen E, **Cori A**, Funk S (2022) *Comparing human and model based forecasts of COVID-19 in Germany and Poland* **PLoS Comp Biol**, in press
- Abbas M, **Cori A**, Cordey S, Laubscher F, Nunes TR, Myall A, Salamun J, Huber P, Zekry D, Prendki V, Iten A, Vieux L, Sauvan V, Graf C, Harbarth S (2022) *Occupational versus community risk of SARS-CoV-2 infection among employees of a long-term care facility: an observational study* **elife**, in press

- Nash RK, Nouvellet P, **Cori A** (2022) *Real-time estimation of the epidemic reproduction number: applications and challenges* **PLoS Digital Health**, in press
- Lenggenhager L, Martischang R, Sauser J, Perez M, Vieux L, Graf C, Cordey S, Laubscher F, Nunes TR, Zingg W, **Cori A**, Harbarth S, Abbas M (2022) *Occupational versus community risk of SARS-CoV-2 infection among employees of a long-term care facility: an observational study* **Antimicrobial resistance and infection control**, in press
- Lindsey BB, Villabona-Arenas CJ, Campbell F, Keeley AJ, Parker MD, Shah DR, Parsons H, Zhang P, Kakkar N, Gallis M, Foulkes BH, Wolverson P, Louka SF, Christou S, State A, Johnson K, Hsu S, Jombart T, **Cori A**, Sheffield COVID-19 Genomics Group, The COVID-19 Genomics UK (COG-UK) consortium¹, CMMID COVID-19 working group, Evans CM, Partridge DG, Atkins KE, [Hué S](#), de Silva TI (2021) *Characterising within-hospital SARS CoV-2 transmission events: a retrospective analysis integrating epidemiological and viral genomic data from a UK tertiary care setting across two pandemic waves* **Nature communications**, in press
- Green W, Ferguson NM, **Cori A** (2021) *Inferring the reproduction number using the renewal equation in heterogeneous epidemics* **J. R. Soc. Interface**, 19(188):20210429
- Sonabend R, Whittles LK, Imai N, Perez-Guzman PN, Knock ES, Rawson T, Gaythorpe KAM, Djaafara BA, Hinsley W, Fitzjohn RG, Lees, JA, Thekke Kanapram D, Volz EM, Ghani AC, Ferguson NM, Baguelin M, **Cori A**, (2021) *Non-pharmaceutical interventions, vaccination and the Delta variant: epidemiological insights from modelling England's COVID-19 roadmap out of lockdown – a mathematical modelling study* **The Lancet** 398(10313): 1825-35
- Abbas M, Nunes TR, **Cori A**, Cordey S, Laubscher F, Baggio S, Jombart T, Iten A, Vieux L, Teixeira D, Perez M, Pittet D, Frangos E, Graf CE, Zingg W, Harbarth S (2021) *Explosive nosocomial outbreak of SARS-CoV-2 in a rehabilitation clinic: the limits of genomics for outbreak reconstruction* **Journal of Hospital Infection** 117:124-134
- Mishra S, Scott JA, Laydon JD, Flaxman S, Gandy A, Mellan TA, Unwin HJT, Vollmer M, Coupland H, Ratmann O, Monod M, Zhu HH, **Cori A**, Gaythorpe KAM, Whittles LK, Whittaker C, Donnelly CA, Ferguson NM, Bhatt S (2021) *Comparing the responses of the UK, Sweden and Denmark to COVID-19 using counterfactual modelling* **Scientific reports** 11, 16342
- Desai A, Nouvellet P, Bhatia S, **Cori A**, Lassmann B (2021) *Data Journalism and the COVID-19 Pandemic - Challenges and Opportunities* **The Lancet Digital Health** 3(10), E619-621
- Imai N, Hogan A, Williams L, **Cori A** et al. (2021) *Interpreting estimates of COVID-19 vaccine efficacy and effectiveness to inform simulation studies of vaccine impact: a systematic review* [version 1; peer review: awaiting peer review] **Wellcome Open Research**, 6:185
- Knock ES, Whittles LK, Lees, JA, Perez-Guzman PN, Verity R, Fitzjohn RG, Gaythorpe KAM, Imai N, Hinsley W, Okell LC, Rosello A, Kantas N, Walters CE, Bhatia S, Watson OJ, Whittaker C, Cattarino L, Boonyasiri A, Djaafara BA, Fraser K, Fu H, Wang H, Xi X, Donnelly CA, Jauneikaite E, Laydon DJ, White PJ, Ghani AC, Ferguson NM*, **Cori A***, Baguelin M (2021) *The 2020 SARS-CoV-2 epidemic in England: key epidemiological drivers and impact of interventions*, **Science Translational Medicine** 13(602)
- Ragonnet-Cronin M, Boyd O, Geidelberg L, Jorgensen D, Nascimento FF, Siveroni I, Johnson RA, Baguelin M, Cucunubá ZM, Jauneikaite E, Mishra S, Thompson HA, Watson OJ, Ferguson NM, **Cori A**, Donnelly CA, Volz E on behalf of the Imperial COVID-19 Response Team (2021) *Genetic evidence for the association between COVID-19 epidemic severity and timing of non-pharmaceutical interventions*, **Nature communication** 12, 2188
- Nouvellet P, Bhatia S, **Cori A**, et al., (2020) *Reduction in mobility and COVID-19 transmission* **Nature communication** 12, 1090
- Fitzjohn RG, Knock ES, Whittles LK, Perez-Guzman PN, Bhatia S, Guntoro F, Watson OJ, Whittaker C, Ferguson NM, **Cori A**, Baguelin M, Lees JA (2020) *Reproducible parallel inference and simulation of stochastic state space models using odin, dust, and mcstate* [version 2; peer review: 1 approved, 1 approved with reservations] **Wellcome Open Research**, 5:288
- Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, Cuomo-Dannenburg G, Thompson H, Walker PGT, Fu H, Dighe A, Griffin JT, Baguelin M, Bhatia S, Boonyasiri A, **Cori A**, Cucunubá Z, FitzJohn R, Gaythorpe K, Green W, Hamlet A, Hinsley W, Laydon D, Nedjati-Gilani G, Riley S, Van Elsland S, Volz E, Wang H, Wang Y, Xi X, Donnelly CA, Ghani AC, Ferguson NM (2020) *Estimates of the severity of coronavirus disease 2019: a model-based analysis*, **Lancet** ID 20(6): 669-77
- Bhatia S, Imai N, Cuomo-Dannenburg G, Baguelin M, Boonyasiri A, **Cori A**, Cucunubá Z, Dorigatti I, FitzJohn R, Fu H, Gaythorpe K, Ghani A, Hamlet A, Hinsley W, Laydon D, Nedjati-Gilani G, Okell L, Riley S,

Thompson H, van Elsland S, Volz E, Wang H, Wang Y, Whittaker C, Xi X, [Donnelly](#) CA, Ferguson NM (2020) *Estimating the number of undetected COVID-19 cases among travellers from mainland China* [version 1; peer review: 3 approved with reservations] **Wellcome Open Research**, 5:143

The reports our group published in real-time are all available at <https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/covid-19-reports/>.

I have given about a dozen interviews with media in the UK and in France which I have not kept a detailed record of. I have summarised below, to the best of my recollection, press briefings, expert reactions, Imperial news and web series episodes which I have contributed to:

PRESS BRIEFINGS

14-07-2021 [SMC Roadmap](#)
15-06-2021 [SMC Roadmap](#)
21-01-2021 [SMC Modelling](#)

EXPERT REACTIONS

12-07-2021 [SMC Roadmap](#)
14-06-2021 [SMC SAGE documents published](#)

WEBSERIES

[Episode 17](#) 26-08-21 Impact of schools and waning immunity
[Episode 13](#) 11-06-21 Delta variant and third wave
[Episode 10](#) 30-04-21 UK third wave
[Episode 6](#) 02-04-21 Impact 1st step roadmap out of lockdown
[Episode 2](#) 04-03-21 Brazil variant (P.1) in UK, modelling variants

YOUTUBE

18-09-2020 [Panel discussion Webinar](#)

IMPERIAL NEWS

12-07-2021 [Magnitude of third wave highly uncertain, suggests new analysis](#) 14-06-2021 [Delta variant could cause significant third wave - latest Imperial modelling](#) 10-05-2021 [Latest models suggest smaller third wave in late summer but variant risks remain](#)
08-05-2021 [COVID-19 roadmap for reopening could lead to a third wave in England](#) 21-01-2021 [Vaccines may not signal immediate end to epidemic, researchers say](#) 19-03-2021 [The Imperial women tackling COVID-19](#)

6. Your views as to whether the work of the above-mentioned groups in responding to the Covid-19 pandemic (or the UK's response more generally) succeeded in its aims. This may include, but is not limited to, your views on:

- a. The composition of the groups and/or their diversity of expertise;
- b. The way in which the groups were commissioned to work on the relevant issues;
- c. The resources and support that were available;
- d. The advice given and/or recommendations that were made;
- e. The extent to which the groups worked effectively together;

f. The extent to which applicable structures and policies were utilised and/or complied with and their effectiveness.

As outlined above, I was mostly involved in modelling work to inform the design and monitoring of the roadmap out of lockdown. As I understand it, the aim of the SPI-M-O subgroup focused on this topic was to bring multiple independent mathematical modelling teams to evaluate the potential impact on the epidemic trajectory of relaxing non-pharmaceutical interventions at a given pace. As such, I think the group did succeed in this aim.

Three academic groups contributed independent analyses; all were led by internationally renowned experts in the field of mathematical modelling of infectious diseases.

I found the communication between the SPI-M secretariat and the academic modelling groups to be effective; the secretariat provided specific questions of interest to the government and there were back-and-forth exchanges between the secretariat and the modellers to clarify the questions, highlight which questions could or could not be addressed by modelling analyses, request the necessary data. Divergence in results between the groups was examined with scrutiny until resolved or understood, and consensus documents were produced that were approved by all parties.

Although the group did not make recommendations, I do believe that our work was considered for the design of the roadmap out of lockdown as well as for the decision to delay the last step of the roadmap.

7. Your views as to any lessons that can be learned from the UK's response to the Covid-19 pandemic, in particular relating to the work of the above-mentioned groups. Please describe any changes that have already been made, and set out any recommendations for further changes that you think the Inquiry should consider making.

I believe that the formal way in which mathematical modelling experts were brought together through SPI-M-O to provide up-to-date scientific evidence on the national epidemic in real-time is unique to the UK and should be commended. Here are a few personal thoughts on how this could be done more effectively to support an effective epidemic response in the future:

- A network similar to SPI-M-O to facilitate discussions with and learning from modellers in other countries.
- Possibly more formal links between SPI-M-O and other SAGE subgroups (e.g. SPI-B) to facilitate knowledge exchanges at a level below SAGE.
- Dedicated funding for academic groups contributing analyses on a regular basis during an epidemic. A major struggle to provide frequent high quality analyses during the pandemic, particularly in the later stage, was lack of capacity among academic groups.
- Some official recognition mechanism for junior researchers involved in the work, who did this at the cost of traditional academic input (e.g papers) and whose careers may suffer, which in turn may undermine real-time work in future epidemics.

8. A brief description of documentation relating to these matters that you hold (including soft copy material held electronically). Please retain all such material. I am not asking for you to provide us with this material at this stage, but I may request that you do so in due course.

We as a group retain records of all the research we conducted, all documents submitted to UK government and international bodies, and all academic reports/preprints/journal articles. I have

retained most email correspondence relating to COVID-19 that I was involved in (although I may have deleted some emails, particularly those received during maternity leave and those with large attachments); this likely amounts to several thousand emails.

The questions and answers above span almost 2-years of work which was undertaken at pace. The responses are as accurate and complete as possible but if you require further details or there are inadvertent omissions, please do not hesitate to let me know.

Yours sincerely,

Anne Cori

Personal Data