

UK COVID-19 Inquiry: Module 2B - Rule 9 Request to Dr Thomas Woolley - Reference: M2B/TW/01

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

EMPLOYMENT:

Senior lecturer in Applied Mathematics, Cardiff University. 2017-Present

Permanent faculty member supporting teaching and research.

Mathematical Biosciences Institute, University of Ohio. Spring 2017

Achieved a highly competitive Early Career Award to work on pigmentation patterns.

St John's College Junior Research Fellow in Mathematics. 2013 – 2017

Achieved a highly competitive research position allowing continuing investigations into cellular motility.

London Science Museum Fellow of Modern Mathematics. 2014 - 2016

Advising on the creation of two new mathematics exhibitions.

Oxford Centre for Collaborative Applied Mathematics, University of Oxford. 2012 – 2014

Named post-doctoral research assistant on an academic proposal researching mechanical approaches to cellular motility.

EDUCATION:

University of Oxford, St John's College. 2004 – 2012

D.Phil. Title: Spatiotemporal behaviour of stochastic and continuum models for biological signalling on stationary and growing domains. Supervisors: Ruth Baker, Eamonn Gaffney and Philip Maini.

MMath: First class degree. Modules studied: Mathematical Ecology and Biology, Mathematics and Physiology, Mathematics and the Environment, Applied Partial Differential Equations.

PRIMARY RESEARCH:

I am a mathematical biologist, thus, although I have been trained in a range of mathematical principles I tend to work in collaborations with biologists and apply my theoretical and numerical skills to extract new understanding from experimental observations and data. My applications have been varied as I have worked on such diverse projects as calculating spinal tumour radiation doses, pancreatic cancer modelling and bat roost identification. However, the techniques I use to understand these systems are broadly the same, namely I construct mechanistic simulations that reproduce the biological principles, to try to reproduce reality.

Although not my primary research, I have the skills to do epidemic modelling and teach the theory to 4th year undergraduate students.

PUBLICATIONS:

The following lists the four publications on Covid that I have worked on and then five more papers that are my most cited.

1. A general computational framework for COVID-19 modelling with applications to testing varied interventions in education environments
JW Moore, Z Lau, K Kaouri, TC Dale, TE Woolley
COVID 1 (4), 674-703
2. Covid-19 transmission modelling of students returning home from university
PR Harper, JW Moore, TE Woolley
Health Systems 10 (1), 31-40
3. Long term environmental implications of social distancing on public transport emissions. L Henley, JW Moore, T Ostler, TE Woolley
London: UK Government. UK COVID-19 Inquiry
4. Generic probabilistic modelling and non-homogeneity issues for the UK epidemic of COVID-19
A Zhigljavsky, R Whitaker, I Fesenko, K Kremnizer, J Noonan, P Harper, J Gillard, TE Woolley, D Gartner, J Grimsley, E de Arruda, V Fedorov
arXiv preprint arXiv:2004.01991
5. Turing's model for biological pattern formation and the robustness problem
PK Maini, TE Woolley, RE Baker, EA Gaffney, SS Lee
Interface focus 2 (4), 487-496
6. Interactions between Shh, Sostdc1 and Wnt signaling and a new feedback loop for spatial patterning of the teeth
SW Cho, S Kwak, TE Woolley, MJ Lee, EJ Kim, RE Baker, HJ Kim, ...
Development 138 (9), 1807-1816
7. Age-related changes in speed and mechanism of adult skeletal muscle stem cell migration
H Collins-Hooper, TE Woolley, L Dyson, A Patel, P Potter, RE Baker, ...
Stem Cells 30 (6), 1182-1195
8. Stochastic reaction and diffusion on growing domains: understanding the breakdown of robust pattern formation
TE Woolley, RE Baker, EA Gaffney, PK Maini
Physical Review E 84 (4), 046216

2. A list of the groups (i.e. TAG and/or any of its subgroups) in which you have been a participant, and the relevant time periods. Please also confirm if you are or have been a participant in SAGE or other relevant groups.

WG TAG policy modelling subgroup, October 2020 – Present

WG TAG environmental subgroup, April 2021 – Present

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

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

October 2020 I was asked to help model the number of secondary infections that Universities would create over Christmas. This extended to modelling disease spread in Higher Education settings.

April 2021 I was asked to join TAG Environmental to use my agent-based modelling to advise on social distancing and policies for reopening cafes, night clubs, etc.

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

The meetings were initially at least monthly, with sporadic meetings on the specific projects taking place when needed. Currently the meetings are bimonthly and I've tried to attend all meetings I've been invited to.

My contributions have been to present the results regarding the pieces of work completed in part (a) and advise on the modelling from other groups.

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

Alongside the research project specified in (a) and the advisory role specified in (b) we have also created several web applets to support the Welsh Government in doing their job. Namely, we found that our interactions mainly stemmed from requiring the same maths but different numbers being used. Thus, we provided our contacts with calculators that would apply our calculations to any numbers they specify. These applets are specified in the next section.

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

- a. Moore, J. W., Lau, Z., Kaouri, K., Dale, T. C. and Woolley, T. E. 2021. A general computational framework for COVID-19 modelling with applications to testing varied interventions in education environments. COVID 1(4), pp. 674-703. (10.3390/covid1040055)

Accompanying applet: https://josh-will-moore.shinyapps.io/Covid_19_Intervention_IBM/

- b. Harper, P., Moore, J. and Woolley, T. 2021. Covid-19 transmission modelling of students returning home from university. Health Systems 10(1), pp. 31-40. (10.1080/20476965.2020.1857214)

Accompanying applet: https://josh-will-moore.shinyapps.io/Infection_rates_returning_students/

- c. Henley, L., Moore, J., Ostler, T. and Woolley, T. 2020. Long term environmental implications of social distancing on public transport emissions. Project Report. [Online]. London: UK Government. Available at: <https://committees.parliament.uk/writtenevidence/8995/pdf/>

Accompanying applet:

https://lucyhenley.shinyapps.io/CardiffMATHBIO_NERCHackathonTwo_PublicTransport/

Our research was used in, or I read drafts of the following Welsh Government outputs

<https://research.senedd.wales/research-articles/back-to-school-education-in-the-time-of-covid/>

https://www.gov.wales/sites/default/files/publications/2021-07/technical-advisory-group-5-harms-arising-from-covid-19_0.pdf

<https://www.ons.gov.uk/peoplepopulationandcommunity/educationandchildcare/articles/coronavirusandtheimpactonstudentsinhighereducationinenglandseptembertodecember2020/2020-12-21>

Health and Economic Impacts of Missed Primary and Secondary Education due to the COVID-19 Pandemic in Wales, Welsh Government TAC Policy Modelling, Version 3, 5th April 2021 (no public version appears to exist).

Discussion on Covid vaccine prioritisation for disabled groups in Wales Covid-19 Moral and Ethical Advisory Group for Wales Meeting 12 Feb 2021, Updated document: 18 Feb 2021 (no public version appears to exist).

Estimating COVID-19 infection transmission amongst departing HE students – Winter vacation 2021 (no public version appears to exist).

Comparing multiple infection interventions in FE environments (no public version appears to exist).

Comparing LFD testing strategies in HE residencies (no public version appears to exist).

Ventilation vs testing in a classroom (no public version appears to exist).

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 Welsh Government's response to the Covid-19 pandemic. Please include links to those documents where publicly available.

- a. a Moore, J. W., Lau, Z., Kaouri, K., Dale, T. C. and Woolley, T. E. 2021. A general computational framework for COVID-19 modelling with applications to testing varied interventions in education environments. COVID 1(4), pp. 674-703. (10.3390/covid1040055)

SUMMARY - Although LFD testing can be used to mitigate the spread of SARS-CoV-2, it is more effective to invest in personal protective equipment, e.g., masks, and in increasing ventilation quality.

- b. Harper, P., Moore, J. and Woolley, T. 2021. Covid-19 transmission modelling of students returning home from university. *Health Systems* 10(1), pp. 31-40.
(10.1080/20476965.2020.1857214)

SUMMARY - During the initial phase of the pandemic the number of secondary cases created by students returning home was 1 to 1. Namely, every infected student sent home would lead to a further case.

- c. Henley, L., Moore, J., Ostler, T. and Woolley, T. 2020. Long term environmental implications of social distancing on public transport emissions. Project Report. [Online]. London: UK Government. Available at: <https://committees.parliament.uk/writtenevidence/8995/pdf/>

SUMMARY – Social distancing measures mean that diesel trains cannot carry enough passengers to ensure that they are more environmentally friendly than small family cars for commuting.

6. Your views as to whether the work of the above-mentioned groups in responding to the Covid-19 pandemic (or Wales'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; and*
- f. The extent to which applicable structures and policies were utilised and/or complied with and their effectiveness.*

The TAGs did the best they could with the resources they had available. However, nearly all resources were at a minimum. None of the research done by me, or my students, was funded by the Welsh Government. Instead, we were tasked with problems and had to seek funding elsewhere. Overall the Welsh Government representatives in the meetings applied our research well. However, the interpretation of the results were sometimes extrapolated beyond their true applicability.

My biggest sadness and regret about the whole process is that now the process of working with the TAGs is over, many academics that I know have not received any kind personal thank you, or letter of support that would highlight their input into the TAGs that could be reported back to their Universities, supporting their promotion capabilities. Moreover, the contributions of the academics were not always made clear. For example, many citations of unpublished work were not included, and many hours of draft reading was done thanklessly.

7. Your views as to any lessons that can be learned from the Welsh Government'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.

1) There should be clearer repositories of data and knowledge. Much of the work was repeated by different bodies because they were in different TAGs and didn't know of each other.

2) There should be clearer links between tasks done and outputs generated. Not only will this aid the academics working with the Welsh Government, it will also ensure accountability as the academic takes responsibility for the outputs of their work.

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.

All the documents mentioned in the answer to Question 4.