

Witness Name: Prof Davey Jones

Statement No.: 1

Exhibits: 21 (E1-E21)

Dated: 22-07-2023

## **UK COVID-19 INQUIRY**

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### **WITNESS STATEMENT OF PROF DAVEY JONES**

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I, Professor Davey Jones will say as follows: -

1. I am professor of Environmental Science and Public Health at Bangor University. I also hold a joint position as Professor of Soil Science at Murdoch University in Australia. My previous experience in public health involved dealing with local and national issues surrounding the contamination of rivers and coastal waters with bacterial and viral pathogens. I had not previously worked on coronaviruses specifically.
2. I hold an undergraduate degree in Soil Science from the University of Aberdeen and a PhD in Plant Sciences from the University of Oxford. After my PhD I went to work for the US Government (US Department of Agriculture) at Cornell University for two years in their crop science research programme. This involved a combination of cell biology and molecular biology. Subsequently, I moved to Bangor University where I am currently Professor in Environment Science and Public Health. My main research focuses on understanding plant-soil processes with respect to nutrients and human pathogen behaviour, but this also has strong links to freshwater and marine ecosystems. I am particularly interested in the pathogen load of human derived wastewater and the impact this has on public and environmental health when discharged into the environment. Our specific interest has been on Norovirus, Hepatitis A/E, CrAssphage, Adenovirus and other enteric pathogens. I have published more than 706 ISI listed scientific journal papers with an h-index of 97 and which have been cited over 40,700 times. I have advised UK

Government and Welsh Government on their COVID-19 public health strategy, mainly related to environmental issues. I also lead the wastewater-based public health surveillance programme for Wales which involves the monitoring of wastewater for communicable diseases such as COVID-19, norovirus, influenza, respiratory syncytial virus (RSV), polio and enterovirus.

3. In my role as lead of the wastewater-based public health surveillance system for Wales, I was responsible for managing the science programme as well as the staff, financial resourcing, reporting, and liaison with Welsh government. The wastewater-based public health surveillance system involved the monitoring of wastewater at 47 sites located across Wales, five days a week (Mon-Fri). We also monitored levels of SARS-CoV-2 in wastewater in prisons and hospitals to estimate levels of infection. These activities captured approximately 70% of the Welsh population. The wastewater samples were subsequently analysed for a range of viruses, including SARS-CoV-2. The data was collected and reported weekly to Welsh Government. All of our reports about the prevalence of SARS-CoV-2 were made publicly available on the Welsh Government website and these were updated weekly (<https://www.gov.wales/strategy-evidence-coronavirus>). Part of the programme also involved the sequencing of SARS-CoV-2 in our samples and the reporting of variants-of-concern to Welsh Government. The data for other viruses and the sequencing report for SARS-CoV-2 was not released publicly, being just used for internal review by Ministers and Public Health Wales. Overall, the wastewater-based surveillance programme was highly successful from an operational and reporting perspective. The data was typically available 48 hours after sample collection with sequencing reports available after 7 days. In my view this provided a much more comprehensive and unbiased estimate of COVID-19 circulating in the population and a fraction of the cost of doing clinical testing. The correlation between cases numbers and clinical testing and those measured in wastewater were very close. I've shown this on the following page which shows the correlation between wastewater and the COVID Infection Survey, which at the time was believed to be the gold standard.

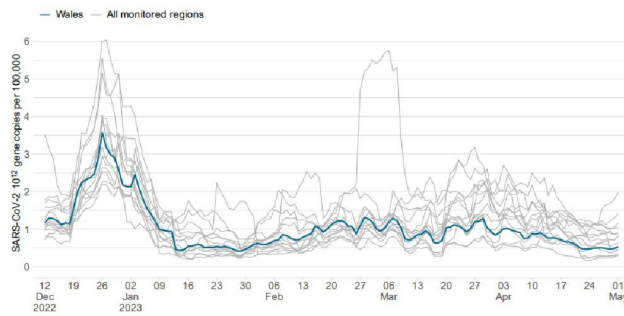


Figure 2 - National (blue lines) and Regions (grey lines)  
Rolling Mean SARS-CoV-2 gc/day per 100k

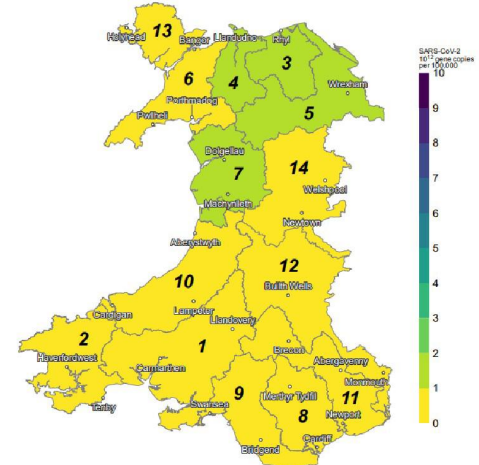


Figure 3 - National Heat Map showing Regional  
Mean SARS-CoV-2 gc/day per 100k

fection

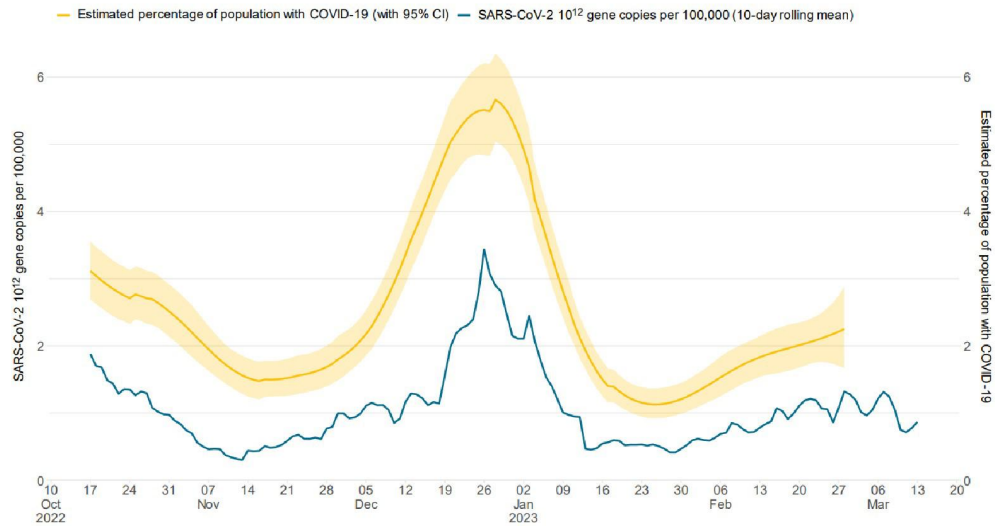


Figure 47 – ONS CIS vs Wastewater National Mean (SARS-CoV-2 gc/day per 100k)

In the top graph I show the levels of SARS-CoV-2 across 47 sites within Wales and the bottom one shows the correlation between wastewater and the COVID Infection Survey (results taken from the report to Welsh Government: <https://www.gov.wales/sites/default/files/publications/2023-03/wastewater-monitoring-16-march-2023.pdf>).

It must be noted, however, that wastewater-based epidemiology is a new and emerging science field and Wales was at the forefront of this technology development. During the programme we published many scientific studies on the development of the wastewater approach and how it could be validated. These were all subject to external peer review and are in good quality scientific journals. Many of these were also published in collaboration with colleagues in England and Scotland. These are listed below:

- E1. Jones, D. L., Rhymes, J. M., Green, E., Rimmer, C., Kevill, J. L., Malham, S. K., Weightman, A. J., & Farkas, K. (2023). Poor air passenger knowledge of COVID-19 symptoms and behaviour undermines strategies aimed at preventing the import of SARS-CoV-2 into the UK. *Scientific Reports*, 13, 3494. [DJ/1 - INQ000362214]
- E2. Kasprzyk-Hordern, B., Sims, N., Farkas, K., Jagadeesan, K., Proctor, K., Wade, M. J., & Jones, D. L. (2023). Wastewater-based epidemiology for comprehensive community health diagnostics in a national surveillance study: Mining biochemical markers in wastewater. *Journal of Hazardous Materials*, 450, 130989. [DJ/2 - INQ000362225]
- E3. Farkas, K., Pellett, C., Williams, R., Alex-Sanders, N., Bassano, I., Brown, M. R., Denise, H., Grimsley, J. M. S., Kevill, J. L., Khalifa, M. S., Pântea, I., Story, R., Wade, M. J., Woodhall, N., & Jones, D. L. (2023). Rapid Assessment of SARS-CoV-2 Variant-Associated Mutations in Wastewater Using Real-Time RT-PCR. *Microbiology Spectrum*, 11, e0317722. [DJ/3 - INQ000362228]
- E4. Brunner, F. S., Brown, M. R., Bassano, I., Denise, H., Khalifa, M. S., Wade, M. J., van Aerle, R., Kevill, J. L., Jones, D. L., Farkas, K., Jeffries, A. R., COVID-19 Genomics UK (COG-UK) Consortium, Cairns, E., Wierzbicki, C., & Paterson, S. (2022). City-wide wastewater genomic surveillance through the successive emergence of SARS-CoV-2 Alpha and Delta variants. *Water Research*, 226, 119306. [DJ/4 - INQ000362229]
- E5. Lambert-Slosarska, K., Singer, A.C., Williams, G.B., Bargiela, R., Brown, R.W., Wade, M.J., Farkas, K., Jones, D.L., (2022). Critical Evaluation of Different Passive Sampler Materials and Approaches for the Recovery of SARS-CoV-2, Faecal-Indicator Viruses and Bacteria from Wastewater. *Water* 14, 3568. [DJ/5 - INQ000362230]
- E6. Jones, D. L., Rhymes, J. M., Wade, M. J., Kevill, J. L., Malham, S. K., Grimsley, J. M. S., Rimmer, C., Weightman, A. J., & Farkas, K. (2023). Suitability of aircraft wastewater for pathogen detection and public health surveillance. *The Science of the total environment*, 856, 159162. [DJ/6 - INQ000362231]
- E7. Robins, P. E., Dickson, N., Kevill, J. L., Malham, S. K., Singer, A. C., Quilliam, R. S., & Jones, D. L. (2022). Predicting the dispersal of SARS-CoV-2 RNA from the wastewater treatment plant to the coast. *Heliyon*, 8, e10547. [DJ/7 - INQ000362232]
- E8. Wilde, H., Perry, W.B., Jones, O., Kille, P., Weightman, A., Jones, D.L., Cross, G., Durance, I., (2022). Accounting for dilution of SARS-CoV-2 in

- wastewater samples using physico-chemical markers. *Water* 14, 2885. [DJ/8 - INQ000362233]
- E9. Robins, K., Leonard, A. F. C., Farkas, K., Graham, D. W., Jones, D. L., Kasprzyk-Hordern, B., Bunce, J. T., Grimsley, J. M. S., Wade, M. J., Zealand, A. M., & McIntyre-Nolan, S. (2022). Research needs for optimizing wastewater-based epidemiology monitoring for public health protection. *Journal of water and health*, 20(9), 1284–1313. [DJ/9 - INQ000362234]
- E10. Farkas, K., Pellett, C., Alex-Sanders, N., Bridgman, M. T. P., Corbishley, A., Grimsley, J. M. S., Kasprzyk-Hordern, B., Kevill, J. L., Pântea, I., Richardson-O'Neill, I. S., Lambert-Slosarska, K., Woodhall, N., & Jones, D. L. (2022). Comparative Assessment of Filtration- and Precipitation-Based Methods for the Concentration of SARS-CoV-2 and Other Viruses from Wastewater. *Microbiology Spectrum*, 10(4), e0110222. [DJ/10 - INQ000362215]
- E11. Kevill, J. L., Lambert-Slosarska, K., Pellett, C., Woodhall, N., Richardson-O'Neill, I., Pântea, I., Alex-Sanders, N., Farkas, K., & Jones, D. L. (2022). Assessment of two types of passive sampler for the efficient recovery of SARS-CoV-2 and other viruses from wastewater. *The Science of the total environment*, 838(Pt 4), 156580. [DJ/11 - INQ000362216]
- E12. Tlhagale, M., Liphadzi, S., Bhagwan, J., Naidoo, V., Jonas, K., van Vuuren, L., Medema, G., Andrews, L., Béen, F., Ferreira, M. L., Saatci, A. M., Alpaslan Kocamemi, B., Hassard, F., Singer, A. C., Bunce, J. T., Grimsley, J. M. S., Brown, M., & Jones, D. L. (2022). Establishment of local wastewater-based surveillance programmes in response to the spread and infection of COVID-19 - case studies from South Africa, the Netherlands, Turkey and England. *Journal of water and health*, 20(2), 287–299. [DJ/12 - INQ000362217]
- E13. Kevill, J. L., Pellett, C., Farkas, K., Brown, M. R., Bassano, I., Denise, H., McDonald, J. E., Malham, S. K., Porter, J., Warren, J., Evens, N. P., Paterson, S., Singer, A. C., & Jones, D. L. (2022). A comparison of precipitation and filtration-based SARS-CoV-2 recovery methods and the influence of temperature, turbidity, and surfactant load in urban wastewater. *The Science of the total environment*, 808, 151916. [DJ/13 - INQ000362218]
- E14. Wade, M. J., Lo Jacomo, A., Armenise, E., Brown, M. R., Bunce, J. T., Cameron, G. J., Fang, Z., Farkas, K., Gilpin, D. F., Graham, D. W., Grimsley, J. M. S., Hart, A., Hoffmann, T., Jackson, K. J., Jones, D. L., Lilley, C. J., McGrath, J. W., McKinley, J. M., McSparron, C., Nejad, B. F., Kasprzyk-Hordern, B. (2022). Understanding and managing uncertainty and variability for wastewater monitoring beyond the pandemic: Lessons learned from the United Kingdom national COVID-19 surveillance programmes. *Journal of hazardous materials*, 424, 127456. [DJ/14 - INQ000362219]
- E15. Dancer, S. J., Li, Y., Hart, A., Tang, J. W., & Jones, D. L. (2021). What is the risk of acquiring SARS-CoV-2 from the use of public toilets? *The Science of the Total Environment*, 792, 148341. [DJ/15 - INQ000362220]
- E16. Hillary, L. S., Farkas, K., Maher, K. H., Lucaci, A., Thorpe, J., Distaso, M. A., Gaze, W. H., Paterson, S., Burke, T., Connor, T. R., McDonald, J. E., Malham, S. K., & Jones, D. L. (2021). Monitoring SARS-CoV-2 in municipal wastewater to evaluate the success of lockdown measures for

- controlling COVID-19 in the UK. *Water research*, 200, 117214. [DJ/16 - INQ000362221]
- E17. Farkas, K., Hillary, L. S., Thorpe, J., Walker, D. I., Lowther, J. A., McDonald, J. E., Malham, S. K., & Jones, D. L. (2021). Concentration and Quantification of SARS-CoV-2 RNA in Wastewater Using Polyethylene Glycol-Based Concentration and qRT-PCR. *Methods and protocols*, 4(1), 17. [DJ/17 - INQ000362222]
- E18. Jones, D. L., Baluja, M. Q., Graham, D. W., Corbishley, A., McDonald, J. E., Malham, S. K., Hillary, L. S., Connor, T. R., Gaze, W. H., Moura, I. B., Wilcox, M. H., & Farkas, K. (2020). Shedding of SARS-CoV-2 in feces and urine and its potential role in person-to-person transmission and the environment-based spread of COVID-19. *The Science of the total environment*, 749, 141364. [DJ/18 - INQ000362223]
- E19. Polo, D., Quintela-Baluja, M., Corbishley, A., Jones, D. L., Singer, A. C., Graham, D. W., & Romalde, J. L. (2020). Making waves: Wastewater-based epidemiology for COVID-19 - approaches and challenges for surveillance and prediction. *Water research*, 186, 116404. [DJ/19 - INQ000362224]
- E20. Fitzgerald, S. F., Rossi, G., Low, A. S., McAteer, S. P., O'Keefe, B., Findlay, D., Cameron, G. J., Pollard, P., Singleton, P. T. R., Ponton, G., Singer, A. C., Farkas, K., Jones, D., Graham, D. W., Quintela-Baluja, M., Tait-Burkard, C., Gally, D. L., Kao, R., & Corbishley, A. (2021). Site Specific Relationships between COVID-19 Cases and SARS-CoV-2 Viral Load in Wastewater Treatment Plant Influent. *Environmental Science & Technology*, 55(22), 15276–15286. [DJ/20 - INQ000362226]
- E21. Farkas, K., Hillary, L. S., Malham, S. K., McDonald, J. E., & Jones, D. L. (2020). Wastewater and public health: the potential of wastewater surveillance for monitoring COVID-19. *Current opinion in environmental science & health*, 17, 14–20. [DJ/21 - INQ000362227]

Some of the best exemplars of its use Included the early detection of novel variants of SARS-CoV-2 within Wales, often before clinical detection. Thus, wastewater-based epidemiology represents an early warning system for society. In addition, the wastewater-based programme also tracked the COVID-19 infection survey extremely well. This suggests that wastewater provides a very simple and cheap way to track COVID-19 levels within the community without testing individuals and without incurring any major ethical issues. It also allowed the simultaneous tracking of other respiratory diseases, a component that was not part of other testing programmes (e.g., influenza, RSV). The tracking of other respiratory viruses was particularly important considering that the GP surgery network was largely offline and there were major concerns from public health practitioners about the emergence of other respiratory viruses that may have directly impacted on the severity of COVID-19 infections, particularly within vulnerable sectors of society. In my view, another primary benefit is that wastewater captures all sectors of

society connected to an urban sewage system, particularly vulnerable groups and can function even when people cannot get access to GP surgeries. One caveat is that it does not detect COVID-19 within rural communities who are connected to septic tank wastewater treatment systems. The data was used to inform national policy, particularly during the winter periods with the emergence of the omicron variants and other respiratory diseases. To my knowledge (based on discussions with Welsh government staff), the data was used to inform about whether lockdowns needed to be implemented during the Christmas periods of 2021 and 2022. I have to note, however, that I was not personally involved in the discussions about the potential for introducing lockdowns so it's difficult for me to know exactly how the data was used. In both cases, however, the decisions made using wastewater were backed up by other clinical evidence at a later date (e.g. hospitalizations), suggesting that the decision making based on wastewater-based data was valid. In no cases, was the wastewater-based data on COVID-19 proven to be unreliable within a Welsh context. This refers to the incidence of disease circulating in the population and the variants in circulation. The wastewater programme is still in operation and still reporting on a weekly basis to Welsh Government. This is vital considering that COVID-19 is still very much in circulation and that (i) the COVID-19 Infection Survey has now ceased to operate, and (ii) the amount of clinical testing that is being undertaken is minimal (including sequencing of variants). It is my firm recommendation that wastewater-based testing for public health surveillance becomes mainstream and directly supports other public health monitoring systems operating within Wales. The use of wastewater-based epidemiology will then form a key pillar in the nation's preparations for the next pandemic. The use of wastewater public health surveillance also directly aligns with the newly released UK Biosecurity Strategy from the Cabinet Office in June, 2023. The decision of Welsh Government to terminate wastewater surveillance in August 2023 was in my opinion incredibly short-sighted and showed a complete lack of vision in terms of pandemic preparedness. It felt at the time that we had learnt nothing from the COVID-19 pandemic in terms of being prepared for the next emergency. Subsequently, the Welsh Government reversed the decision and wastewater monitoring commenced again in November 2023, albeit with no long-term plan. The current contract is due to end in March 2023 and no plans are in place to extend it beyond this date. **Based on my experience, I would therefore**

**recommend the wastewater-based epidemiology should be a central pillar and public health surveillance within Wales. This would align with the advice from the World Health Organisation.**

#### **COVID-19 Technical Advisory Group for the Environment**

4. The main role of the Technical Advisory Group for The Environment (TAG-E) was to evaluate evidence, based on information requests from Welsh Government. At the start of the pandemic, it was unclear about the transmission routes and also the persistence of the virus within a range of environments, Both indoors and outdoors. One of the key functions of the committee was therefore to critically evaluate and assimilate evidence on viral behaviour and the likelihood of infection in a range of settings. Typically, this involved the synthesis of this information and the publication of a report with recommendations that were submitted to Welsh Government. In many instances, the reports were also communicated at the main Technical Advisory Group meetings. The committee used both the scientific published literature (peer reviewed) to make recommendations, but also used expert opinion from the committee members where no evidence currently existed. During the course of the pandemic, we produced many reports pertaining to the likelihood and risk of infection in a range of indoor, semi outdoor, and outdoor settings.
5. I was the chair of the TAG-E committee for the duration of the pandemic (from 2020 onwards). I was given this role based on my previous publication track record in viral ecology and also my practical experience of tracking viruses in the environment (on many large projects funded by UKRI). Many of these previous projects were tracking viruses, such as norovirus, in a Welsh context. I had also previously sat on a range of other government committees relating to environmental issues. As chair of the committee I was responsible for running the meetings, making sure the meetings kept time, allowing people to express their opinions during the meetings, and also to participate in the writing of reports, and ultimately the signing off of the reports and final submission to Welsh Government.
6. The TAG-E Committee consisted of a range of academics, public health officials and representatives of key organisations and industries. Almost all of them had previous experience to some extent in public health related issues. Very few had experience in coronaviruses, reflecting the lack of importance of these viruses in



public health context within Wales Prior to the pandemic. Overall, there was a good gender balance on the committee, however, most of the committee members tended to be in the age group from 35 to 60, mainly reflecting their senior level of expertise in public health related issues and virology (note, that there are not enough early career virologists within Wales and that this needs to be rectified). The membership of the committee was based on an initial internet search for experts in the field, but also from recommendations from within the committee and from external organisations. The membership of the committee was reviewed at regular intervals (ca. monthly). Those individuals Who were felt to be making no contribution were not included in further discussions and emails, and new members recruited to the committee. In other cases, we reviewed the committee and decided that we needed more expertise in specific areas leading to the recruitment of new panel members. Some Committee members did not actively contribute to the work of TAG-E because they were either too busy, did not feel that it was sufficiently rewarding, or felt that their expertise was out of scope (i.e. they made minimal contributions). In my view, the committee had a good international perspective, however we did not have members from other international countries. In retrospect, I feel that this did not hinder the ability of the panel to deliver quality information and recommendations. The range of disciplines covered included virology, general microbiology, human geography, public health, water quality, hydrology, mathematical modelling, atmospheric behaviour, soil science, food systems, and education. It would have been good to have more behavioural scientists on the committee as it became apparent as the pandemic progressed that the effectiveness of many control measures related as much to human behaviour (compliance) as to the behaviour of the virus in different environmental settings.

7. The TAG-E committee lacked a bit of age balance (particularly representation from the age group 16-25). Overall, this probably did not greatly affect any of the recommendations Made by the committee, however, it is always good to capture the range of views on a particular subject area. It is noted that while the age group 16 to 25 probably had minimal expertise in virology, they could have provided insights on human behaviour, particularly in settings dominated by this age group (e.g. university halls of residence, night clubs, schools) for which the committee was producing reports. It would also be good to get their views on compliance to

mitigation measures implemented to try to prevent the spread of COVID-19. **It is therefore recommended that future committees like TAG-E should include representatives from all age groups.**

8. The inclusion of behavioural scientists on TAG-E probably would have not changed the recommendations of the reports, however, it would have made the reports more well-rounded. In many cases, the risk of viral transmission is as much related to the ability for SARS-CoV-2 to survive in an environmental setting as it is about how people behave in those settings. Often, TAG-E only dealt with the former not the latter. **It is therefore recommended the behavioural scientists are integral to the formation of future TAG-E like committees during a future pandemic. See also the recommendation to Point 9 below.**
9. TAG-E tended to be dominated by middle-aged people of white ethnic background, probably with a moderate income. Consequently, this this does not adequately reflect the population of Wales. In one particular instance, we had to produce recommendations on the transmission risk associated with attendance at churches, weddings, funerals and other religious settings. Clearly in this context, the committee would have benefited from representation from a greater range of ethnic backgrounds To capture the diversity of views. it should be noted, but we did not have representation from the older age groups (60+). I'm sure that they would also have contributed well to the debates and discussions held by TAG-E. The failure to capture the full diversity of backgrounds was due to the sudden onset of the pandemic and the lack of preparedness for this type of event. **It is therefore recommended the guidelines are produced for the formation of future committees like TAG-E.**
10. In my opinion, there was no evidence for 'groupthink' within TAG-E. In committee meetings All members were provided with ample time to express their vires and opinions and to present alternative arguments. The committee relied heavily on peer-reviewed scientific evidence, thus providing a clear evidenced trail for how recommendations were made and arrived at.
11. TAG-E was adequately resourced from an administrative perspective. The meetings were well organised, the meetings were well monitored and action points for the committee were clear. All meetings had a clear evidenced trail with all documents being placed on a secure government e-portal (Objective Connect). One major issue that TAG-E faced was where key evidence was lacking as we

had no way of filling this knowledge gap. Primarily, this needed Welsh scientists to undertake new experiments within a Category 3 laboratory setting and would have required financial resources to be able to undertake the work, however, no central funding became available during the course of the pandemic. many of these questions still remain unanswered and I have no doubt will be asked again during the next pandemic. In addition, there were many questions associated with the movement of the virus within building (e.g. school classroom) and transport settings. Although the panel had clear expertise to address these questions, they had no resources to be able to employ people to undertake these modelling exercises (e.g. to assess the efficacy of air purifiers within classrooms). The committee found this incredibly frustrating. In addition, when resources were available from UKRI or other UK government agencies these appeared to be incredibly slow, badly administered, poorly refereed, with most of the money going to English institutions. **My recommendation is that UKRI set aside a separate fund to specifically address issues Specifically related to Wales. In addition, we need several new environmental-related Category 3 viral containment facilities within Wales to be able to undertake more experimental work during the next pandemic.**

12. None of the members of TAG-E were paid for their contributions. This meant that members were trying to juggle normal work activities alongside family life with commissions sent to TAG-E. Unsurprisingly, the virology expertise of the committee also meant that they had conflicts with other meetings relating to management of the pandemic. This meant that on many occasions the committee was not complete with some members being absent to fulfil other pandemic related duties. This probably slowed down the activities of the committee somewhat as the recommendations needed to be viewed by all members of the committee. In the future, it might be good to financially recompense members of the committee for their contributions, however in reality, this would be difficult to administer as people contributed differentially during the course of the pandemic. Most of the members of the committee contributed willingly, knowing that the activities of TAG-E were for the public good not for their own personal gain. **I would recommend that future committees are also voluntary, but that a directory of expertise is maintained at all major institutions relating to potential future pandemics and that this directory is updated annually.**

13. TAG-E's commissions remaining related to the fate and behaviour of SARS-CoV-2 in a range of public settings and to assess the likely transmission risk in these settings under different scenarios. These included settings such as schools, educational environments, healthcare settings, swimming pools, saunas and steam rooms, churches and places of worship, ice rinks, outdoor gatherings, restaurants, pubs and other entertainment establishments, exercise facilities and gyms, childcare facilities, choirs, orchestras, public transport, taxis, outdoor eating venues, weddings, funerals, sporting events, adult entertainment facilities etc. in each case, a report was produced and sent to the Technical Advisory Group for further comment. In each case, scientific evidence and expert opinion was gathered on the likely risk of viral transmission and the level of containment/access required to minimise risk. The limitations of the evidence and thus uncertainty were clearly stated in the reports. Typically, the committee would discuss one of these topics listed above at a weekly meeting, the leads for the report identified, and then the report produced one to four weeks later, depending on the level of urgency. TAG-E's commissions were not directly related to the movement of COVID-19 from England into Wales. On occasions, however, there was a discussion about the role of tourism and commuters in the transfer of COVID-19 through the porous borders of Wales and differences in policy between England and Wales (e.g. mask wearing on public transport).

TAG-E was not really concerned with wastewater monitoring directly, however, it was sometimes discussed in relation to the latest evidence surrounding COVID-19 prevalence in Wales. wastewater monitoring directly reported to the First Minister and therefore was not part of the remit of TAG-E.

Overall, the reports produced by TAG-E have all stood the test of time and are as relevant now as they were when they were written, albeit more comprehensive evidence now exists to support them. The reports will be useful for the next pandemic, assuming that the virus behaves in a similar way. If the next pandemic involves an enteric virus that is infectious in water, then wastewater discharges to the environment will pose a major hazard and completely new risk assessments and reports will be needed. I still think there is a lot of uncertainty regarding the effectiveness of mask/face covering wearing, partly due to the lack of evidence at the time when this mitigation strategy was introduced, but also due to the poor understanding of the general public about how to wear a mask

effectively and What constitutes an effective viral barrier. there is still a lack of understanding that face coverings don't really protect you against contracting the virus but moreover protect others from infection when you are carrying the virus. more work is still required transform people about the different types of masks and their effectiveness. Some of the governmental recommendations about the use of Perspex barrier screens (e.g. as used in shops) to minimise viral spread are probably not valid and the evidence base about their effectiveness this weak due to the wide variety of conditions in which they were implemented.

14. With respect to the report entitled "*TWEG (2020) Environmental monitoring of viral presence, infectivity and transmission of SARS-CoV-2*", I have the following comments. Based on the available evidence, this report concluded that environmental monitoring for SARS-CoV-2 is vital to provide epidemiological evidence on the extent of outbreaks, and to provide evidence on the hazard posed by contaminated surfaces, water and air. It also highlighted that viral RNA is generally more stable in the environment than a fully intact infectious virus. qPCR (RNA detection) may therefore overestimate the presence of infectious virus and such data needs to be interpreted carefully. It also concluded that risk assessment of transmission via water, surfaces, food or air need to use evidence obtained from studies using cell culture (to demonstrate the presence of infectious virus) in combination with epidemiological evidence (demonstrating that infection has taken place). It also highlighted that environment sampling requires a robust sampling design to capture the large temporal and spatial heterogeneity that may exist in environmental settings.

With respect to the report entitled "*EMG/SPI-B/TWEG (2020) Mitigations to reduce transmission of the new variant SARS-CoV-2 virus, 22 December 2020*", I have the following comments. Based on the available evidence, this report concluded that in response to the emergence of a new variant of SARS-CoV-2 (B.1.1.7) that the risk of transmission of this variant was higher than those seen previously and that this requires more stringent control measures to limit its spread. These measures included reducing social contacts; effective testing and tracing; robust outbreak identification and control; support to ensure effective isolation and quarantine; and population vaccination. Population level approaches to further reduce contact between people are likely to be necessary, such as extending Tier

4; changing the operation of schools/universities; travel restrictions between regions and internationally; and/or introducing a national lockdown.

With respect to the report entitled “*Technical Advisory Group (2020)*”, I have the following comments. *swimming pools, hot tubs, saunas and steam rooms and risk from COVID-19*”, I have the following comments. The conclusions were that the risk of disease transmission in saunas was deemed medium risk (with medium confidence based on the evidence) and that transmission in steam rooms was deemed high risk (with medium confidence based on the evidence). The 2 m rule also needed to be critically evaluated as the evidence base was still weak that the distance was sufficient to reduce transmission.

With respect to the report entitled “*Technical Advisory Group (2020) SARS-CoV-2 infection risks at ice rinks*”, I have the following comments. The key findings were that compromised social distancing, pressure on healthcare, prolonged viability of SARS-CoV-2 in cold environments, and the large number of surfaces and shared items were principal factors in elevating the risk posed by ice rink use to beyond acceptable levels in terms of potential disease transmission risk. We therefore recommended that recreational ice venues remain closed.

With respect to the report entitled “*Technical Advisory Group (2021) use of face coverings in childcare and educational settings for Under 18s*”, I have the following comments. Based on the available evidence, we reported that good ventilation was a primary measure for controlling the risk of airborne disease transmission in these settings. We also concluded that most type of face coverings were likely to reduce the dispersion of respiratory droplets and small aerosols that carry the virus into the air from an infected person; and that they provide some protection for the wearer against exposure to droplets (albeit less protection against small aerosols). The report also concluded that there is the potential for face coverings to induce harms to children, young people and staff when used for sustained periods of time. Their use should respond to the evolving nature of the pandemic and emerging evidence. Their usage should reflect both low as well as high community prevalence and the changing conditions around the virus. Decisions about the use of face coverings should take account of the full range of the hierarchy of control interventions in place within a school setting to control the spread of the virus. In situations of low community prevalence, the harms

associated with the use of face coverings may well outweigh the overall benefits. We also recommended future research needs (e.g. efficacy of different materials).

With respect to the report entitled “*Technical Advisory Group (2022) Consensus statement on face masks for the public*”, I have the following comments. Based on the available evidence, this report concluded that face masks help mitigate SARS-COV-2 transmission through two different mechanisms: source control (preventing onward transmission from an infected wearer) and wearer protection. Widespread use of masks can offer a benefit at the population-level. When worn correctly, masks can reduce transmission through source control at the level of a population if worn by most people. It also concluded that concomitant use of face masks with other protective measures combines to reduce the transmission of SARS-CoV-2. It also came to the conclusion that with the removal of measures such as distancing, there is still evidence for the benefit of masking to reduce transmission as a supplement to attaining high levels of vaccination. It also concluded that face coverings can act as an effective barrier to transmission in situations where ventilation is a problem, where there is high occupancy of spaces or close personal interaction. It also concluded that face coverings are only effective if fitted properly and of sufficient quality/performance.

15. TAG-E had access to the reports from SAGE and regularly consulted these where applicable. In addition, several members of TAG-E were also present on the SAGE-TWEG committee, ensuring the free flow of information between the two. TAG-E also invited members from SAGE to attend our meetings and provide the latest updates on aspects of disease transmission in specific settings when required.
16. See above. TAG-E did not challenge the work of SAGE or SAGE-TWEG as there was never a point where a major lack of agreement between the two occurred.
17. As chair of TAG-E, few challenges or difficulties arose during the day-to-day running of the committee. Sometimes it was difficult to commit as much time as I would have liked to the gathering of evidence, however, my colleagues always compensated for this when I lacked time. The major issue we had was that we were not able to secure financial resources to be able to commission experimental and modelling work to fill some of the knowledge gaps, but which were fundamental to the work of TAG-E (see above).

#### **Technical Advisory Group for the Environment**

18. TAG-E was a subcommittee of TAG. It dealt with environmental issues related to the transmission of COVID-19 in different environmental settings. Members of TAG-E regularly attended TAG meetings so there was good information flow between the two. At every TAG meeting, there was always representation from at least one TAG-E member. We also regularly reported our findings at TAG (typically a 5-10 minute slot involving a presentation summarising the findings of a report produced by TAG-E).
19. I cannot reliably comment on the interactions between TAG, the Chief Scientific Advisor for Health and Welsh ministers as we were not party to these interactions. All I can say is that the evidence produced by TAG-E was generally used to guide policy interventions and at no point did the ministers ignore our expert advice. TAG had very good representation from the behavioural sciences through one of their subcommittees so in my opinion I do not feel this hampered the decision-making process.
20. Vulnerable groups, including those with protected characteristics were fully considered in all the discussions and reports written by TAG-E. I never felt that these sectors of society were ever overlooked.
21. I saw no evidence for 'groupthink' in TAG, however, as with all committees there were people who like to express their views more vociferously than others. Sometimes their views were misguided, however, they did not unduly influence the outcomes and sometimes promoted better discussions.
22. I cannot comment on TAG, however, TAG-E had a flat structure where everyone was equal. The key roles included the Chair of the committee, the Deputy Chair of the committee, the Welsh Government representative, an administrative support officer and the other members of the committee. No specific job titles/roles were allocated, except when writing specific reports where the lead author was identified and the other contributors (depending on the expertise required). In my opinion the roles of the members of TAG were clear.
23. TAG has a wide membership containing a wide range of disciplines and viewpoints. When reports were written, or evidence presented at TAG, the issues were well debated. One issue I identified was that TAG meetings were always held on Microsoft Teams. This is not the best platform for stimulating debate. A future recommendation would be to develop new on-line approaches to undertake meetings that facilitate member participation and the canvassing of views.



24. I would agree with Professor Bundy that more communication and joint working could have taken place between the sub-groups. As the pandemic progressed, the amount of information being generated was vast and it was impossible to read everything. More cross-talk would therefore have helped. The only barrier to this is the availability of people who were on these committees at the same time they were doing their day job (often in highly stressful COVID-19 related activities). I expect that the use of AI technology will greatly help synthesise complex information in the future (particularly evidence gathering).
25. Welsh Government Ministers and their representatives directly commissioned scientific evidence from TAG-E, however, it should be noted that we did not provide advice *per se*, just recommendations and evidence. Ultimately, Welsh Government made the decisions based on our evidence.
26. Yes, the commissions set to TAG-E were all valid and reflected topical issues such as the provision of evidence and guidance on minimising COVID-19 infections at events such as weddings, funerals, ice rinks, sporting events, restaurants, places of worship etc. Never once did anyone question the rationale for undertaking a commission.
27. If we were ever unsure about the remit or boundaries of a commission, we sought clarification from TAG. In all cases these were speedily answered (within 24 h), and the commission progressed with minimal delay.
28. See above (27). Yes, there was a clear 2-way feedback. I don't see how this could be improved. Everyone was committed to delivering the best possible evidence.
29. Yes, I do agree with Professor Humphreys to some extent. It would have been good to see how the information was used, however, I am also conscious that everyone was working at pace and things moved on very rapidly. When the pandemic had lessened in intensity we received letters thanking us for our work and efforts. In summary, the lack of feedback did not affect the work of TAG-E in any way – we did our job and had confidence that the tier above us was doing theirs.
30. My experience was that when consensus statements were produced, everyone on TAG had ample opportunity to critically review them and provide feedback. In all cases, to my knowledge the feedback was taken on board and where appropriate the consensus statements moderated accordingly.

31. I would probably disagree with the statement "It sometimes felt like the ability of the groups to maximise effective operation was sometimes handicapped by unequal access to information or to influence the timing of actions which had impacts in all 4 nations." I never felt that we didn't have access to information relevant to our commissions or committee workings.
32. I have no further comments on the structure or functioning of TAG or its sub-committees.
33. I am not personally aware of any WhatsApp or other messaging groups (other than Email) that were connected with the interchange of information pertaining to COVID-19 between TAG/TAG-E with Welsh Ministers, senior advisors, and senior civil servants. All information exchange took place by Email and Microsoft Teams with all information archived on Welsh Government's secure e-portal Objective Connect.

#### **The early stages of the pandemic**

34. I became aware of COVID-19 as soon as the first reports came out of Wuhan in 2019 about a new contagious respiratory infection. At this time we knew that it would not take long to reach the UK based on the amount of international travel and the failure to prevent this from happening. We also speculated that wastewater would be a good way to track the disease (based on our previous work).
35. I did not provide any advice to Welsh Government in this early period (Jan-Feb 2020) as TAG-E was not in operation at that time.
36. Prior to the establishment of TAG we were setting up the first UK-wide wastewater surveillance programme for COVID-19 in March 2020. In December 1999 we could see that the virus would transfer to the UK and that it was just a matter of time for this to occur. We therefore had the idea that instead of monitoring lots of individuals to look at infection levels, we would be able to test the community in one sample by taking one sample of sewage effluent at a central wastewater treatment plant and measuring the amount of SARS-CoV-2 RNA present. This relied on the premise that the virus would be shed in faeces, which we didn't know for sure at that stage. At this point, wastewater-based surveillance was an unproven technology. We were funded by UKRI via a £197,108 NERC Urgency Grant ([https://gotw.nerc.ac.uk/list\\_full.asp?pcode=NE%2FV004883%2F1](https://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FV004883%2F1)) to test out our idea. Unlike normal procedures, this grant did not go through external peer-review

as this would have taken too long. My view is that we do need a new system for awarding research grants during a pandemic as traditional procedures are too slow. We presented our initial data to the Office for National Statistics (to Dr Jasmine Grimsley) in April 2020 who were very supportive and helped scale up the programme to cover both England and Wales in the 6 months that followed. The Environment Agency led the programme in England. The Welsh wastewater programme went live in Wales in August, 2020. This was a collaboration between Bangor University and Cardiff University. We were also involved in working with Welsh Water to try to establish whether SARS-CoV-2 was infectious in water and biosolids and therefore posed a risk to their workers. This information was not presented to Ministers, Senior Advisors or Senior Civil Servants in the Welsh Government as we had no route of communication at that stage. At that stage Welsh academic institutions outside of Bangor and Cardiff were not actively collaborating on wastewater-based surveillance as there was no forum to facilitate this. The first wastewater monitoring report in Wales was made publicly available on the 17<sup>th</sup> February 2022.

37. I was not personally aware of (or involved in), any discussions within Public Health Wales or the Welsh Government surrounding the organisation of large events such as the Stereophonics or Scotland/Wales rugby events and whether they should have gone ahead in March 2020.
38. In March 2020 the severity of COVID-19 infection and the exact modes of transmission were not well established. Consequently, the precautionary principle was the correct approach (i.e. cancellation of events). In retrospect, they should probably have been cancelled earlier, however, I was not party to the decision making surrounding these events so cannot really comment on this process. In future pandemics there will always be a period of uncertainty about how the disease is spread (as all viruses are different, and some evolve very rapidly). It is therefore best to limit large public gatherings where shouting and singing occur (as this represents a high risk for the release of respiratory viruses from individuals). The wearing of face coverings at large public gatherings is also problematic due to a lack of compliance and suitable face coverings. This was evidenced when football matches recommenced. Unlike other countries, there are sectors of society who think the guidance and rules do not apply to them. Unfortunately, given this, the best approach is to limit social gatherings and superspreader events.

39. We have learnt many things from the COVID-19 pandemic. Due to the lack of personal testing in the early stages of the pandemic (2020), the lack of a national wastewater surveillance system and other ways to measure disease prevalence, imposing a national lockdown was the correct approach in my opinion. At that stage there was too much uncertainty about how to treat the disease, how it was transmitted, medical interventions, the outcome of the disease (i.e. long-covid) etc. The communication of a potential lockdown, however, could have been better. For example, it was clear from China in January 2020 that this was a likely end-point so the population should have been prepared for this eventuality.
40. I am not sure 'desire' is the correct word here. Decisions are made based on the best scientific evidence to protect the population as a whole. In such a situation everyone will be better protected from contracting COVID-19 but clearly there will be winners and losers. There are trade-offs between economics and personal wellbeing. Further, lockdowns have the potential to increase domestic violence and social deprivation, the legacy of which might last for generations to come. There are no clear metrics to directly compare these outcomes, and I have yet to see a critical analysis where this is all brought together.
41. I cannot comment reliably on whether the lockdown in March 2020 came from SAGE / UK groups rather than those advising the Welsh Government as I was not part of the decision-making process.
42. My feeling was that we were slow to adopt some non-pharmaceutical interventions (NPIs) such as the mandatory wearing of face coverings. This was due in part to the conflicting evidence on the efficacy of some NPIs and push-back from the public. I would say that a "slow and gradualist approach" is not helpful. NPIs, however, only slow the spread of the disease, they do not halt it. Their key role is to slow hospital admissions and put less strain on the healthcare system. I cannot comment on the 'groupthink' in the decisions made by Welsh Government as I was not part of that process.
43. In retrospect a lockdown should have been imposed 1-2 weeks earlier to limit the spread of the disease in Wales. This would have reduced the number of infections, hospitalisations and ultimately deaths. The exact number of deaths that could have been avoided by the imposition of an earlier lockdown can be estimated from epidemiological modelling.

44. I completely agree Vaughan Gething's statement that if Wales had entered a national lockdown a week or two earlier in March 2020 "we'd have saved more lives. As stated in (43), however, the exact number is not known.

**April 2020 onwards**

45. It is difficult for me to comment whether the aims of the Welsh Government in managing the spread of COVID-19 were clear to members of TAC and TAG in March 2020 as I was not part of TAG at that time and TAG-E was not in existence.
46. There is no doubt that 'behavioural fatigue', selfishness, ignorance, naivety and belligerence all played a major part in the spread of the disease, however, in no way do I think it influenced decision making regarding the imposition of NPIs in Wales.
47. I was not involved in advising on the "Eat Out to Help Out Scheme" in the summer of 2020 so cannot comment on this decision-making process. I have also not reviewed the evidence of whether this was successful in economic terms or posed an unnecessary risk in terms of COVID-19 transmission.
48. I provided evidence from the wastewater-based COVID-19 surveillance programme on levels of COVID-19 in Wales and whether these were increasing or decreasing. Typically, wastewater provides a reliable estimate of infections 1-2 weeks before clinical surveillance systems (i.e. early warning system). This is because individuals who have contracted the virus start shedding the virus in faeces even before they start showing symptoms, typically by a few days. Further, people are normally hospitalised 5-8 days after symptom onset. This gives a good head start using wastewater-based surveillance. In addition, wastewater-based surveillance has a fast sample turnaround (ca. 24-48 h). According to Welsh Government officials (e.g. Gareth Cross), this data was used twice as information not to enter a national lockdown. In both cases, the wastewater signal turned out to be correct. Within TAG-E we submitted a range of advice on the effectiveness of various NPIs to TAG/TAC. We also produced papers on border controls and how these were ineffective in preventing the entry of infected individuals entering the country.

Jones, D. L., Rhymes, J. M., Green, E., Rimmer, C., Kevill, J. L., Malham, S. K., Weightman, A. J., & Farkas, K. (2023). Poor air passenger knowledge of COVID-19 symptoms and behaviour undermines strategies aimed at

preventing the import of SARS-CoV-2 into the UK. Scientific Reports, 13, 3494. [DJ/1 - INQ000362214]  
Jones, D. L., Rhymes, J. M., Wade, M. J., Kevill, J. L., Malham, S. K., Grimsley, J. M. S., Rimmer, C., Weightman, A. J., & Farkas, K. (2023). Suitability of aircraft wastewater for pathogen detection and public health surveillance. The Science of the Total Environment, 856, 159162. [DJ/6 - INQ000362231]

We also provided recommendations/evidence on transmission in a range of settings in relation to person contact and social distancing. My key role was to present the current scientific evidence rather than be involved in decision to implement NPIs. I still stand by the evidence we provided.

49. In the TAC advice summary dated 11 September 2020<sup>7</sup>, advice was given by TAG that: “The pattern of increasing cases is similar to the situation in February. Action should be taken to prevent significant harm arising from Covid-19 or another full lockdown” and “While the R number for Wales is estimated by SAGE to be between 0.7 and 1.0, we believe the current R number is higher than this suggests”. The TAC advice summary dated 18 September 2020<sup>8</sup> stated: “There is consensus that the situation continues to be serious” and “A package of non-pharmaceutical interventions (NPIs) on local and national scale may be needed to bring R back below 1. Some NPIs may need to be in place for a significant length of time, though an earlier and more comprehensive response is likely to reduce the length of time for which they are required”. The TAC advice summary dated 25 September 2020<sup>9</sup> stated: “If the current measures do not bring R below 1 then further restrictions will be needed to control the epidemic in Wales. The earlier additional measures are introduced, the more effective they will be.” The next advice summary on 2 October 2020<sup>10</sup> stated: “Unless measures bring R back below 1, it is possible that infection incidence and hospital admissions may exceed scenario planning levels.” With respect to the advice given in the advice summaries dated 11, 18 and 25 September 2020 and 2 October 2020, I was not party to the discussions held by Welsh Government.
50. I think the decision to impose firebreaks was made on the best available evidence. In addition, the duration seemed to be correct to me and I believe that they were successful in achieving their goals.
51. Although research on coronaviruses has been ongoing for decades (including human strains), the emergence of a new strain brings with it uncertainty in its mode

of transmission, replication, cell targets, rate of mutation, infectivity, persistence under different environmental conditions (humidity, temperature, UV etc), susceptibility to biocides, potential to infect secondary animal hosts etc. At the start of the pandemic almost no information existed on the environmental behaviour of SARS-CoV-2, however, this did change rapidly as the pandemic progressed. One key issue was the efficacy of different types of face coverings or NPI interventions (e.g. air purifiers, screens etc) due to the vast number of scenarios (e.g. room sizes, shapes, activities, cleaning regime, occupancies etc). Also, due to the nature of SARS-CoV-2 most experiments were carried out in Category 3 Biological Safety facilities which fail to reflect/simulate real world conditions. Even now the evidence base is weak on the capacity for SARS-CoV-2 to remain infectious in environmental settings. I would say that TAG-E was always careful to caveat the level of uncertainty surrounding the evidence presented in its reports. I would say that all the reports contained an incomplete evidence base. As stated above this was not helped by the lack of capacity to fill these knowledge gaps in a Welsh context (i.e. lack of funding, lack of Category 3 facilities for undertaking these types of studies).

52. There is no doubt that a lack of Welsh-specific data hampered TAG-E's ability to produce the most robust evidence and guidance. For example, we still need data on how SARS-CoV-2 persists in response to the environmental conditions experienced in Wales and also how people behave in Wales. An example of this is data on the degree of overcrowding on public transport in different parts of Wales and compliance to NPIs during the pandemic.
53. I do not know why TAG did not publish its advice before May 2020 as I was not part of TAG at that time. The reports from TAG and TAG-E were published on the internet so I would consider them to be open access.
54. I think that 'following the science' was effective as a communications strapline. At the end of the day, most of the general public do not understand the fundamental science (for example, viral genomics, epidemiology) or know how to interpret complex datasets. Overall, I think Welsh Government did an excellent job in presenting the key evidence to the general public (i.e. trends in infection in different parts of the country, numbers of deaths etc). It could be argued that these estimates were subject to bias, depending on the way they were calculated, however, the underlying messages were the same.

55. Overall, I think that TAG and its substructures were very effective in providing evidence and guidance to Welsh Government given the rapidly emerging science and nature of the pandemic.
56. The key thing is to learn from this pandemic and retain the structures for the next pandemic that is inevitable. The advance of artificial intelligence should also make evidence gathering much more efficient in future scenarios and data science will be vital to the future of managing public health and disease outbreaks. It is also vital to retain key physical infrastructure for providing scientific evidence and surveillance leading up to and during the next pandemic (e.g. national wastewater monitoring, BSL Cat 3 laboratories). We also need to train a younger generation of virologists to provide critical evidence when the time comes and also to replace current members of TAG and TAG-E.
57. See also above (56). I do think that scientists and policymakers can work more closely together. In Wales, this needs more funding to address Welsh specific issues. My personal view is that a representative proportion of UKRI funding should be devolved to Wales to allocate to address Welsh-specific and international issues. Far too much of the research power is retained in England. This is a perpetual cycle that needs to be broken as soon as possible (levelling up). Within this we also need to foster cross-institutional working in Wales through the creation of a Post-Pandemic Institute or a One Health Institute. Wales is the right size politically and scientifically for effective communication; however, we need the right mechanisms in place to make this happen.
58. Representatives from public organisations could have been more engaged in the development of pandemic policy, however, in my view decision should still be made based on evidence. If they can realistically contribute to the gathering and synthesis of evidence, then that would be good.
59. The issues of diversity and equality and how to maximise these in public decision making is not my field of expertise. Therefore, I cannot comment on how to achieve this more effectively.

### **Statement of Truth**

I believe that the facts stated in this witness statement are true. I understand that proceedings may be brought against anyone who makes, or causes to be made, a false



statement in a document verified by a statement of truth without an honest belief of its truth.

**Personal Data**

**Signed:** \_\_\_\_\_

**Dated:** 22-07-2023 (revised 03-12-2023) \_\_\_\_\_