UK COVID-19 Inquiry: Module 2- Rule 9 Request to Professor Paul Kellam- Reference: M2/SAGE/01/PK

Please provide the following information:

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

Professor of Virus Genomics, Department of Medicine, Imperial College London 2016 – to date
Vice President, Infectious Disease & Vaccines, Kymab Ltd, UK, until Sept 30th 2022
Chief Scientific Officer, RQ Biotechnology, UK, from 1st Oct 2022

Paul Kellam is the Professor of Virus Genetics at Imperial College London and Vice President of infectious diseases & vaccines at Kymab Ltd, UK. From October 2022 he becomes the CSO of RQ Biotechnology, a company focused on the discovery and development of monoclonal antibodies to virus diseases. He has published over 250 primary research papers, reviews, book chapters and patents. Paul Is a Fellow of the American Academy of Microbiology.

Paul's scientific career has spanned the pharmaceutical industry, at the Wellcome Foundation Ltd and Kymab Ltd and academia, where Paul was the Virus Genomics lead at the Wellcome Trust Sanger Institute and a Professor of Virology at UCL. Paul's current laboratory at Imperial College London studies the genetics of infection and the corresponding B cell repertoire responses, whilst his therapeutic area at Kymab Ltd. uses a genetically modified mouse to evaluate vaccines and discover antibodies to treat infectious diseases.

Paul's research career has identified how HIV develops resistance to antiviral drugs and identified the first influenza disease severity gene in people hospitalised with influenza virus. His laboratory produced the virus genome analysis of the Middle East Respiratory Syndrome Coronavirus (MERS CoV) outbreaks working with the Department of Health in Saudi Arabia, showing that the transmission pattern of the virus was consistent with multiple transfer events from an animal reservoir and contributing to the identification of camels as the animal reservoir. His laboratory contributed to the international Ebola virus genome analysis to help the WHO control the outbreak and to show the factors influencing virus transmission.

More recently, Paul's work on B cell repertoires has showed how the application of genetics and computational biology can lead to insights into infectious and non-infectious disease biology, and led to the discovery of antibodies to treat infections. Paul's lab has developed B cell receptor repertoire deep sequencing and uses these methods to characterise and develop vaccines and monoclonal antibodies to infectious diseases. Paul was seconded to the UKs COVID-19 Vaccine Task Force in 2020 and is a contributor to SAGE and various COVID-19 expert working groups.

PROFESSOR PAUL KELLAM

ACADEMIC ATTAINMENTS

2000	New Venture Development Elective - Distinction London Business School
1991 – 1994	PhD Study: Drug resistance of HIV-1 University of London, St. Mary's Hospital Medical School (Awarded letter: 1995)
1984 – 1987	University of Reading, BSc. Honours Degree in Microbiology

MEMBERSHIP OF PROFESSIONAL ORGANISATIONS

Elected to the MRC College of Experts for Infection & Immunity	2006-2011
Member of the Society of General Microbiology Virus Division	2009-2012
Fellow of the American Academy of Microbiology	2015-
Microbiology Society Elected Council Member	2017-2021
Fellow of the Royal Society of Biology	2018-
Chair for the microbiology society council policy committee	2019-2021

EMPLOYMENT HISTORY

2022 – to date	**CSO**, RQ Biotechnology Ltd.
2019 – 2022	**Seconded to Dept BEIS Vaccine Task Force (VTF)**
2016 - 2022	**Vice President for Vaccines & Infectious Diseases**, Kymab Ltd
2016 – to date	**Professor of Virus Genomics**, Department of Medicine, Imperial College.
2009 – 2016	**Viral Genomics Senior Group Leader and Senior Faculty** Welcome Trust Sanger Institute. (Renewed 2013-18)
2009 – 2016	**Professor of Virus Pathogenesis,** Department of Infection, UCL.
2006 - 2008	**Reader of Host & Pathogen Interactions**, Department of Infection, UCL.
2002 – 2006	**Senior Lecturer,** Centre for Virology, Department of Infection, UCL
1999 – 2002	**Research Fellow/Lecturer**, Dept. of Immunology and Molecular Pathology, UCL
1996 – 1999	**ICR Research Fellow**, Section of Virology, The Institute of Cancer Research
1994 – 1996	**Post-doctoral Research Scientist,** Wellcome Research Laboratories, Kent
1991 – 1994	**PhD Studentship**, Wellcome Research Laboratories & University of London
1989 – 1991	**Research Officer**, Wellcome Research Laboratories, Beckenham, Kent
1987 – 1989	**Research Officer**, ICI International Seeds Business, Jealott's Hill, Berkshire

OTHER APPOINTMENTS AND AFFILIATIONS

Guy's & St Thomas' Charitable Foundation	2004 – 2006
R&D Infection & Sexual Health Themed Grants Committee	
MRC College of Experts for Infection & Immunity	2006 – 2011
MRC Biomarkers Initiative Grant Funding Panel Member,	2008
Leukaemia and Lymphoma Research Foundation,	2010-2014
BBSRC Committee A, Grant Funding Panel Member,	2009-2012
Scientific Advisory Board, ENFIN 6th EU Framework project.	2007-2010
Scientific Advisory Board, Retroscreen.	2009-2012
Scientific Advisory Board, Population Genomics.	2010-2012
Genome Canada, Research Oversight Committee	2013-2105
'Viral and Human Genetic Predictors of Response to HIV Therapies'	
Scientific Advisory Board, NIBSC	2014 – 2022
MRC Zika virus grant panel	2016

Publications [260 publications, H-index 84]

See https://scholar.google.co.uk/citations?user=-FTSqg8AAAAJ&hl=en

10 Major Publications

1) **Kellam P**, Boucher C.A, Larder B.A. Fifth mutation in human immunodeficiency virus type 1 reverse transcriptase contributes to the development of high-level resistance to zidovudine. **Proc. Natl. Acad. Sci. USA** 1992: 89, 1934-1938.
2) Larder B.A, **Kellam P**, Kemp S.D. Convergent combination therapy can select viable multidrug resistant HIV-1 in vitro. **Nature** 1993: 365, 451-453
3) Mar Alba, et al. Genome wide function conservation and phylogeny in the Herpesviridae. **Genome Research.** 2001: 11, 43-54.
4) Jenner, R., et al. Kaposi's sarcoma-associated herpesvirus-infected primary effusion lymphoma has a plasma cell gene expression profile. **Proc. Natl. Acad. Sci. USA**. 2003: 100(18), 10399- 404.
5) Everitt AR, et al. IFITM3 restricts the morbidity and mortality associated with influenza. **Nature**. 2012; 484:519-23.
6) Cotton M, et al. Transmission and evolution of the Middle East Respiratory Syndrome (MERS) coronavirus Saudi Arabia: a descriptive genomic study. **Lancet.** 2013; 382(9909): 1993-02.
7) Bashford-Rogers, RJM, et al. Network properties derived from deep sequencing of the human B-cell receptor repertoires delineates B-cell populations. **Genome Research** 2013; **23**; 11; 1874-84
8) Dudas G, et al. Virus genomes reveal factors that spread and sustained the Ebola epidemic. **Nature**. 2017;544(7650):309-315.
9) Hastie KM, et al. Defining variant-resistant epitopes targeted by SARS-CoV-2 antibodies: A global consortium study. **Science**. 2021; **374**, 472-478.
10) Wymant C, et al; Netherlands ATHENA HIV Observational Cohort†; BEEHIVE Collaboration†. A highly virulent variant of HIV-1 circulating in the Netherlands. **Science**. 2022; **375**:540-545.

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.

1) SAGE for specific questions and evidence gathering papers (March 2020 onwards)
2) PHE Serology Working Group member (~April 2020 onwards)
3) Wellcome/PHE Serology Working Group member (~April 2020 onwards; Chair Sharon Peacock)
4) Coronavirus Serology Diagnostics Taskforce (~April 2020 onwards; Chair Mike Ferguson)
5) Advisory Group on Testing (~August 2020 onwards; Dr Andrew Buckley Scientific Advisor; COVID-19 Response: Antibody Testing (WS3); Chair Mike Ferguson)
6) PHE National COVID Response Centre Variant Technical Group (~April 2020 onwards; Chair Meera Chand)
7) Vaccine Taskforce Scientific Advisor for monoclonal antibodies and vaccines (~under Confidentiality agreements from May 2020)
8) Vaccine Taskforce (VTF) Scientific Advisor, seconded to BEIS from 29th June 2020 – 30th Sept 2022
9) Vaccine Update Expert Advisory Group (VUEAG) (February 2021-July 2021; Chair Paul Kellam)
10) Vaccine Science Coordination Group (VSCG)(~Jan 2021; Chair Wendy Barclay)

11) Vaccine Efficacy Expert Panel (VEEP)(June 2021)
12) NERVTAG Observer for the VTF (April 2021 – January 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;

See dates above.

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

I attended all meetings for each group (occasional apologies for absence) contributing my expertise of virus genetic variation & evolution, vaccines and monoclonal antibodies. My contributions were verbal, written, review of material and advice, production of written responses to questions directed to a group, and chairing the VUEAG group.

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

My role was to provide comment, research, information and advice based on my expertise of virus genetic variation & evolution, vaccines and monoclonal antibodies.

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.

1) Kellam and Barclay. The dynamics of the humoral immune response following SARS-CoV-2 infection and the potential for reinfection. (Paper 4a for SAGE 26; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/893183/S0151_Dynamics_of_humoral_immune_response_following_SARS-CoV-2.pdf).
2) Kellam P, Barclay W. The dynamics of humoral immune responses following SARS-CoV-2 infection and the potential for reinfection. J Gen Virol. 2020;101(8):791-797. PMID: 32430094; PMCID: PMC7641391.

The rapid review of published data for SAGE and subsequent publication in J Gen Virol of an adaptation of the SAGE paper, providing information that infection by SARS-CoV-2 may not lead to lasting immunity to reinfection and therefore epidemiological models should be explored that allow reinfection.

3) SARS-CoV-2 Evolution and Implications (SAGE 82, paper in repository "for interest" paper accessible to SAGE members and officials across Government, paper available on request).

Review of the evolution of SARS-CoV-2 and possible impacts

4) Vaccine Updates Group (the Vaccine Science Coordination Group) on when and how to update SARS-CoV-2 vaccines. (SAGE 83; Considerations on when and how to update SARS-CoV-2 vaccines. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/973189/S1144_SAGE_Vaccine_Update_Group.pdf).
5) Vaccines Update Subgroup (the Vaccine Science Coordination Group) on vaccine strain selection. (SAGE 88; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/988226/S1226_Setting_up_medium-_and_long-term_vaccine_strain_selection_and_immunity_management_for_SARS-CoV-2__1_.pdf).

Review and future looking strategy to allow guided vaccine updates in the face of continued evolution of SARS-CoV-2.

6) Long term evolution of SARS-CoV-2, 26 July 2021. (SAGE 94; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1007566/S1335_Long_term_evolution_of_SARS-CoV-2.pdf).

Updated review of the evolution of SARS-CoV-2 and possible impacts

7) Paper presented on how long vaccines will protect against COVID-19. (SAGE 94; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1007573/S1332_How_long_will_vaccines_continue_to_protect_against_COVID-19.pdf).

Review of the potential decline of vaccine efficacy as SARS-CoV-2 evolves.

8) NERVTAG on scenarios for the longer term evolution of SARS-CoV-2. (SAGE 105; https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1055746/S1512_220201_Long_term_evolution_of_SARS-CoV-2.pdf).

Updated review of the evolution of SARS-CoV-2 and possible impacts

9) Vaccine Update Expert Advisory Group (VUEAG) (February 2021-July 2021) 6 reports and 3 notes to the DCMO (Van Tam) relating to SARS CoV-2 variants and the potential for vaccine strain updates (copies held, and with the DCMO)

Reports of the discussions of the VUEAG focused on specific questions and considering data of the evolution of SARS-CoV-2.

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.

See answers to Question 4). In addition, before secondment to the VTF, I conducted a number of interviews about SARS CoV-2 virology to media outlets such as the BBC, LBC, Bloomberg, the Daily Mail, the Times etc.

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.

The process of providing scientific advice to inform decision making improved throughout the pandemic. In the first half 2020 there was a frenetic level of activity that, although I believed distilled the science knowledge, was not as structured as later systems.

Overall, I think the scientific advisory groups were well structured and as well-resourced as possible. However, a very heavy burden was placed on all involved. In most instances the scientific advisors were simultaneously providing detailed advice as well as running their laboratories either to undertaking basic SARS CoV-2 research, model epidemiology, provide diagnostic services or develop therapies.

The move to make public the membership of SAGE and associated groups, the minutes and associated papers very welcome. This approach should be applied to as much scientific advice as possible.

There was a continued drive to make ensure groups and remits were not overlapping. This is clearly desirable; however, a degree of duplication is necessary to ensure topics and evidence is not missed.

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.

Where possible make all membership, minutes and advice public.

Ensure some of the groups and structures are preserved with a refreshable but sleeping membership, to allow rapid reaction to future pandemic and epidemic threats.

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.

VUEAG meeting notes, agendas and reports that were then sent to the VTF Steering Group and DCMO.