UK COVID-19 Inquiry: Module 2 - Rule 9 Request to Professor Mark Woolhouse - Reference: M2/SAGE/01/MW

RESPONSE: SEPTEMBER 20th 2022

As instructed (e-mail 06/09/22), this response covers only SAGE and its subgroups.

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

Mark Woolhouse is Professor of Infectious Disease Epidemiology at the University of Edinburgh. He has BA in Zoology from the University of Oxford, an MSc in Biological Computation from the University of York and a PhD in Ecology from Queen's University, Canada. He held research fellowships at the University of Zimbabwe, Imperial College London and Oxford before moving to Edinburgh in 1997. He studies viral threats to human and animal health. He has published over 300 research papers, is a frequent invited speaker to audiences of academics, clinicians and the general public, and makes regular contributions in the national and international press and media. He has advised governments and national and international agencies and was a member of two senior UK advisory groups on the Covid-19 response: the Scientific Pandemic Influenza Group on Modelling (SPI-M) and the Scottish Covid-19 Advisory Group. He is a Fellow of the Royal Society of Edinburgh, the Academy of Medical Sciences and the African Academy of Sciences and was awarded an OBE in 2002. His book about lockdown – *The Year The World Went Mad* (Sandstone Press) – was published in February 2022.

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QUESTION 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

Member of SPI-M from 29/01/20 to 25/03/22

Attended one meeting of NERVTAG 21/12/21

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QUESTION 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;
   Invited to contribute to SPI-M meeting on 27/01/20 by e-mail from the Co-Chair on 24/01/20. Formally added to SPI-M membership on 29/01/20.

b. The number of meetings you attended, and your contributions to those meetings;
   SPI-M records show that I was invited to 102 SPI-M meetings from 01/22 to 02/22 and attended 86 of these. I also attended one NERVTAG meeting (21/12/21). On occasion a report of my group's work (see Table 4.1) was included as an agenda item. More usually, my role was to comment on the work being presented by others and to contribute to the general discussion. Rarely, I was invited to comment on the consensus statement prior to release.

c. Your role in providing research, information and advice.
   At various times between 01/20 and 02/22 I provided research outputs, information and advice through contributions to SPI-M meetings and related correspondence by e-mail.

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QUESTION 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.

24 briefs for SPI-M (list attached – Table 4.1)

1 brief for SAGE (list attached – Table 4.2)

QUESTION 4

TABLE 4.1: Briefs for SPI-M

1. **Sent:** 02 March 2020 08:03
   Title: Time limited social distancing measures and the shape of the epidemic curve, (29/02/20)
   Authors: M. Woolhouse, A. Morgan, B. van Bunnik
   Link: not available online

2. **Sent:** 04 March 2020 16:48
   Title: Optimising trigger times for social distancing measures (SDMs) (04/03/20)
   Authors: Woolhouse, B. van Bunnik
   Link:
   https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/891904/S0038_SAGE13_Optimising_Time_Varying_SDMs.pdf

3. **Sent:** 08 March 2020 21:13
   Title: Optimising trigger times for social distancing measures (SDMs) (04/03/20)
   Authors: M. Woolhouse, B. van Bunnik
   Link: updated version not available online

4. **Sent:** 11 March 2020 11:29
   Title: Course of epidemic with 2 fixed period interventions optimised to day of introduction, against a background of reduced transmissions, 12/03/20
   Authors: authors not stated
   Link: not available online

5. **Sent:** 30 March 2020 08:04
   Title: Lockdown duration and additional ICU capacity (29/03/20)
   Authors: M. Woolhouse, A. Morgan, P. Bessell, B. van Bunnik
   Link: not available online

6. **Sent:** 12 April 2020 22:29
   Title: Enhanced shielding as an exit strategy from COVID-19 lockdown (10/04/20)
   Authors: Mark Woolhouse, Alex Morgan, Paul Bessell, Bram van Bunnik
   Link: not available online

7. **Sent:** 27 April 2020 08:47
   Title: Segmentation and shielding as part of an exit strategy from COVID-19 lockdown (26/04/20)
   Authors: Epigroup, University of Edinburgh and colleagues
   Link: not available online

8. **Sent:** 03 June 2020 08:52
   Title: Beyond R: instantaneous COVID-19 risks
   Author: Mark Woolhouse
   Link: not available online

9. **Sent:** 15 July 2020 08:39
   Title: Segmentation and Shielding Models
   Authors: Mark Woolhouse and colleagues
   Link: not available online

10. **Sent:** 16 July 2020 15:53
    Title: Segmentation and Shielding Models
    Authors: Mark Woolhouse, Bram van Bunnik, and colleagues
    Link: not available online

11. **Sent:** 15 July 2020 08:39;
    04 August 2020 18:34
    Title: Segmentation and shielding of the most vulnerable members of the population as elements of an exit strategy from COVID-19 lockdown
    Authors: Bram A.D. van Bunnik, Alex L.K. Morgan, Paul R. Bessell, Giles Calder-Gerver, Feifei Zhang, Samuel Haynes, Jordan Ashworth, Shengyuan Zhao, Nicola Rose Cave, Meghan R. Perry, Hannah C. Lepper, Lu Lu, Paul Kellam, Aziz Sheikh, Graham F. Medley & Mark E.J. Woolhouse
    Link: not available online

12. **Sent:** 04 August 2020 18:34
    Title: RESTRICTING OUR OPTIONS "Painting ourselves into a corner", 25/04/20
    Authors: Epigroup, University of Edinburgh
    Link: not available online

13. **Sent:** 04 August 2020 18:34
    Title: Segmentation and Shielding Models, July 16th 2020
    Authors: Mark Woolhouse, Bram van Bunnik and colleagues
    Link: not available online

14. **Sent:** 05 August 2020 21:44
    Title: PROTECTING HIGH RISK INDIVIDUALS AS AN APPROACH TO CONTROLLING COVID-19 OUTBREAKS – IMPORTANCE OF TRANSMISSION NETWORKS AND THE CHAIN OF TRUST, August 4th 2020
    Authors: Mark Woolhouse, Bram van Bunnik, Aziz Sheikh
    Link: not available online

15. **Sent:** 04 November 2020 07:57
    Title: Daily positive cases in Scotland
    Authors: authors not stated
    Link: not available online

16. **Sent:** 11 November 2020 08:32
    Title: Weekly ratios and school closures, 11/11/20
    Authors: authors not stated
    Link: not available online

17. **Sent:** 05 January 2021 21:33
    Title: Illustrative model-based analysis of vaccination and release strategies (Scotland), 05/01/21
    Authors: Mark Woolhouse, Alex Morgan, Bram van Bunnik
    Link: not available online

18. **Sent:** 06 January 2021 08:04
    Title: Illustrative model-based analysis of vaccination and release strategies (Scotland), 05/01/21
    Authors: Mark Woolhouse, Alex Morgan, Bram van Bunnik
    Link: not available online

19. **Sent:** 27 January 2021 09:57
    Title: Weekly ratio statistic for Scotland (21/01/21)
    Authors: Epigroup at the University of Edinburgh
    Link: not available online

20. **Sent:** 08 September 2021 09:26
    Title: WEEKLY RATIO STATISTICS FOR SCOTLAND 08/20-09/21
    Authors: Epigroup, University of Edinburgh
    Link: not available online

21. **Sent:** 01 December 2021 10:11
    Title: SARS-CoV-2 omicron variant modelling, 01/12/21
    Authors: Bram van Bunnik, Mark Woolhouse
    Link: not available online

22. **Sent:** 08 December 2021 10:29
    Title: SARS-CoV-2 omicron variant modelling Interim Progress Report 08/12/21
    Authors: Bram van Bunnik, Alex Morgan, Mark Woolhouse
    Link: not available online

23. **Sent:** 17 December 2021 11:47
    Title: SARS-CoV-2 omicron variant modelling Final Report 17/12/21
    Authors: Bram van Bunnik, Alex Morgan, Mark Woolhouse
    Link: not available online

24. **Sent:** 21 December 2021 20:08
    Title: SARS-CoV-2 omicron variant modelling Final Report 21/12/21 (Supplementary material added to Report 17/12/21)
    Authors: Bram van Bunnik, Alex Morgan, Mark Woolhouse,
    Link: not available online

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QUESTION 4

TABLE 4.2: Briefs for SAGE

1. **Sent:** 05/10/20
   Title: Mortality due to a second wave of COVID-19 in Scotland: The case for additional measures to protect the vulnerable, 05/10/20
   Author: University of Edinburgh and Health Protection Scotland
   Link: University of Edinburgh and Health Protection Scotland: Mortality due to a second wave of COVID-19 in Scotland: The case for additional measures to protect the vulnerable, 5 October 2020 - GOV.UK (www.gov.uk)

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QUESTION 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.

16 peer-reviewed articles in scientific journals (list attached – Table 5.1)

9 pre-prints on recognised pre-print servers (list attached – Table 5.2)

6 opinion articles in the popular and professional press (list attached – Table 5.3)
5 Science Media Centre and 1 Scottish Government live briefings to journalists
58 comments posted via Science Media Centre recorded by the SMC
Estimated >100 media interviews
15,547 press mentions (national and international) recorded by the University of Edinburgh Press Office
0 social media outputs

5 presentations to academic institutions

1 book, *The Year the World Went Mad* (Sandstone Press, February 2022)

5 appearances as a witness to Parliamentary committees (list attached – Table 5.4)

QUESTION 5

TABLE 5.1: Peer-reviewed articles in scientific journals

1. Stein, F., Perry, M., Banda, G., Woolhouse, M. and Mutapi, F. (2020). Oxygen provision to fight COVID-19 in sub-Saharan Africa. *BMJ Global Health* 5: e002786.
    Published: 11 June 2020 BMJ Global Health
    http://dx.doi.org/10.1136/bmjgh-2020-002786

2. Simpson, C.R., Robertson, C., Vasileiou, E., McMenamin, J., Gunson, R., Ritchie, L.D., Woolhouse, M., Morrice, L., Kelly, D., Stagg, H.R., Marques, D., Murray, J. and Sheikh, A. (2020). Early pandemic evaluation and enhanced surveillance of COVID-19 (EAVE II): protocol for an observational study using linked Scottish national data. *BMJ Open* 10: e039097.
    Published: 21 June 2020 BMJ Open
    http://dx.doi.org/10.1136/bmjopen-2020-039097

3. Lu, L., Lycett, S.J., Ashworth, J., Mutapi, F. and Woolhouse, M. (2021). What are SARS-CoV-2 genomes from the World Health Organization Africa Region member states telling us? *BMJ Global Health* 6: e004408.
    Published: 8 January 2021
    http://dx.doi.org/10.1136/bmjgh-2020-004408

4. Flook, M., Jackson, C., Vasileiou, E., Simpson, C.R., Muckian, M.D., Agrawal, U., McCowan, C., Jia, Y., Murray, J.L.K., Ritchie, L.D., Robertson, C., Stock, S.J., Wang, X., Woolhouse, M.E.J., Sheikh, A. and Stagg, H.R. (2021). Informing the public health response to COVID-19: a systematic review of risk factors for disease severity and mortality. *BMC Infectious Diseases* 21: 342.
    Published: 12 April 2021
    https://doi.org/10.1186/s12879-021-05992-1

5. Vasileiou, E., Simpson, C.R., Ting, S., Kerr, S., Agrawal, U., Akbari, A., Bedston, S., Beggs, J., Bradley, D., Chuter, A., de Lusignan, S., Docherty, A.B., Ford, D., Hobbs, F.D.R., Joy, M., Katikireddi, S.V., Marple, J., McCowan, C., McGagh, D., McMenamin, J., Moore, E., Murray, J.L.K., Pan, J., Ritchie, L., Shah, S.A., Stock, S., Torabi, F., Tsang, R.S.M., Wood, R., Woolhouse, M., Robertson, C. and Sheikh, A. (2021). Interim findings from first does mass COVID-19 vaccination roll-out and COVID-19 hospitalisations in Scotland: a prospective cohort study of 5.4 million people. *The Lancet* 397: 1646-1657.
    Published: 23 April 2021
    http://doi.org/10.1016/S0140-6736(21)00677-2

6. Morgan, A.L.K., Woolhouse, M.E.J., Medley, G.F. and van Bunnik, B.A.D. (2021). Optimizing time-limited non-pharmaceutical interventions for COVID-19 outbreak control. *Philosophical Transactions of the Royal Society, Biological Sciences* 376: 20200275.
    Published: 31 May 2021
    https://doi.org/10.1098/rstb.2020.0282

7. van Bunnik, B.A.D., Morgan, A.L.K., Bessell, P.R., Calder-Gerver, G., Zhang, F.F., Haynes, S., Ashworth, J., Zhao, S.Y., Cave, R.N.R., Perry, M.R., Lepper, H.C., Lu, L., Kellam, P., Sheikh, A., Medley, G.F. and Woolhouse, M.E.J. (2021). Segmentation and shielding of the most vulnerable members of the population as elements of an exit strategy from COVID-19 lockdown. *Philosophical Transactions of the Royal Society, Biological Sciences* 376: 20200282.
    Published online: 31 May 2021
    Published: 19 July 2021, *Philosophical Transactions,* Vol. 376, Issue 1829
    https://doi.org/10.1098/rstb.2020.0275

8. Mulholland, R.H., Vasileiou, E., Simpson, C.R., Robertson, C., Ritchie, L.D., Agrawal, U., Woolhouse, M., Murray, J.L.K., Stagg, H.R., Docherty, A.B., McCowan, C., Wood, R., Stock, S.J. and Sheikh, A. (2021). Cohort profile: early pandemic evaluation and enhanced surveillance of COVID-19 (EAVE II). *International Journal of Epidemiology* 50: 1064-1074.
    Published: 05 June 2021
    https://doi.org/10.1093/ije/dyab028

9. Zhang, F., Karamagi, H., Nsenga, N., Nanyunja, M., Karinja, M., Amanfo, S., Chase-Topping, M., Calder-Gerver, G., McGibbon, M., Huber, A., Wagner-Gamble, T., Guo, C.-G., Haynes, S., Morrison, A., Ferguson, M., Awandare, G.A., Mutapi, F., Yoti, Z., Cabore, J., Moeti, M.R. and Woolhouse, M.E.J. (2021). Predictors of COVID-19 epidemics in countries of the World Health Organization African Region. *Nature Medicine* 27: 2041-2047.
    Published: 03 September 2021
    https://doi.org/10.1038/s41591-021-01491-7

10. Agrawal, U., Katikireddi, S.V., McCowan, C., Mulholland, R.H., Azcoaga-Lorenzo, A., Amele, S., Fagbamigbe, A.F., Vasileiou, E., Grange, Z., Ting, S., Kerr, S., Moore, E., Murray, J.L.K., Shah, S.A., Ritchie, L., O'Reilly, D., Stock, S.J., Beggs, J., Chuter, A., Torabi, F., Akbari, A., Bedston, S., McMenamin, J., Wood, R., Tang, R.S.M., de Lusignan, S., Hobbs, F.D.R., Woolhouse, M., Simpson, C.R., Robertson, C. and Sheikh, A. (2021). COVID-19. COVID-19 hospital admissions and deaths after BNT162b2 and ChAdOx1 nCoV-19 vaccinations in 2.57 million people in Scotland (EAVE II): a prospective cohort study
    Published online: 29 September 2021
    Published: 30 November 2021, *The Lancet, Medicine,* Vol. 9, Issue 12, December 2021, Pages 1439-1449
    https://doi.org/10.1016/S2213-2600(21)00380-5

11. Agrawal, U., Azcoaga-Lorenzo, A., Fagbamigbe, A., Vasileiou, E., Henry, P., Simpson, C., Stock, S., Shah, S., Robertson, C., Woolhouse, M., Ritchie, L., Sheikh, A., Harrison, E., Docherty, A. and McCowan, C. (2021). Association between multimorbidity and mortality in a cohort of patients admitted to a hospital with COVID-19 in Scotland. *Journal of the Royal Society of Medicine* 115: 22-30.
    Published: 21 October 2021
    https://doi.org/10.1177/01410768211051715

12. Lu, L., Sikkema, R.S., Velkers, F.C., Nieuwenhuijse, D.F., Fischer, E.A.G., Meijer, P.A., Bouwmeester-Vincken, N., Rietveld, A., Wegdam-Blans, M.C.A., Tolsma, P., Koppelman, M., Smit, L.A.M., Hakze-van der Honing, R.W., van der Poel, W.H.M., van der Spek, A.N., Spierenburg, M.A.H., Molenaar, R.J., de Rond, J., Augustijn, M., Woolhouse, M., Stegeman, J.A., Lycett, S., Munnink, B.B.O., Koopmans, M.P.G. (2021). Adaptation, spread and transmission of SARS-CoV-2 in farmed minks and associated humans in the Netherlands. *Nature Communications* 12: 6802.

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Published: 23 November 2021
https://doi.org/10.1038/s41467-021-27096-9

13. Calder-Gerver, G., Mazeri, S., Haynes, S., Simonet, C., Woolhouse, M. and Brown, H. (2021). Real-time monitoring of COVID-19 in Scotland. *Journal of the Royal College of Physicians of Edinburgh* 51: S20-S25.
Published: 1 December 2021
https://doi.org/10.4997/jrcpe.2021.237

14. Kerr, S., Joy, M., Torabi, F., Bedston, S., Akbari, A., Agrawal, U., Beggs, J., Bradley, D., Chuter, A., Docherty, A.B., Ford, D., Hobbs, R., Katikireddi, S.V., Lowthian, E., de Lusignan, S., Lyons, R., Marple, J., McCowan, C., McGagh, D., McMenamin, J., Moore, E., Murray, J-L.K., Owen, R.K., Pan, J., Ritchie, L., Shah, S.A., Shi, T., Stock, S., Tang, R.S.M., Vasileiou, E., Woolhouse, M., Simpson, C.R., Robertson, C. and Sheikh, A. (2022). First dose ChAdOx1 and BNT162b2 COVID-19 vaccinations and cerebral venous sinus thrombosis: A pooled self-controlled case series study of 11.6 million individuals in England, Scotland, and Wales. *PLoS Medicine* 19: e1003927.
Published: 22 February 2022
https://doi.org/10.1371/journal.pmed.1003927

15. Shah, S.A., Mulholland, R.H., Wilkinson, S., Katikireddi, S.V., Pan, J., Shi, T., Kerr, S., Agrawal, U., Rudan, I., Simpson, C.R., Stock, S.J., Macleod, J., Murray, J-L.K., McCowan, C., Ritchie, L., Woolhouse, M. and Sheikh, A. (2022). Impact on emergency and elective hospital-based care in Scotland over the first 12 months of the pandemic: interrupted time series analysis of national lockdowns. *Journal of the Royal Society of Medicine*.
Published: 3 May 2022
https://doi.org/10.1177/01410768221095239

16. Sheikh, A., Kerr, S., Woolhouse, M., McMenamin, J. and Robertson, C. (2022). Severity of omicron variant of concern and effectiveness of vaccine boosters against symptomatic disease in Scotland (EAVE II): a national cohort study with nested test-negative design. *Lancet Infectious Diseases*, July 2022 22: 959-966
Published: online 22 April 2022, Version of Record 22 June 2022
https://doi.org/10.1016/S1473-3099(22)00141-4

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QUESTION 5

TABLE 5.2: Pre-prints

1. Bram A. D. van Bunnik, Alex L. K. Morgan, Paul R. Bessell, Giles Calder-Gerver, Feifei Zhang, Samuel Haynes, Jordan Ashworth, Shengyuan Zhao, Roo Nicola Rose Cave, Meghan R. Perry, Hannah C. Lepper, Lu Lu, Paul Kellam, Aziz Sheikh, Graham F. Medley, and Mark E. J. Woolhouse, Segmentation and shielding of the most vulnerable members of the population as elements of an exit strategy from COVID-19 lockdown
Posted: 8 May 2020 MedRxiv
Published: 31 May 2021 Philosophical Transactions of the Royal Society B: Biological Sciences
https://doi.org/10.1101/2020.05.04.20090597

2. Mary Flook, Charlotte Jackson, Eleftheria Vasileiou, Colin R. Simpson, Marisa D. Muckian, Utkarsh Agrawal, Colin McCowan, Yumeng Jia, Josie L.K. Murray, Lewis D. Ritchie, Chris Robertson, Sarah J. Stock, Xin Wang, Mark E. J. Woolhouse, Aziz Sheikh, Helen R. Stagg, Informing the public health response to COVID-19 (and lessons learnt for future pandemics): a systematic review of risk factors for disease, severity, and mortality.
Posted: 19 June 2020 Research Square
https://doi.org/10.21203/rs.3.rs-36375/v1

3. Giles Calder-Gerver, Stella Mazeri, Samuel Haynes, Camille Simonet, Mark Woolhouse, Helen Brown, Real-Time Monitoring of Covid-19 in Scotland
Posted: 2 August 2020 MedRxiv
Published: 1 December 2021 Journal of the Royal College of Physicians of Edinburgh
https://doi.org/10.1101/2020.07.30.20158790

4. Samantha J Lycett, Joseph Hughes, Martin P McHugh, Ana da Silva Filipe, Rebecca Dewar, Lu Lu, Thomas Doherty, Amy Shepherd, Rhys Inward, Gianluigi Rossi, Daniel Balaz, Rowland R Kao, Stefan Rooke, Seb Cotton, Michael D Gallagher, Carlos Balcazar Lopez, Áine O'Toole, Emily Scher, Verity Hill, John T McCrone, Rachel M Colquhoun, Ben Jackson, Thomas C Williams, Kathleen A Williamson, Natasha Johnson, Katherine Smollett, Daniel Mair, Stephen Carmichael, Lily Tong, Jenna Nichols, Kirstyn Brunker, James G Shepherd, Kathy Li, Elihu Aranday-Cortes, Yasmin A Parr, Alice Broos, Kyriaki Nomikou, Sarah E McDonald, Marc Niebel, Patawee Asamaphan, Igor Starinskij, Natasha Jesudason, Rajiv Shah, Vattipally B Sreenu, Tom Stanton, Sharif Shaaban, Alasdair MacLean, The COVID-19 Genomics UK (COG-UK) consortium, Mark Woolhouse, Rory Gunson, Kate Templeton, Emma C Thomson, Andrew Rambaut, Matthew T.G. Holden, David L Robertson, Epidemic waves of COVID-19 in Scotland: a genomic perspective on the impact of the introduction and relaxation of lockdown on SARS-CoV-2
Posted: 20 January 2021 MedRxiv
https://doi.org/10.1101/2021.01.08.20248677

5. Eleftheria Vasileiou, Colin R. Simpson, Chris Robertson, Ting Shi, Steven Kerr, Utkarsh Agrawal, Ashley Akbari, Stuart Bedston, Jillian Beggs, Declan Bradley, Antony Chuter, Simon de Lusignan, Annemarie Docherty, David Ford, Richard Hobbs, Mark Joy, Srinivasa Vittal Katikireddi, James Marple, Colin McCowan, Dylan McGagh, Jim McMenamin, Emily Moore, Josephine-L.K Murray, Jiafeng Pan, Lewis D Ritchie, Syed Ahmar Shah, Sarah Stock, Fatemeh Torabi, Ruby S. M. Tsang, Rachael Wood, Mark Woolhouse, Aziz Sheikh, Effectiveness of First Dose of COVID-19 Vaccines Against Hospital Admissions in Scotland: National Prospective Cohort Study of 5.4 Million People
    Posted: 19 February 2021 Preprints with The Lancet
    Published: Available online 23 April 2021, Version of Record 29 April 2021, The Lancet Volume 397, Issue 10285, 1–7 May 2021, Pages 1646-1657
    https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3789264

6. Lu Lu, Reina S. Sikkema, Francisca C. Velkers, David F. Nieuwenhuijse, Egil A.J. Fischer, Paola A. Meijer, Noortje Bouwmeester-Vincken, Ariene Rietveld, Marjolijn C.A. Wegdam-Blans, Paulien Tolsma, Marco Koppelman, Lidwien A.M. Smit, Renate W. Hakze-van der Honing, Wim H. M. van der Poel, Arco N. van der Spek, Marcel A. H. Spierenburg, Robert Jan Molenaar, Jan de Rond, Marieke Augustijn, Mark Woolhouse, J. Arjan Stegeman, Samantha Lycett, Bas B. Oude Munnink, Marion P. G. Koopmans, Adaptation, spread and transmission of SARS-CoV-2 in farmed minks and related humans in the Netherlands
    Posted: 14 July 2021 BioRxiv
    https://doi.org/10.1101/2021.07.13.452160

7. Nisha Kriplani, Sara Clohisey, Sonia Fonseca, Sarah Fletcher, Hui-Min Lee, Jordan Ashworth, Dominic Kurian, Samantha J. Lycett, Christine Tait-Burkard, J. Kenneth Baillie, Mark E. J. Woolhouse, Simon R. Carding, James P. Stewart, Paul Digard, Secreted SARS-CoV-2 ORF8 modulates the cytokine expression profile of human macrophages
    Posted: 13 August 2021 BioRxiv (version 1)
    https://www.biorxiv.org/content/10.1101/2021.08.13.456266v1?versioned=true
    Posted: 18 August 2021 (version 2)
    https://doi.org/10.1101/2021.08.13.456266

8. Marcello S Scopazzini, Roo Nicola Rose Cave, Callum P Mutch, Daniella A Ross, Anda Bularga, Margo Chase-Topping, Mark Woolhouse. Oliver Koch, Meghan R Perry, Claire L Mackintosh, Scottish Index of Multiple Deprivation (SIMD) Indicators as Predictors of Mortality Among Patients Hospitalised with COVID-19 Disease in the Lothian Region, Scotland During the First Wave: A Cohort Study
    Posted: 30 November 2021 Research Square
    https://doi.org/10.21203/rs.3.rs-1102651/v1

9. Jordan Ashworth, Dayna Mathie, Fiona Scott, Yuvaraj Mahendran, Mark Edward John Woolhouse, Oda Stoevesandt, Takafira Mdluza, Mutapi Francisca, Pre-SARS-CoV-2 Human Sera Reacts with Peptides from All the 7 Human Coronaviruses: Peptide Microarray IgM and IgG Screening
    Posted: 17 Jan 2022 Preprints with The Lancet
    https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4010886

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TABLE 5.3: Opinion articles in the popular and professional press

1. Woolhouse, M., History may judge lockdown a monumental mistake (Where did the UK go wrong on coronavirus?
   Published: 1 July 2020 New Statesman
   https://www.newstatesman.com/long-reads/2020/07/where-did-uk-go-wrong-coronavirus (paywall)

2. Woolhouse, M., History may judge lockdown a monumental mistake
   Published: 19 September 2020 Sunday Telegraph
   https://www.telegraph.co.uk/news/2020/09/19/uk-needs-follow-swedish-model-learn-live-covid/ (paywall)

3. Woolhouse, M., Why vaccinating the over-80s should see the rest of us live with more freedom
   Published: 12 December 2020 Telegraph
   https://www.telegraph.co.uk/news/2020/12/12/vaccinating-over-80s-should-see-rest-us-live-freedom/ (paywall)

4. Woolhouse, M., Eradicating Covid-19 coronavirus seems unlikely but we are getting better at living with it
   Published: 26 April 2021 The Scotsman
   https://www.scotsman.com/news/opinion/columnists/eradicating-covid-19-coronavirus-seems-unlikely-but-we-are-getting-better-at-living-with-it-professor-mark-woolhouse-3213797

5. Woolhouse, M., Were Covid lockdowns really the best course of action?
   Published: 28 March 2022 The Scotsman
   https://www.scotsman.com/news/opinion/columnists/were-covid-lockdowns-really-the-best-course-of-action-professor-mark-woolhouse-3629384

6. Woolhouse, M., The case against lockdown as a public health intervention
   Published: Article first published online: June 9, 2022; Print issue dated: March 1, 2022
   Journal of the Royal College of Physicians of Edinburgh Volume: 52 issue: 1, page(s): 12-13
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QUESTION 5

TABLE 5.4: Appearances as a witness to Parliamentary committees

Date: 02/06/2020 [Video: start of testimony @ approximately 11:01]
Committee: House of Lords Science and Technology Committee
Link to public record of session:
https://parliamentlive.tv/event/index/c36d74b3-2fe2-4309-8554-f50fe966f7a3

Date: 10/06/2020 [Video: start of testimony @ approximately 14:30]
Committee: The House of Commons Science and Technology Committee
Link to public record of session:
https://parliamentlive.tv/event/index/b2d5f983-c32e-4e66-8f34-311deac63215

Date: 21/10/2020 9:30am [Video: start of testimony @ approximately 10:15]
Committee: The House of Commons Science and Technology Committee and Health and Social Care Committee
Link to public record of session:
https://parliamentlive.tv/event/index/ee5cf8f5-81df-4344-97e4-f28e1fb537fe

Date: 17/02/2021 [Video: start of testimony @ approximately 9:15]
Committee: The House of Commons Science and Technology Committee
Link to public record of session:
https://parliamentlive.tv/event/index/f6eb8607-9550-4a92-af50-5def31087f66

Date: 25/02/2021 8:30am [Transcript only – no video]
Committee: Scottish Parliament COVID-19 Committee
Link to public record of session:
https://www.parliament.scot/chamber-and-committees/official-report/what-was-said-in-parliament/pa-25-02-2021?meeting=13162&iob=119149

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QUESTION 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;
The membership of SPI-M was exceptionally well-qualified in epidemiology, epidemiological modelling and public health. The group was fit for purpose with regard to quantifying the direct health harms caused by Covid-19. SPI-M could perhaps have modelled the impact of harms to wider health care provision (though it was not, to my knowledge, asked to do so) but it was not well qualified to model the harm to the economy (though some modest attempts were made to do so), nor the harms to education, mental health or societal well-being. The issue of lack of attention to wider harms was repeatedly raised within SPI-M but never addressed.

b. The way in which the groups were commissioned to work on the relevant issues;
Most commonly, tasks were handed down to the group by the co-chairs. It was always possible to suggest that other pieces of work were discussed though this was not the norm. The tasks handed down were heavily weighted towards advice on the timing and severity of interventions involving social distancing. Far less attention was paid to alternatives to social distancing. For example, to my knowledge SPI-M was never asked to identify alternatives to lockdown for managing the public health burden of Covid-19 (apart from, later, vaccination)[1]. When work of that kind was done regardless it required a bespoke modelling effort (e.g. [2]) that could not be evaluated properly by the models SPI-M used for most of its projections. This inevitably biased SPI-M advice towards lockdown.

c. The resources and support that were available;
The work of DHSC team running and supporting the operation of SPI-M was outstanding; they were consistently accessible, responsive and supportive.

d. The advice given and/or recommendations that were made;
In my view as an epidemiological modeller, policy makers gave far too much weight to the outputs of epidemiological models[3]. This is most easily explained by a lack of understanding of the models' weaknesses and limitations. In particular: robustness of long-term predictions; choices of counterfactuals; estimation of the impact of government interventions; use of worst case scenarios; and the relationship between model structure and the policy recommendations that emerge. In practice, all of these biased the advice towards social distancing and lockdown. There is an open question as to whose responsibility it was to communicate these issues; they were understood within SPI-M but that group reported to SAGE and did not engage directly with policy makers.

e. The extent to which the groups worked effectively together;
See response to Q7 for comments on the relationship between SPI-M and SAGE.

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[1] There has been some discussion of this point and it was raised at Select Committees on 02/06/2020 and 21/10/2020 (see Table 5.4)
[2] van Bunnik, B. *et al.* (2021) Segmentation and shielding of the most vulnerable members of the population as elements of an exit strategy from COVID-19 lockdown. *Philosophical Transactions of the Royal Society, Biological Sciences* 376: 20200282 doi.org/10.1098/rstb.2020.0275
[3] I reiterated this point at Select Committee on 10/06/2020 (see Table 5.4)

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

I discuss utilisation of policies and their effectiveness at length elsewhere[4]. In brief, the workings of the advisory groups tended to favour interventions involving social distancing over alternatives that might have both saved more lives and caused less indirect harm. Social distancing and lockdown undoubtedly reduced the short-term public health burden due to Covid-19 itself (though the magnitude of reduction is disputed) but alternative interventions were available. However, lockdown was far from fully effective in protecting those most vulnerable to Covid-19: an estimated 50-75% of deaths in the first wave were due to infections acquired *during* lockdown[5]. In addition, lockdown caused enormous indirect harms. There is a strong case that the UK's pandemic response overemphasized the need for and the impact of extreme social distancing and consequently was suboptimal.

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[4] Woolhouse, M. (2022) *The Year the World Went Mad*, Sandstone Press

[5] Mortality+due+to+a+second+wave+of+COVID-19+in+Scotland+-
+The+Case+for+additional+measures+to+protect+the+vulnerable+%285+October+2020%29.pdf
(www.gov.scot)

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QUESTION 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.

In my view, lessons to be learned include:

i) We need to agree and adhere to best practice for epidemiological modeling. There has been in-depth work on this in the past[6] and much of that remains applicable, though a thorough review and re-evaluation would be timely. Best practice needs to cover all of: framing of the problem; implementation; communication of the outputs, especially uncertainty and limitations. There need to be explicit recommendations regarding the role of worst case scenarios and best practice for generating them.

ii) There was insufficient real-time challenge to the outputs of SPI-M. This role could, and perhaps should, have been performed by SAGE. But the SAGE members with modelling expertise were also leading figures within SPI-M itself. If, instead, senior scientists with modelling expertise but outside of SPI-M had been appointed to SAGE then this challenge function could have been better performed. In general, it is inadvisable for those directly involved in generating research outputs (e.g. model projections) also to evaluate how those outputs should guide policy – there is a natural tendency to be overconfident in work we have done ourselves and underplay findings that differ from our own. As it was, there is a case to be made that SPI-M was marking its own homework and SAGE became an echo chamber for a subset of opinion within SPI-M.

iii) An enormous volume of scientific information was generated during the Covid-19 pandemic. Rapid, objective and independent collation and synthesis of that evidence ('knowledge broking') was invaluable but was largely performed outside the core advisory system (two good examples were the Royal Society's DELVE and the University of Edinburgh's UNCOVER initiatives), though ad hoc briefings were held from time to time within the advisory groups. Frameworks for evaluating an evidence base already exist[7] and some are used by agencies such as the World Health Organization. These activities can provide invaluable support for the work of the science advisory groups but must be divorced from the decision-making process and from advocacy more generally. Formalising this relationship would be helpful, especially given that during a fast-moving emergency the kinds of evidence available may fall well below normal standards (e.g. recommendations have to be made on the basis of observational data rather than experiments or clinical trials).

iv) At times (such as the build-up to the November 2020 lockdown), advisors appeared to shift from a purely advisory role to advocating for a specific policy option, despite the fact that the advisory groups did not have expertise in all areas relevant to the policy decision (see Q6a).

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[6] Quantitative Veterinary Epidemiology Good Practice Guide (qve-goodpracticeguide.org.uk)

[7] Godfray, H.C.J *et al*. (2013) A restatement of the natural science evidence base relevant to the control of bovine tuberculosis in Great Britain. *Proceedings of the Royal Society B* 280: 20131634
doi.org/10.1098/rspb.2013.1634

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QUESTION 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.

Electronic drafts but not necessarily final versions of all scientific papers, pre-prints and commentaries as listed in answer to Question 5. Final versions are available on-line from source publications.

Electronic copies of all briefing documents sent to SPI-M as listed in answer to Question 4.

Computer code for analyses included in briefing documents sent to SPI-M (also available through the GitHub server).

Electronic copies of presentations given.

Estimated several hundred e-mails to/from SPI-M (using or copied to the address SPI-M@dhsc.gov.uk). This is a subset of my e-mails pertaining to Covid-19.

Hard copies of the book *The Year The World Went Mad*.