Questionnaire answers

Daniela De Angelis

October 10, 2022

UK COVID-19 Inquiry: Module 2 - Rule 9 Request to Professor Daniela De Angelis - Reference: M2/SAGE/01/DDA

Please provide the following information:

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

   - I am Professor of Statistical Science for Health in the Department of Primary Care and Public Health, University of Cambridge; and a Medical Research Council (MRC) Investigator (programme leader) at the MRC Biostatistics Unit (MRC-BSU), University of Cambridge. At MRC-BSU I lead a research programme on Population Health and, in particular on infectious diseases. My work is at the interface between statistical/computational methodology and infectious disease epidemiology. I focus on the development and application of methods to estimate characteristics of epidemics, including natural history and burden and prediction of future evolution, and to evaluate non-randomised public health interventions.
     Please see attached a short CV and a list of publications.

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.

   - Scientific Pandemic Influenza Group on Modelling (SPI-M) - January 2020 - May 2022
   - SPIM Subgroup on Short-term Forecasting and Medium Term Projections - end March 2020 - May 2022

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;

   I started participating in SPIM meetings in January 2020 (27th of January). I participated as a Core Member. I had previously attended SPIM during the 2009 H1N1 pandemic. I became a specialist Member at the end of the 2009 pandemic and then a Core Member in 2015. Since 2009 SPIM met regularly every year to review ongoing and published work on various aspects of preparedness for a potential influenza pandemic. When the SARS-COV-2 started, SPIM become rapidly operational (SPI-M-O) from the end of January 2020.

   In late March/beginning of April 2020 SPI-M-O was organised in a number of subgroups, focussing on specific tasks. I became a member of the Subgroup on Short-term Forecasting and Medium Term Projections, tasked with producing and discussing weekly national and regional estimates of key pandemic quantities (eg reproduction numbers; growth rates; disease incidence and prevalence) and short term and medium term projection of deaths and hospitalisations. I also became a member of the Regional Variation Group, which discussed more local estimates of the above quantities, typically at Local Authority levels.

b) The number of meetings you attended, and your contributions to those meetings;

I have attended most of the main SPI-M-O meetings (over 95%, the exact dates can be checked from the SPI-M-O minutes); and most of those of the Subgroup on Short-term Forecasting and Medium Term Projections (around 80%); and only a minority of the meetings of the Regional Variation Group

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

- I am part of SPI-M-O for my expertise in statistical epidemiology and (statistical) modelling of infectious disease dynamics. I have contributed to SPI-M-O by advising on data interpretation and data analysis and by providing regular estimates of the current state of the epidemic (which is typically referred to as "Nowcasting") in England, stratified by age groups and region, and short term-projections of epidemic burden ("Forecasting").

  At MRC-BSU I lead a team of statistician and quantitative scientists. During the pandemic I collaborated closely with Public Health England (PHE) through membership of PHE's Modelling Team; and with colleagues from the JUNIPER Consortium, of which I am a member. Relevant outputs communicated to SPI-M-O result from my team's work and from the joint work with PHE (now UK Health Security Agency, UKHSA) and JUNIPER's members.

  Regular outputs included:

  - estimates of the number of deaths over time. Data on deaths suffer from "reporting delays", namely it takes time for a death to be reported to the register, so the number observed is an under-count of the number of deaths that have already occurred. To have a picture of current trends (fundamental for policy making) it is important to correct the observed data for reporting delay and estimate the number of deaths that would have been observed had it not been for the delay. This work was done weekly for most of the time since 2020 and these estimates were used by the SPI-M-O team responsible for producing consensus estimates (through use the CrystalCast software).

  - estimates of the number of currently infected individuals (prevalence); number of new daily infections (incidence); current epidemic growth; current transmission (as measured by the effective reproduction number); and short-term predictions (at most 6 weeks) of the number of deaths and hospitalisations. These aspects of the pandemic are not observed and need to be estimated. To do so, we developed a transmission model for SARS-COV-2 adapting previous work carried out for pandemic influenza after the 2009 H1N1 outbreak. The model uses multiple streams of data over time (deaths, number of individuals with antibodies, hospitalisations, number of individuals with active infection from the Office of National Statistics COVID-19 infection survey) to reconstruct the mechanism of transmission that generates the observed data. Once the transmission mechanism is estimated, any unobserved aspect of the pandemic can also be estimated, with appropriate uncertainty, through statistical procedures. Our estimates were used as part of the weekly consensus communicated by SPIM to SAGE and were used by many other stakeholders, including the UKHSA, media and the public (https://www.mrc-bsu.cam.ac.uk/tackling-covid-19/nowcasting-and-forecasting-of-covid-19/

  - estimates of severity, namely the risk of experiencing a severe event following infection with SARS-COV-2. Severe events included hospitalisation after a SARS-COV-2 diagnosis, admission to intensive care and death as well lengths of stay in hospital. We estimated these quantities by calendar period, vaccination status, variants and other important covariates. Much of this work also went to the UKHSA Joint Modelling Team and the Variant Technical

Group coordinated by UKHSA to inform the Variant Technical Briefings and Risk Assessments (https://www.gov.uk/government/publications/investigation-of-sars-cov-2-variants-technical-briefings)

In addition to these regular outputs, we carried out other collaborative work as the need arose.

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.

- My team's work has contributed to SPI-M-O through short reports, comments and presentations as well as through the main regular Nowcasting and Forecasting from the Cambridge/PHE Team. Reports, comments and presentations are mainly stored on the DH exchange SPI-M repository (https://dhexchange.kahootz.com/system/login. Access is not open, but SPI-M-O's secretariat are co-ordinating access to it for the inquiry). The main regular contribution to SPI-M-O Nowcasting and short/medium-term Projection Consensus has been delivered in a machine-readable format to be processed through CrystalCast and results shared for discussion at the Short-term Forecasting and Medium Term Projections meeting (typically, the day before the full SPI-M-O meeting). We also openly disseminated our Nowcasting and Forecasting results via regular publication on the MRC-BSU website (https://www.mrc-bsu.cam.ac.uk/tackling-covid-19/nowcasting-and-forecasting-of-covid-19/.

  Here is a list of the documents I am able to trace at present

  - February 2020
    * Ascertainment of infected individuals - Comments on the work from LSHTM, Daniela De Angelis, Paul Birrell
    * Simulations of COVID-19 epidemic timing and duration in the UK Daniela De Angelis, Paul Birrell (Cambridge, PHE)
    * Epidemic profiles from UK research teams (PHE Real-time model (with Cambridge))
    * Scenario analysis - nCoV-2019 - UK Daniela De Angelis, Paul Birrell (Cambridge, PHE)
    * Scenario analysis - nCoV-2019 - UK Daniela De Angelis, Paul Birrell (Cambridge, PHE) (revised document)
  - March 2020
    * Age-specific epidemic profiles from UK research teams - SPI-M 02/03/2020 (PHE Real-time model (with Cambridge))
    * FF100 Analysis Paul Birrell, Edwin van Leeuwen, Daniela De Angelis on behalf of the PHE Modelling Cell
    * PHE real time model - initial results Joint PHE Modelling Cell (PHE, Cambridge, Manchester)
  - April 2020
    * Short-term Forecasting: Proposed Process for discussion - Comments from D De Angelis

    * Estimating the distribution from death from Covid-19 to report - Report no 3 Shaun Seaman and Daniela De Angelis (26/04/20) on behalf of the MRC-BSU COVID-19 Working Group and the PHE Modelling Cell.

    * Outputs on the number of deaths adjusted for reporting delays.

    * Estimated case/severity rates and length of stay in hospital and ICU (22nd of April) Christopher Jackson, Brian Tom, Anne Presanis, Peter Kirwan, Kevin Kunzmann, Alice Corbella, Daniela De Angelis on behalf of the MRC-BSU COVID-19 working group.

    * Estimated case/severity rates and length of stay in hospital and ICU. (Updated to 26th April) Christopher Jackson, Brian Tom, Anne Presanis, Peter Kirwan, Kevin Kunzmann, Alice Corbella, Daniela De Angelis on behalf of the MRC-BSU COVID-19 working group.

- May 2020:

    * Nowcast and forecast. Paul Birrell, Joshua Blake, Edwin van Leeuwen, Daniela De Angelis, Joint PHE Modelling Cell, MRC Biostatistics Unit COVID-19 Working Group. (2020-05-11)

    * COVID-19: nowcast and forecast. Paul Birrell, Joshua Blake, Edwin van Leeuwen, Daniela De Angelis, Joint PHE Modelling Cell, MRC Biostatistics Unit COVID-19 Working Group. (2020-05-17)

- June 2020: Estimated severity: infection-fatality risks and hospitalised case-severity risks. Christopher Jackson, Brian Tom, Paul Birrell, Anne Presanis, Daniela De Angelis on behalf of the MRC-BSU COVID-19 working group, the PHE Modelling Cell and the ISARIC (CO-CIN) Collaboration.

- July 2020: Estimated severity: infection-fatality risks and hospitalised case-severity risks. Christopher Jackson, Brian Tom, Peter Kirwan, Paul Birrell, Anne Presanis, Daniela De Angelis on behalf of the MRC-BSU COVID-19 working group, the PHE Modelling and Surveillance Cells and the ISARIC (CO-CIN) Collaboration.

- August 2020: Update on CoVID19 deaths and real time model sensitivity analysis. This was an assessment of the impact of different definitions of a COVID-19 death (e.g. whether within 28 or 60 days of a positive test). Paul Birrell, Joshua Blake, Daniela De Angelis, PHE EpiCell

- September 2020:

    * COVID-19: nowcast and forecast. Paul Birrell, Joshua Blake, Edwin van Leeuwen, MRC Biostatistics Unit COVID-19 Working Group, Daniela De Angelis (2020-09-2)

    * COVID-19: nowcast and forecast. Paul Birrell, Joshua Blake, Edwin van Leeuwen, MRC Biostatistics Unit COVID-19 Working Group, Daniela De Angelis (2020-09-23)

    * "Which model predictions are highly dependent on assumptions about parameter values?". A discussion of what assumptions in various models would cause the conclusions to be incorrect. We carried out a "Value of Information" analysis to assess how sensitive predictions were to the value assumed for the infection/fatality risk.

    * Incorporating ONS / REACT prevalence in real-time modelling: Provisional thoughts. Paul Birrell, Thomas House, Daniela De Angelis.

- December 2020: Notes on within-hospital severe burden. MRC Biostatistics Unit.

- April 2021:

    * Updated incidence estimates from ONS CIS. Joshua Blake, Paul Birrell, Thomas House, Daniela De Angelis

    * Investigating recent changes in Covid19 death reporting patterns. Pantelis Samartsidis, Shaun R. Seaman, Daniela De Angelis.

    * Estimated COVID-19 hospitalised case-fatality risks: March 2020 to February 2021. Peter Kirwan, Suzanne Elgohari, Chris Jackson, Brian Tom, Sema Mandal, Daniela De Angelis, Anne Presanis.

- June 2021: Estimates of R_t from the PHE-Cambridge model: what's going on? Paul Birrell, Edwin van Leeuwen, Joshua Blake, Daniela De Angelis. This is a sensitivity analysis carried out to understand the different estimates produced through this model.

- June 2021: Updated estimates of COVID-19 hospitalised case-fatality risks and length of stay: SARI-Watch sentinel data from March 2020 to April 2021. Peter Kirwan, Suzanne Elgohari, Chris Jackson, Brian Tom, Sema Mandal, Daniela De Angelis, Anne Presanis, MRC Biostatistics Unit, Cambridge & PHE Surveillance Cell & PHE Joint Modelling Team

- June 2021: Risk of hospital admission and emergency care attendance with Delta vs Alpha variants: Preliminary results. Tommy Nyberg, Anne Presanis, Daniela De Angelis (MRC Biostatistics Unit, Cambridge), Kate Twohig, Asad Zaidi, Simon Thelwall, Shirin Aliabadi, Mary Sinnathamby, Gavin Dabrera (PHE COVID-19 Epidemiology Cell); Ross Harris, Andre Charlett (PHE Joint Modelling Team). Later published as a peer-reviewed paper here: https://doi.org/10.1016/S1473-3099(21)00475-8

- June 2021: Hospital severity update. Anne Presanis, Peter Kirwan, Tommy Nyberg, Andre Charlett, Daniela De Angelis (MRC Biostatistics Unit, PHE Joint Modelling Team, in collaboration with PHE COVID-19 Epidemiology Cell, PHE Surveillance Cell, PHE Genomics Cell, PHE HO-COVID, PHE Immunisation and Countermeasures Division, COG-UK).

- July 2021: Hospital severity: update by vaccination status, using SUS/ECDS. Peter Kirwan, Andre Charlett, Daniela De Angelis, Anne Presanis (MRC Biostatistics Unit, PHE Joint Modelling Team; Acknowledgements: PHE Surveillance Cell, PHE COVID-19 Epidemiology Cell, PHE HO-COVID, PHE Immunisation and Countermeasures Division).

- December 2021: Estimates of COVID-19 hospitalised mortality and length of stay: data from March 2020 to September 2021. Peter Kirwan, Anne Presanis, Andre Charlett, Paul Birrell, Daniela De Angelis (MRC Biostatistics Unit, Cambridge PHE Joint Modelling Team).

- December 2021: Trends in hospitalised mortality risk and lengths of stay during the first, second and current waves of COVID-19 in England: a cohort study. Peter Kirwan et al. Later published as a peer-reviewed paper here: https://doi.org/10.1038/s41467-022-32458-y

- December 2021: No higher hospitalisation or mortality risk for COVID-19 cases with SARS-CoV-2 AY.4.2 (VUI-21OCT-01) compared to non-AY.4.2 Delta variant sub-lineages. Tommy Nyberg, Katie Harman, Asad Zaidi, Shaun R Seaman, Nick Andrews, Sophie G Nash, Andre Charlett, Jamie Lopez Bernal, Richard Myers, Natalie Groves, Eileen Gallagher, Saheer Gharbia, Meera Chand, Simon Thelwall, Daniela De Angelis, Gavin Dabrera, Anne M Presanis. Later published as a peer-reviewd paper here: https://doi.org/10.1093/infdis/jiac063

- January 2022: COVID-19 severity risk for Omicron compared with Delta VOCs. Tommy Nyberg, Daniela De Angelis, Anne Presanis (MRC Biostatistics Unit, University of Cambridge; Joint work with: UKHSA COVID-19 Epidemiology Cell; Joint Modelling Team; Statistics, Modelling and Economics Department; Genomics Cell; HO-COVID; Immunisation and Countermeasures Division).

- The following reports were presented at SAGE:

  - March 23, 2020, Meeting 18. PHE real-time model - initial results. Paul Birrell, Daniela De Angelis. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/890227/s0069-phe-real-time-model-initial-results-010320-sage18.pdf

  - December 2021: Estimates of hospital-fatality risk and length of stay in hospital for COVID-19 patients, March 2020-September 2021. Peter Kirwan, Andre Charlett, Paul Birrell, Suzanne Elgohari, Russell Hope, Sema Mandal, Daniela De Angelis, Anne Presanis (MRC Biostatistics Unit, Cambridge UKHSA). https://www.gov.uk/government/publications/mrc-biostatistics-unit-and-phe-estimates-of-covid-19-hospitalised-mortality-and-length-of-stay-data-from-march-2020-to-september-2021-7-december-20

  - January 2022: MRC and UKHSA: Omicron severity risk in children, 19 January 2022. https://www.gov.uk/government/publications/mrc-and-ukhsa-omicron-severity-risk-in-children-19-january-2022

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.

Articles

- Seaman SR, Samartsidis P, Kall M, **De Angelis D**. (2022) Nowcasting COVID-19 deaths in England by age and region. Journal of the Royal Statistical Society: Series C (Applied Statistics), 1–16. Available from: https://doi.org/10.1111/rssc.12576

- Illingworth CJ, Hamilton WL, Jackson C, Warne B, Popay A, Meredith L, Hosmillo M, Jahun A, Fieldman T, Routledge M, Houldcroft CJ, Caller L, Caddy S, Yakovleva A, Hall G, Khokhar FA, Feltwell T, Pinckert ML, Georgana I, Chaudhry Y, Curran M, Parmar S, Sparkes D, Rivett L, Jones NK, Sridhar S, Forrest S, Dymond T, Grainger K, Workman C, Gkrania-Klotsas E, Brown NM, Weekes MP, Baker S, Peacock SJ, Goulouris T, Goodfellow I, **De Angelis D***, Torok ME*. (2022) A2B-COVID: A tool for rapidly evaluating potential SARS-CoV-2 transmission events. Molecular Biology and Evolution, 39(3):msac025. https://doi.org/10.1093/molbev/msac025

- Pellis L, Birrell PJ, Blake J, Overton CE, Scarabel F, Stage HB, Brooks-Pollock E, Danon L, Hall I, House TA, Keeling M, Read JM, JUNIPER Consortium, **De Angelis D**. (2022) Estimation of reproduction numbers in real time: conceptual and statistical challenges. RSS, https://rss.org.uk/RSS/media/File-library/News/2021/PellisBirrel.pdf

- Kirwan PD, Charlett A, Birrell PJ, Elgohari S, Hope R, Mandal S, **De Angelis D**, Presanis AM. (2022): Trends in COVID-19 hospital outcomes in England before and after vaccine introduction, 2020-2021: a cohort study. *Nat Commun*, 13:4834. https://doi.org/10.1038/s41467-022-32458-y

- Seaman SR, Nyberg T, Overton CE, Pascall D, Presanis AM, **De Angelis D.** (2022): Adjusting for time of infection or positive test when estimating the risk of a post-infection outcome in an epidemic. *Statistical Methods in Medical Research, in press*, online first: June 12, 2022. https://doi.org/10.1177/09622802221107105

- Jackson CH, Tom BDM, Kirwan PD, Mandal S, Seaman SR, Kunzmann K, Presanis AM, **De Angelis D.** (2022): A comparison of two frameworks for multi-state modelling, applied to outcomes after hospital admissions with COVID-19. *Statistical Methods in Medical Research, in press*, online first: July 15, 2022. https://doi.org/10.1177/09622802221106720

- Nyberg T*, Ferguson NM*, Nash SG, Webster HH, Flaxman S, Andrews N, Hinsley W, Bernal JL, Kall M, Bhatt S, Blomquist P, Zaidi A, Volz E, Abdul Aziz N, Harman K, Funk S, Abbott S, Hope R, Charlett A, Chand M, Ghani AC, Seaman SR, Dabrera G, **De Angelis D***, Presanis AM*, Thelwall S*. (2022): Comparative analysis of the risks of hospitalisation and death associated with SARS-CoV-2 omicron (B.1.1.529) and delta (B.1.617.2) variants in England: a cohort study. *The Lancet* 399(10332):1303-12. doi:10.1016/S0140-6736(22)00462-7

- Nyberg T, Harman K, Zaidi A, Seaman SR, Andrews N, Nash SG, Charlett A, Lopez-Bernal J, Myers R, Groves N, Gallagher E, Gharbia S, Chand M, Thelwall S, **De Angelis D**, Dabrera G, Presanis AM. (2022): Hospitalisation and mortality risk for COVID-19 cases with SARS-CoV-2 AY.4.2 (VUI-21OCT-01) compared to non-AY.4.2 Delta variant sub-lineages. *The Journal of Infectious Diseases*; jiac063, doi:10.1093/infdis/jiac063

- Twohig KA*, Nyberg T*, Zaidi A, Thelwall S, Sinnathamby MA, Aliabadi S, Seaman SR, Harris RJ, Hope R, Lopez-Bernal J, Gallagher E, Charlett A, **De Angelis D**, Presanis AM, Dabrera G. (2021): Hospital admission and emergency care attendance risk for SARS-CoV-2 delta (B.1.617.2) compared with alpha (B.1.1.7) variants of concern: a cohort study. *The Lancet Infectious Diseases*. 22(1):35-42. doi:10.1016/S1473-3099(21)00475-8

  - A press release accompanied the publication of this paper (https://www.mrc-bsu.cam.ac.uk/blog/patients-with-sars-cov-2-delta-variant-were-more-likely-to-be-admitted-to-hospital-compared-to-patients-with-alpha-variant/).

- Illingworth CJR, Hamilton WL, Warne B, Routledge M, Popay A, Jackson CH, Fieldman T, Meredith L, Houldcroft CJ, Hosmillo M, Jahun A, Caller L, Caddy S, Yakovleva A, Hall G, Khokhar FA, Feltwell T, Pinckert ML, Georgana I, Chaudhry Y, Curran MD, Parmar S, Sparkes D, Rivett L, Jones NK, Sridhar S, Forest S, Dymond T, Grainger K, Workman C, Gkrania-Klotsas E, Brown NM, Weekes M, Baker S, Peacock SJ, Goodfellow IG, Gouliouris T, **De Angelis D**, Török ME. (2021). Superspreaders drive the largest outbreaks of hospital onset COVID-19 infection. elife, 10:e67308. https://doi.org/10.7554/eLife.67308

- Aggarwal D, Warne B, Jahun AS, Hamilton W, Fieldman T, du Plessis L, Hill V, Blane B, Watkins E, Wright E, Hall G, Ludden C, Myers R, Hosmillo M, Goodfellow Y, Pinckert ML,

Georgana I, Izuagbe R, Leek D, Nsonwu O, Hughes G, Packer S, Page AJ, Metaxaki M, Fuller S, Weale G, Holgate J, Brown CA, The Cambridge Covid-19 testing Centre, University of Cambridge Asymptomatic COVID-19 Screening Programme Consortium, The COVID-19 Genomics UK (COG-UK) Consortium, Howes R, McFarlane D, Dougan G, Pybus OG, **De Angelis D**, Maxwell PH, Peacock SJ, Weekes M, Illingworth C, Harrison EM, Matheson NJ, Goodfellow IG. Genomic epidemiology of SARS-CoV-2 in a UK university identifies dynamics of transmission. Nat Commun 13(1):751. https://pubmed.ncbi.nlm.nih.gov/35136068/

- Cooper DJ, Lear S, Watson L, Shaw A, Ferris M, Doffinger R, Bousfield R, Sharrocks K, Weekes MP, Warne B, Sparkes D, Jones NK, Rivett L, Routledge M, Chaudhry A, Dempsey K, Matson M, Lakha A, Gathercole G, O'Connor O, Wilson E, Shahzad O, Toms K, Thompson R, Halsall I, Halsall D, Houghton S, Papadia S, Kingston N, Stirrups KE, Graves B, Townsend P, Walker N, Stark H, **De Angelis D**, Seaman S, Dougan G, Bradley JR, Török ME, Goodfellow I, Baker S; CITIID-NIHR BioResource COVID-19 Collaboration (2022). A prospective study of risk factors associated with seroprevalence of SARS-CoV-2 antibodies in healthcare workers at a large UK teaching hospital. J Infect S0163-4453(22)00514-X. [PMID: 36058413 DOI: 10.1016/j.jinf.2022.08.030]

- Swallow B, Birrell P, Blake J, Burgman M, Challenor P, Coffeng LE, Dawid P, **De Angelis D**, Goldstein M, Hemming V, Marion G, McKinley TJ, Overton C, Panovska-Griffiths J, Pellis L, Probert W, Shea K, Villela D, Vernon I. (2022) Challenges in estimation, uncertainty quantification and elicitation for pandemic modelling. Epidemics, 38:100547. https://doi.org/10.1016/j.epidem.2022.100547

- Barnard S, Chiavenna C, Fox S, Charlett A, Waller Z, Andrews N, Goldblatt P, Burton P, **De Angelis D**. Methods for modelling excess mortality across England during the COVID-19 pandemic. Statistical Methods in Medical Research (in press), online first: October 23, 2021. https://doi.org/10.1177/09622802211046384

- Birrell PJ, Blake J, van Leeuwen E, Gent N, **De Angelis D** (2021). Real-time Nowcasting and Forecasting of COVID-19 Dynamics in England: the first wave. Proceedings of London Mathematical Society B. 376(1829):20200279. https://royalsocietypublishing.org/doi/full/10.1098/rstb.2020.0279

- Nyberg T*, Twohig KA*, Harris RJ, Seaman SR, Flannagan J, Allen H, Charlett A, **De Angelis D**, Dabrera G, Presanis AM. (2021): Risk of hospital admission for patients with SARS-CoV-2 variant B.1.1.7: cohort analysis. *BMJ*;373. doi:10.1136/bmj.n1412

- Docherty AB, Mulholland RH, Lone NI, Cheyne CP, **De Angelis D**, Diaz-Ordaz K, Donoghue C, Drake TM, Dunning J, Funk S, García-Fiñana M, Girvan M, Hardwick HE, Harrison J, Ho A, Hughes DM, Keogh RH, Kirwan PD, Leeming G, Nguyen-Van-Tam JS, Pius R, Russell CD, Spencer R, Tom BDM, Turtle L, Openshaw PJM, Baillie JK, Harrison EM, Semple MG, for ISARIC4C investigators (2021). Changes in UK hospital mortality in the first wave of COVID-19: the ISARIC WHO Clinical Characterisation Protocol prospective multi-centre observational cohort study. Lancet Respiratory Diseases. https://doi.org/10.1016/S2213-2600(21)00175-2

Interviews/media interaction (selected)

- Radio interview for BBC Radio 4 News on latest Covid nowcasting and forecasting data, aired in May 2020

- Television interview for Channel 4 Dispatches documentary 'Coronavirus: Did the Government get it wrong?' aired in June 2020

- Science Media Centre press briefing - led to coverage of the nowcasting and forecasting work in 12 national newspapers, June 2020
- Radio interview for BBC Radio 4 Today programme on latest Covid nowcasting and forecasting, aired in July 2020
- Television interview, Sky News on latest Covid nowcasting and forecasting data and whether government restrictions worked, aired in January 2021
- Media coverage (online and print) of Nowcasting and Forecasting reports (from (https://www.mrc-bsu.cam.ac.uk/tackling-covid-19/nowcasting-and-forecasting-of-covid-19/; over 3000 articles
- The (https://www.mrc-bsu.cam.ac.uk/tackling-covid-19/nowcasting-and-forecasting-of-covid-19/ has had over 250,000 hits.

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.

   The SPI-M-O groups (and its sub-groups) had the remit of providing the best evidence to support policy decisions. In this respect, in my opinion, it achieved its aim. Every member of the group worked hard, under extreme time pressure, to ensure that relevant results could be delivered on time, and SAGE could use the most-updated evidence during a period of continuous change and great uncertainty.

   This may include, but is not limited to, your views on:

   a) The composition of the groups and/or their diversity of expertise;

      SPI-M-O membership was mainly made up of mathematicians with expertise in infectious diseases dynamics. However, the group also included epidemiologists, clinicians and public health doctors. In addition, there was a link, perhaps not strong enough, with behavioural scientists, belonging to SPI-B (B for behaviour). The gender balance was good. When additional expertise was needed, external experts would be invited to discuss at relevant sessions. An expertise not sufficiently represented was that of data analysis. Many times, as a statistician, I found myself objecting to some data interpretation/presentation and questioning the analyses made. In a situation where data, often affected by observational biases, had a crucial role, and time was short, more dedicated statistical expertise would have been most valuable. In a couple of situations I did indeed suggest the creation of a specific subgroup (SPI-S (Statistics)) with such an expertise, where the limitation of the data could be promptly identified, and the most appropriate analysis carried out rapidly for the benefit of everyone.

   b) The way in which the groups were commissioned to work on the relevant issues;

      At the beginning of 2020 the questions were quite clearly formulated. They were about understanding the potential for a pandemic; its likely size and duration; What groups/geographical locations will be worst affected; and what interventions could mitigate it. When the first cases started to appear, the question became that of understanding the epidemic spread and growth and again of designing appropriate interventions. This clarity was somehow lost mid/late 2020, when, after the lockdown the nation was re-opening, indicators of transmission needed to be identified and the national epidemic was being replaced by smaller outbreaks, difficult to characterise and intervene on. The concept of "tiers" was not easy to deal with and it was difficult to understand how to create useful evidence for action, leading eventually to a second national lockdown. Commissioning became again clearer in 2021 with the consideration of a roadmap to reopening after the 2021 winter lockdown.

c) The resources and support that were available;

The SPI-M-O chairs and secretariat were a great asset to the whole group (I believe the secretariat were deservedly awarded a prize). I am aware that there were financial resources available to some of the groups to undertake specific roles/task, although I never fully understood how this financial support was distributed amongst participants.

d) The advice given and/or recommendations that were made; The group was not giving advice, rather creating the evidence that would support advice. This was always clear.

e) The extent to which the groups worked effectively together;

There were some useful collaborations, particularly amongst the most junior members of SPI-M-O. However, there was also a lot of silo work, particularly by big groups with lots of resources that could be utilised to address multiple questions. Inevitably, there were individuals who would dominate the scene and prevent discussion. Time was also at a premium, and discussions on important issues were curtailed without a thorough examination of the evidence circulated. In fact, it would often happen, that under time pressure, results would only be provided during the meeting, with reduced opportunity for detailed scrutiny.

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

I am not sure I understand the question. I take it as meaning whether in the functioning of the above groups the necessary structures and policies were applied and followed. SPIM had precise terms of reference, confidentiality was paramount and disclosure of potential conflicts of interests were required. If there was a contentious issue about any of the participants, the chairs would discuss it with core members and a consensus would be reached on how to deal with the situation.

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.

After the H1N1 2009 pandemic, the notion of pandemic preparedness became a reality. SPIM had been set up, continued to meet after 2009 and investments were made by funding bodies to ensure a better preparation for the next pandemic (e.g. the sleeping projects funded by the National Institute for Health Research (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7228695/)). However, at the beginning of 2020, the UK was still unprepared. Public Health England, the body with responsibility for pandemic preparedness, had had its funding cut for a number of years prior to 2020 and in March 2020 stopped its Test and Trace program for lack of resources.

The need for appropriate preparation for a potential pandemic is, in my view, the major lesson learned from this pandemic. As a statistician, data are for me the main priority and should be at the centre on any future preparedness plan. It is just not enough to invest in advanced analytics when the available data are not interpretable.

Appropriately designed surveillance and population studies are needed together with a prompt and safe access to data collected routinely. We struggled enormously to make sense of information conveniently collected. It was impossible, for instance, to make sense of data on new cases. These were affected by propensity to test, test resources as well governmental policies and the information collected was incomplete (e.g. the time of symptoms onset). Data on deaths were also incomplete, as

suffering from the delay between the date of death and date of reporting to registries. The available data on the number of people hospitalised and admitted to intensive care, so crucial to understand the burden on the National Health Service, were also limited and delayed. I could give many more examples of the inadequacy of the available data.

What is needed is to ensure proper designs are adopted so that data are interpretable. An example of this is the Office of National Statistics COVID19 Infections Survey. It was designed in much hurry and was only operative from May 2020, but its value has been enormous. A random survey of that type, together with robust and granular data on mortality and morbidity, should the pillars of UK preparedness. In terms of the functioning of the above groups, I would like to see a bigger role played by statisticians, with the creation of a SPI-Statistics subgroup responsible for rapid and robust data analysis. Note, this is very different from the activities of data mining and visualisation that scientists with data science background can carry out.

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.

    - Notes taken in meetings attended

    - Emails and other communication (e.g. downloaded meeting chats)