GOVERNMENTS' STATISTICAL RESOURCES

Report based on RSS event taking place on 3 May 2022

Summary – lessons learned about governments' statistical resources

This report documents the discussion at the second of the RSS's Covid-19 evidence sessions.[1] Before the session, we identified five groups of questions designed to discover what lessons can be learnt around the UK governments' statistical resources – both so that we can learn from what went well, as well as reflecting on where there are areas for improvement. We sought to bring in a wide range of views during the discussion at the event, and these are reported below. However, even over a two hour meeting, only so many people were able to speak, so this is intended as a reflection of views expressed during the meeting and should not be read as representing the views of the RSS.

The five areas we explored were:

1. **The data journey**: what did the journey look like at the start, and what changed through the pandemic? What drove any changes in public and private data availability and use?
2. **Cross-government sharing**: did different public sector institutions – including central government, devolved governments, local government, health services – share and integrate data effectively across organisational boundaries? If not, what were the barriers? What effect did this have on communication with policy-makers, parliament and the public?
3. **Definitions and communication**: were definitions and their caveats – for example, in how deaths or hospitalisations were defined – sufficiently consistent and clearly communicated? How were changes managed?
4. **The Covid Infection Survey (CIS), REACT and ZOE**: what did we learn from these surveys? Did they provide value for money, and were there alternatives? What should the future of the CIS be?
5. **Open data and transparency**: how might greater transparency around the data and research used in policy- and decision-making have improved outcomes? What could have been done to improve transparency?

List of speakers

Main speakers

- **Ed Humpherson** – Director General Regulation, Office for Statistics Regulation (OSR)
- **Adam Kucharski** – Professor of Infectious Disease Epidemiology and Sir Henry Dale Fellow at the London School of Hygiene & Tropical Medicine
- **Rosalind Eggo** – Associate Professor of Epidemiology and Population Health, London School of Hygiene & Tropical Medicine
- **Scott Heald** – Director of Data and Digital Innovation, Public Health Scotland (PHS)
- **Barbara Bodinier** – Doctoral researcher (REACT), Imperial College

Contributing speakers

- **Sheila Bird –** Medical statistician, past vice-president of the RSS and member of the RSS Covid-19 TaskForce

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[1] This document is a work in progress – a final version will be published in 2023. If you notice errors or omissions please email policy@rss.org.uk.

- **Shaun Richards –** Independent financial market commentator
- **Tony Dent –** Founder, Better Statistics
- **Sam Clemens –** Research director, Ipsos MORI
- **Ross Clark –** Journalist at the Spectator, Mail and Telegraph
- **Peter Wells –** Freelancer, politics, policy and delivery in the context of data and technology
- **Matthew Edwards –** Consulting actuary, Willis Towers Watson
- **Denise Lievesley –** Former president of the RSS

1. The data journey

What did the journey look like at the start, and what changed through the pandemic? What drove any changes in public and private data availability and use?

Ed Humpherson looked at the statistics produced by the UK government, considering statistical resources in both a narrow and broad sense. 'Narrow' in the sense that he is concerned with official statistics produced by the UK's four governments (his statutory area of responsibility) – which meant that he would not be talking directly about statistical resources available from non-government producers of statistics and analysis (and he recognised the crucial role played by data analysts outside government in supporting public understanding of the pandemic). 'Broad', in the sense that he defined resources more broadly than the classic idea of just money and people.

There were a lot of statistical successes during the pandemic. For example, the Covid dashboard – certainly by the end of the pandemic – was incredibly informative at very granular levels. It provided a huge amount of information to a public thirsty for information and to policy-makers to inform decision-making. The UK also had a world leading Covid Infection Survey (CIS). There were lots of successes and it would be churlish to deny that.

Humpherson argued, though, that these successes came in spite of resource limitations and in fact, the story of the pandemic for statistics and data was one of a series of successive resource limitations that had to be overcome. Some of those challenges were external to statistics producers and some were internal. It might seem odd to say that there was a limitation in resource given the lavish level of resources given to, eg, Test and Trace or the CIS. But this is why it is important to think about resources in a wide sense and look at limitations in resources with data and data gaps in particular.

The pandemic gave rise to data gaps in many areas:

- *Community testing:* At the beginning there was a complete absence of community testing – to be tested for Covid you had to be sick enough to be in hospital. Clearly for something that was spreading rapidly and asymptomatically, that creates a huge data gap. That data gap was addressed by the ONS's CIS.
- *Care homes:* There was a huge negative impact on care homes and it took some time before there was good information about infection and mortality in that setting.
- *Vaccines:* While the rollout was a tremendous success, at the start of the pandemic there were huge limitations in the granularity of the data available on who was getting vaccines, where they were, and what their socioeconomic characteristics were. All of those gaps were eventually addressed, but it meant that at crucial decision-making points there were limited statistical resources available.

Humpherson also highlighted limitations around data sharing and frameworks, which are detailed in sections two and three below.

Throughout the pandemic, **Humpherson** said, the landscape of statistical organisations evolved and developed. This was certainly true in Scotland where there was an entirely new public health body, Public Health Scotland (PHS), which came into existence on the 1 April 2020, and had a lot of new ambitions and energy. In England, you had Public Health England, which was well established, but somewhat at arm's length from government. It reported to the Department for Health and Social Care (DHSC), which itself was not particularly strong in terms of expertise

on official statistics. In Wales, you had Public Health Wales, and a strong body of expertise in Northern Ireland. There were good statistical teams, but they were rather limited in resource.

That landscape has changed, particularly with DHSC. At the start of the pandemic, it only produced one official statistic and it had no head of profession for statistics -- it now produces many and has a head of profession. This is largely the result of absorbing the public health analysis responsibilities of Public Health England. That shift in the department's centre of gravity is really important and positive in the long term.

Humpherson also pointed to a softer element of organisational capability – the mindset of organisations. Everybody in a policy role during the pandemic became an enthusiast for data. But the mindset differed from place to place, and **Humpherson** demarcated a couple of tensions within that:

- First, between data and statistics that are useful for communicating predetermined decisions, versus data and statistics that are communicated for transparency, so that people are informed and can make decisions. This was seen a lot, eg, through what was communicated in government announcements and speeches: did they aim to make as much information as possible available for everybody, or did they aim to communicate and explain an already determined policy decision?
- Second, between operational delivery and evaluation. Were people collecting data, through eg Test and Trace, in an attempt to improve and refine the management of a big operational delivery, or were people doing so to aid evaluation?[2]

Humpherson argued that while this is a story of success overall, we might see a system that snaps back into its former structures unless organisations like the OSR and RSS keep encouraging continual improvement.

Adam Kucharski provided an overview of the timeline of key data used during the pandemic -- their benefits, limitations and some of the lessons that we can learn. This timeline is summarised in the image below:

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[2] Humpherson made more detailed comments on the issue of evaluation at the fourth evidence session, which focused directly on this issue.
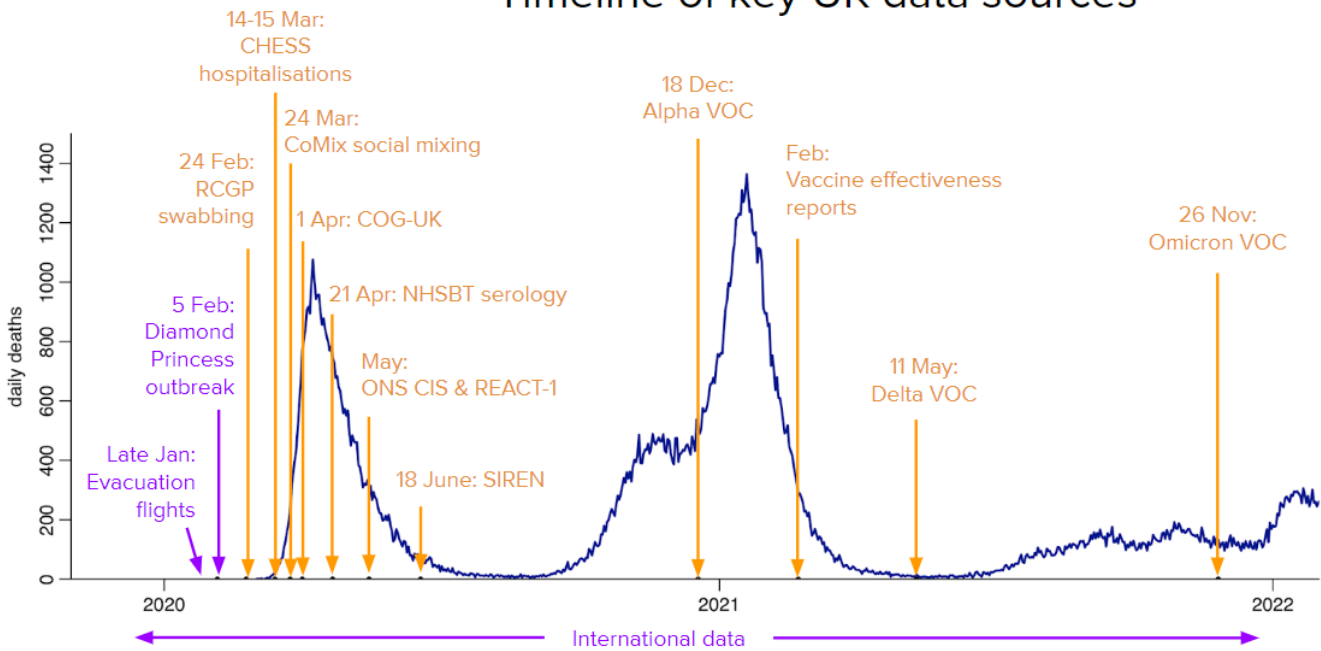
Timeline of key UK data sources

Figure: Deaths within 28 days of positive COVID test, gov.uk

Timeline of when UK data sources became available, produced by Adam Kucharski and Rosalind Eggo.

First of all, he emphasises that as well as the UK data, there was a lot of benefit from international data throughout the pandemic – particularly early on. There were some international data sources that gave us a sense of the extent of missed infections and the implications for fatality risk. The Diamond Princess cruise ship outbreak and early evacuation flights were very useful for narrowing this down.

Early on, in the UK, a lot of cases were being missed and there were a couple of data sources that provided useful indications of that undetected transmission. First, there were the sentinel GP swabbing schemes, and then there was CHESS (the Covid Hospitalisation in England Surveillance System) that linked together critical care admissions. These provided an early indication that the epidemic was far further along in the UK than some of the early case numbers were suggesting.

The challenge with data around hospitalisations is that they represent infections that have occurred in the past two or three weeks. So if you apply control measures, that data is not going to give a very quick signal of what effect the measures are having. Post-lockdown, it was social mixing data that became important: things like the CoMix study, which provided an early indication of the extent that the behaviours driving transmission might be reducing. In that period we also saw COG-UK (the Covid Genomics UK Consortium) come online. This initially provided an indication of imported cases early in the epidemic – showing a lot of importations from France, Italy and Spain, from before those countries had actually reported outbreaks. Later, this would come into its own, as variants of concern emerged.

Kucharski also pointed to the emergence of antibody data from blood bank studies, which gave a really useful indicator of how much exposure there had been within the population, and the relative contribution of possible immunity versus behaviour change and control. Around May 2020 we also started to get a better understanding of true prevalence, as the ONS CIS and REACT-1 started. **Kucharski** also noted a number of really useful healthcare worker cohort studies, such SIREN (as the SARS-CoV2 immunity and reinfection evaluation), which gave information about the risk of reinfection and immunity dynamics within these populations.

As we saw variants of concern emerge, **Kucharski** said, these different data sets were helpful for piecing together both what was going on, and also the characteristics of those variants and their potential implications. As we saw

vaccine roll-out, a lot of the PCR testing that had been put in place could then be repurposed for ongoing analysis of vaccine effectiveness in different groups. As the Delta and Omicron variants emerged, having those different data slices provide timely information on variant characteristics was very important.

Rosalind Eggo reviewed the types of data that were available early on. There was a lot of uncertainty at the start of the epidemic because we didn't understand the natural history of infection – for example, the time to symptoms, the time to death and the fact that those are distributions rather than set intervals (as illustrated below).


The uncertainty in these time distributions was absolutely critical for percolating through the uncertainty into the modelling.

We also did not initially understand the pyramid of severity – if you observe a death, what that would represent in terms of the number of severe hospital cases you would see or the number of infections that were out there. Because these indicators are lagged, if you observe deaths or hospitalisations without knowing time distributions, it means that it is very difficult to work out what might be happening with infections at the same time.

As infection data improved, this provided a better idea of what was happening. **Eggo** also emphasised the importance of having enough of this kind of data to stratify, for example, by age or by location. This is important because if you see, for example, different effects in different areas, it might point to different levels of hospitalisation in different places. It took a long time for data to become available that would allow stratification by age or location – and then latterly, also by vaccine status.

At the start of the epidemic, **Eggo** said, there was very little data available and the quality of data was not very good. As time went on, more data of better quality became available, and this was critical for research. **Eggo** referred to the below diagram:
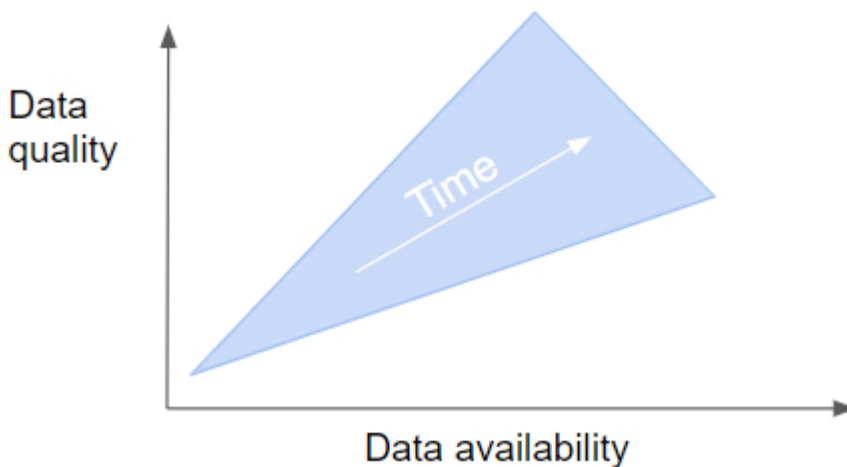
She emphasised that at the start, we were in the bottom-left quadrant with a lot of uncertainty and a lack of clarity. Much of that was rooted in data collection. A lot of the data that were being analysed, especially early on, came from active surveillance (tracing and testing contacts and seeing if they had symptoms) and passive surveillance

(symptomatic testing or counting hospitalisations). There was also indirect surveillance like the evacuation flights, which were really critical early on in providing an understanding of the size of the epidemic in the source location, and remained important for genomic sequencing.

The difficulty with these different approaches to collection is that we don't always understand the observation process, but it has to be incorporated into all analysis. Later on, when design studies, community surveys and other healthcare worker studies came on board, the observation process was clearer, and that helped analysis and reduced uncertainty.

Eggo highlighted the central role of crowdsourcing in the early stages: members of the public participated in collating data, translated data sources, and contextualised international data. This was important both for epidemic data and metadata – helping to understand if data are collected, who they're collected by and under what interventions. This became critical as the epidemic progressed and the volume of data increased – more countries were affected, and it became clear that research teams couldn't do this alone. The public sharing of collated data with traceability (very often on GitHub) and references allowed them to be widely used and helped their limitations to be understood.

Kucharski pointed out that there was a lot of uncertainty at the start: we didn't know whether there was presymptomatic transmission, what the fatality risk was, etc. This didn't just affect knowledge on that specific question – it also impacted all of the downstream analysis you might do on possible scenarios and controls. Throughout the pandemic there were competing hypotheses regarding particular dynamics – if cases are surging, is it just because of behavioural change? Is it because of characteristics of a variant? Is it something to do with waning immunity? Having complementary data to distinguish between those explanations is extremely valuable. **Kucharksi** also highlighted the importance of bearing in mind what question we're trying to answer with a particular data set. So if there's an assumption early on, say, that there's not widespread community transmission yet, it may be a relatively small data set that can allow you to test that assumption. Whereas if you want a very precise estimate of local prevalence, it requires something much larger. So different data, tailored to different questions, is required.

Kucharski argued that there were missed opportunities for good data insights. In particular, the enormous amount of travel testing could have provided really unique insights into global prevalence by looking at cases coming in. That wasn't done because the data weren't linked up or made available in that way. He also stressed that a lot of the value of particular datasets wasn't immediate – data systems were designed for one purpose, and only then really came into their own for something else. When talking about use of data and their value, **Kucharski** argued that it is important not just to focus on the questions we've got in mind now, but potentially the future ones as well.

Scott Heald talked about his experience at PHS. In Scotland there were three main bodies producing Covid statistics. The first is PHS, which was formed by merging Information Service Division (ISD) Scotland, Health Protection Scotland and NHS Health Scotland. PHS was not created because of Covid – it was created to tackle a range of other public health issues, but Covid was present on more or less the first day. PHS employs around 350 analysts and statisticians in the organisation, around 150 data management experts, and also epidemiologists, clinicians and programme managers. The second body producing Covid statistics is the Scottish Government. PHS works very closely with the Scottish Government, who have their own health and social care analysis teams and analysts working in policy directorates. The third major body producing statistics is National Records of Scotland, who focused on death data – PHS coordinated with them on the release of death statistics.

Covid statistics were released in Scotland every day at 2pm. The Scottish Government and Public Health Scotland coordinated so that the government website published high-level figures and the more detailed breakdowns were available on PHS's Covid dashboard. This is where they released all of the details, using open data, so that anybody could take it and use it for their own purposes. PHS also had a weekly report bringing together more of the narrative about what was happening – taking stock on a more week-by-week basis in a way that you can't do on a frantic daily reporting cycle. Here they published a range of special reports, including things like the evaluation of shielding. Again, PHS coordinated across all other bodies so that the weekly reports from all the organisations

were published at 12pm (noon) each Wednesday. This was to ensure that all the data was in the public domain when the First Minister used it in statements, so that everyone had access to all the information that she had.

Heald summarised PHS's data journey and highlighted some key lessons. Initially, high-level numbers were reported and it was very manual – it involved talking to epidemiologists and counting the number of cases coming through on a white board. The epidemiologists were working separately from the data managers and statisticians. As case numbers started rapidly increasing, staff moved into new teams. Cross-professional working became essential: data managers effectively managed the data; statisticians performed the analysis; and epidemiologists and clinicians provided more in-depth analysis and set the direction at different stages of the pandemic.

In hindsight, **Heald** said, PHS perhaps didn't move people rapidly enough onto Covid work, meaning that other workstreams were initially taking up time alongside the Covid work. Although there are quite a lot of statisticians within PHS, many were doing other work at the start of the pandemic. Because of the scale of the challenge, people were moved to work onto Covid pretty quickly – but balancing that with the consequence that some of the statistical series usually published would need to be reduced or stopped for a period.

One of the reasons that cross-professional working became essential, **Heald** said, was the role of data managers in effectively managing and linking the data: this meant that all the testing, vaccination, hospital death, contact tracing, and any other data about the pandemic, was all in one place – the Covid data store – and all linkable. PHS was able to make daily use of that to rapidly turn around the data needed for reporting. It was important to link statisticians with the epidemiologists and clinicians to get the clinical and epidemiological view of what was going on at different stages of the pandemic – which helped inform where the analysis should go.

Heald also highlighted automation as an important aspect of PHS's work. Reproducible analytical pipelines were introduced for all of PHS's work on Covid. Moving from a manual, stressful process to an automated process has been key to daily delivery. In essence now it all runs automatically - when the analysts come in in the morning, all the data is sitting there ready for reporting. That's been a huge lesson for PHS and something that it's applying to other work. **Heald** also highlighted that PHS was using seven day working – initially it was the same people working seven days a week, for weeks on end. Then when it became clear that Covid was going to be a long term challenge, PHS changed its ways of working so that there was always seven day cover, but people weren't expected to work more than five days a week.

PHS's Covid dashboard was a well-used tool – receiving 50 million hits over the 18 months from January 2020 to June 2021. This is much more than the traditional PDF reports received (which is normally between four and one hundred hits on release). **Heald** suggested that this is a valuable lesson for how data is shared in the future.

2. **Cross-government sharing**

   Did different public sector institutions – including central government, devolved governments, local government, health services – share and integrate data effectively across organisational boundaries? If not, what were the barriers? What effect did this have on communication with policy-makers, parliament and the public?

Ed Humpherson identified an important limitation around data sharing: even if data were available, how widely shared and interlinked were they? Again, the answer here is that at the outset of the pandemic there were very clear problems. Parliamentary evidence from members of SAGE shows experts saying this right at the start, as they were attempting to model the pandemic. A key struggle for them was just getting access to data. This limitation has been addressed very effectively by, eg, the Covid data store in Scotland, local data stores in England, and the Public Health Data Asset. There's a degree of optimism in the statistical community that the later success in data sharing might become the norm. However, the example of the GP data sharing attempted in England might suggest that it won't be as easy to generalise from the Covid case to broader data sharing.

Scott Heald discussed some of the issues with ensuring that data is comparable across nations. The working heads of profession across the four nations hold regular forums to try and move towards using common definitions. The difficulty arises when data is being collected in response to a particular policy, and the policies are sufficiently different between the nations that data collection can't be harmonised while supporting a particular government's policy. While this is sometimes unavoidable, in those cases there needs to be greater clarity that this has happened and around explaining why.

Peter Wells argued that there were issues with data for decision-making at the local level. During the pandemic, there were a number of decisions to be made at the level of England as a nation – where to send PPE, where to increase hospital capacity, or which non-pharmaceutical interventions to put in place. Data collection and statistical processes were established to meet national need. But there were also decisions to be made locally: where to advertise new guidance and rules, what languages to use, where to place testing sites, which workplaces needed stronger enforcement and so forth.

Before the pandemic, local authorities were responsible for many aspects of public health. They worked with the NHS and a range of partners such as care providers, police forces, charities, businesses, community groups, and individual citizens – the kinds of partners that help make local decisions effective. However, for many months throughout the summer of 2020, local authorities lacked data about the pandemic, as the data collection and statistical processes did not meet local needs. As a result, decisions were not made or were made with lower levels of evidence than could otherwise have been the case. Local capabilities that could have helped with the pandemic were underused and, as a result, some places started collecting their own data. Businesses started selling proxy data collected from non-healthcare services to local authorities, and this was different to the data that was being used by the national government to make England-wide decisions. It would be helpful to use these different evidence sets to evaluate which data and analytical methods worked better.

Denise Lievesley highlighted the use of international data to learn from the experiences of other countries. She had recently seen the Director General of the WHO give a presentation, during which he thanked statisticians for their critical work during the pandemic, and urged them to continue to share information that was high quality and comparable across nations. On 5 May 2022, the WHO published a report on excess deaths across the world. The UK should use that data in the spirit of building an understanding of what we could have done better. The use of league tables of countries' performance engenders defensiveness – so it is important to approach the data in a constructive manner.

3. Definitions and communication

Were definitions and their caveats – for example, in how deaths or hospitalisations were defined – sufficiently consistent and clearly communicated? How were changes managed?

Ed Humpherson highlighted an issue around data frameworks. Limitations here, he suggested, are just as important as limitations with the data itself. Take the example of deaths: defining what counted as a Covid death was unclear at the start of the pandemic (multiple options were available) and it took some time for the current range of statistics to be settled into a clear framework. Now we have a quick measure – every 28 days after a positive test; then there is a weekly registration measure which comes from death registrations from ONS, National Records of Scotland and the Northern Ireland Statistics and Research Agency; and then there is the gold standard – excess deaths – which takes slightly longer but allows international comparison. It took some time to arrive at this as a coherent framework for explaining the value of the different data sources.

Scott Heald set out the process for changing definitions around testing or vaccination cohorts in Scotland. PHS made sure that changes were communicated in advance – producing short written explainers, and videos to explain key changes. It was also important to have close working relationships with the other nations. Because health is devolved, PHS's focus was on producing statistics which informed the Scottish position. However, it was important to coordinate across nations to harmonise where possible. This was particularly true for vaccination statistics, where there was a lot of work in advance of publication to make sure that reporting was aligned.

Sean Richards set out some of the issues that he saw with economic statistics. During the pandemic the UK reported that GDP fell by 20.4%, which was extraordinary on two counts: the size of the large fall relative both to historic UK trends and to other countries (eg, 10% in Germany and the US, 15% in France, 12% in Italy). Something was different in the UK and part of that, Richards argues, was a problem with the numbers – which could be seen in inflation figures. Looking at GDP compared to nominal GDP you would get an inflation figure of around 5% – but at the same time the Consumer Prices Index (CPI) had inflation at 0.6% and the Retail Price Index (RPI) was at 1%. What was going on?

Richards suggested that part of the problem is around how public sector spending is accounted for. The UK saw huge levels of extra spending in health and education and we measured this for the purpose of GDP, using 'outputs' while the rest of the world uses 'incomes'. So, because doctors, nurses, teachers etc were still being paid the same elsewhere it did not feed through into inflation. But, as the UK used 'output', and government spending had inflation of 32.7% (34.4.% in education, 36.1% in health) this distorted the overall figures.

Ross Clark identified the most significant problem as being with the publication of daily death figures. In particular, they lacked the context of who was dying – their age, other conditions, whether they died *of* or *with* Covid – and they lacked any comparison with the number of deaths that would be expected in an ordinary year. At one stage there was a claim, based on an ONS release, that 2020 was the deadliest year in a century – it was only explained low down in the news stories that this was simply a raw measure of the number of deaths, ignoring the massive population growth over the years. The ONS was publishing figures for excess deaths once a week, and these should have been more enlightening. But there was a similar problem with these figures. The number of deaths was being compared with the five year average, without adjusting for population growth or aging. Given that the number of people over the age of 70 is rising by around 2% a year due to the post-war baby boom, you would expect the number of deaths to rise over time even without a pandemic.

Clark suggested that the most illuminating, but little reported, figures were those for age-standardised mortality from the Institute and Faculty of Actuaries (IFA). These adjusted for change in population profile, and revealed that rather than being the deadliest year since 1920, 2020 only took us back to the mortality rate of 2008. However, this was a privately published data set and, to his knowledge, neither the ONS nor any other public body attempted anything similar.

Clark also noted some issues with the presentation of graphs in government briefings, which too often did not give context – for example, that number of cases is partly a function of how many tests were being undertaken, and is influenced by how many of these tests were actually being reported. Until the Omicron wave, hospitalisation figures throughout the pandemic did not distinguish between people who were in hospital *because* of Covid, as opposed to those who caught Covid, for example, while they were in hospital.

Matthew Edwards detailed how actuaries handled data around Covid fatalities. The IFA runs the continuous mortality investigation and, during the pandemic, had to make certain changes to how excess deaths were being monitored. Their mortality investigation started two or three years before the pandemic. It involved taking quarterly data on deaths, and thinking about how the data fed into actuaries' views of mortality improvements. At the start of the pandemic, this seemed a good basis to build on, to create a methodology for reporting excess deaths. But the IFA identified problems with two basic measures of deaths: the ONS measure (based on death certification) and the PHE measure (based on recent positive tests). The IFA thought from the outset that excess deaths would likely be more reliable, so developed a methodology to measure this.

Excess deaths is the number of actual deaths minus expected deaths. Everything hinges on how you define and calculate expected deaths. The IFA's model used age- and gender- standardisation to get a baseline. They used 2019 data for a baseline – because that seemed a defensible, representative model of 2020 fatalities without a pandemic. The first two months of 2020 were very close to what happened in 2019, so it seemed a good fit. The other reason to use just one year as a baseline was that mortality had been increasing year-on-year for decades, so the previous year as a baseline seems the natural default. So they used age- and gender- standardised data with 2019 as a baseline. This was extremely useful in early 2020 when the other two metrics were not particularly

reliable. It has also been very helpful over 2021 and 2022 as a way of seeing the impact of the pandemic – net of the various different influences.

4. **Covid infection survey, REACT and ZOE:**

What did we learn from these surveys? Did they provide value for money, and were there alternatives? What should the future of the CIS be?

Barbara Bodinier discussed her experience of conducting analysis for the REACT-1 study – setting out some of the techniques used and lessons learned. REACT-1 was set up very early on in the pandemic, with data collection starting in May 2020. REACT-1 was one of two streams and focused on monitoring Covid-19 prevalence in the community in England, using swab tests. The other stream, REACT-2, focused on monitoring antibody prevalence in the community. Data collection was organised in rounds, which took place in monthly rounds. Randomly-sampled English residents were invited to participate. They were asked to fill in a questionnaire about their experience and characteristics – whether they had experienced any symptoms, if they were shielding, etc – and they were asked to send a nose and throat swab. The swabs were tested by PCR to determine if they were positive. If the sample was positive, it was also sequenced to determine which variant it was. Samples were sent in and tested very quickly, which meant that test results were coming in every day for participants who had enrolled only a couple of days before that. This meant that the data could be used to monitor the prevalence in the community in more-or-less real time.

There were three main things that were learned from the data:

1. An estimate of prevalence
2. Temporal and spatial trends
3. Tracking variants and sub-lineages

The main objective of the study was to get reliable estimates of the prevalence. Unweighted prevalence was calculated as the ratio of the positive swabs over the total number of swabs collected in a given period of time. But not everyone who was invited took part in the study – so the study team also corrected for potential biases introduced here as well as, working with Ipsos MORI, ensuring that the weighted prevalence was representative of the population of England in terms of age, sex, deprivation index, local authority and ethnicity. To get a more precise picture of how the epidemic evolved over time, **Bodinier** said, they modelled the daily prevalence so that they could understand trends even at the points between rounds when they had no data. This helped them in visualising trends and allowed them to produce visualisations such as the below:
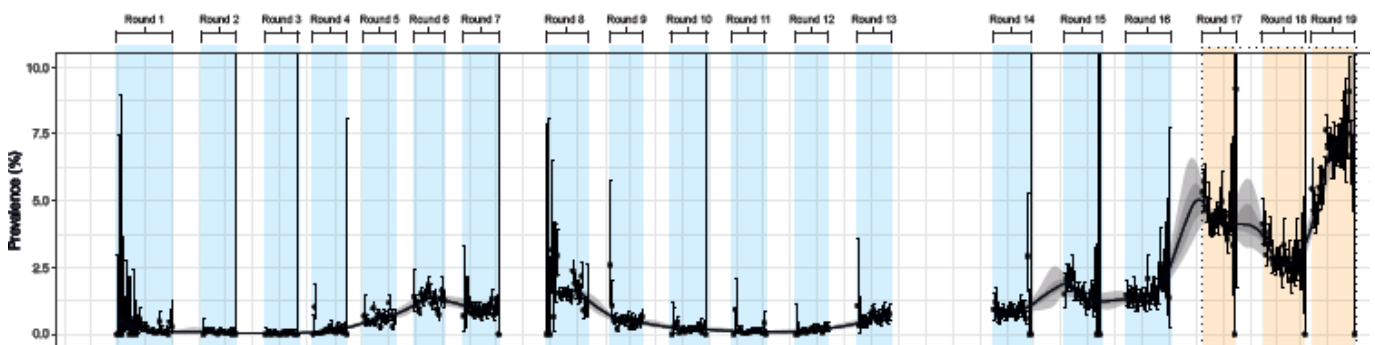

In the above chart, you can see a steep increase in the prevalence during March 2022 (corresponding to Round 19). Because they had a representative sample, REACT researchers were also able to breakdown prevalence by age group – shown below.
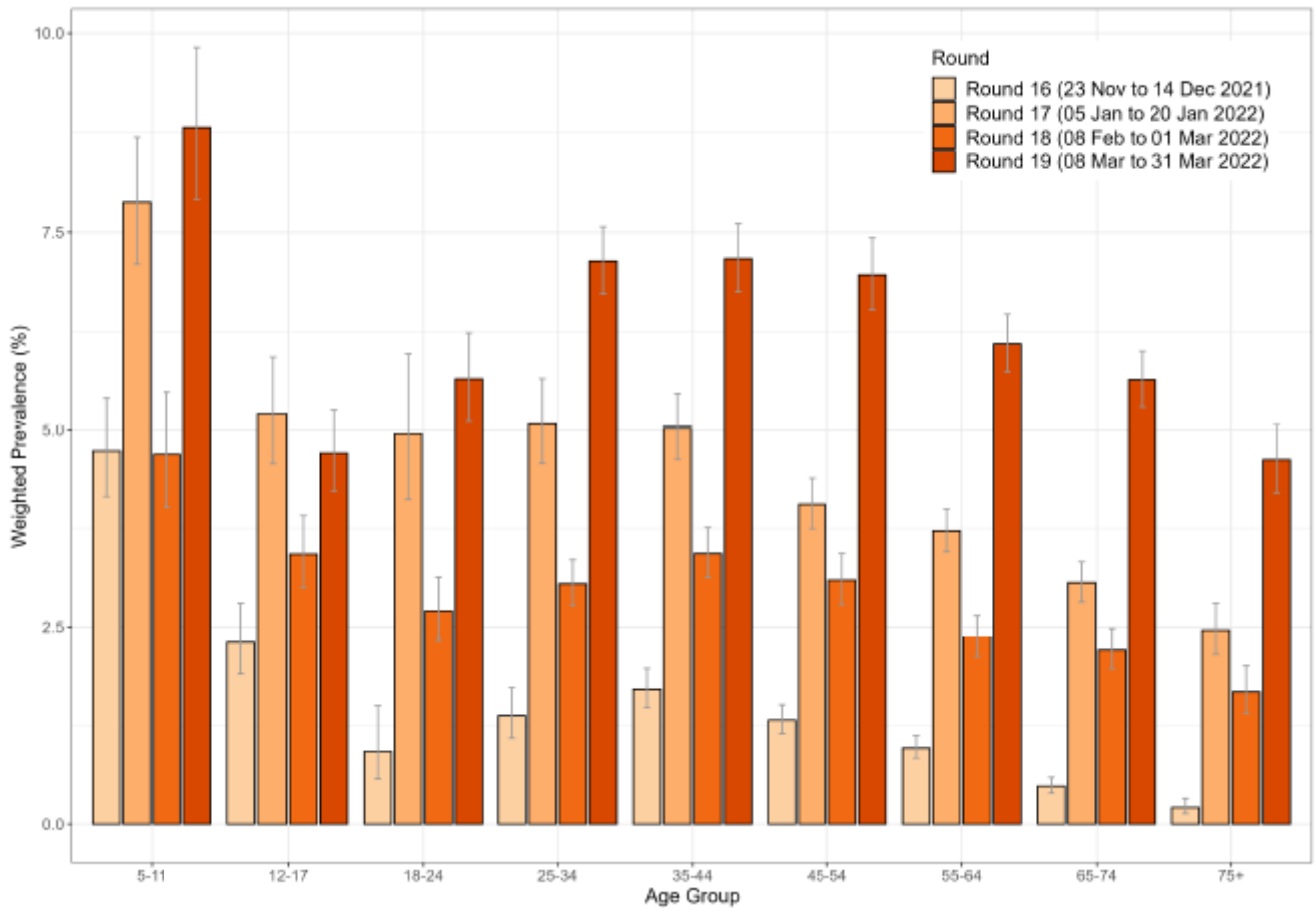
Here you can see that the high prevalence in March 2022 (Round 19) was being contributed to by children aged between 5-11.

Bodinier then set out how REACT-1 was helpful in identifying geographic trends. The REACT team used a neighbourhood spatial smoothing model to estimate the prevalence at the LTLA (Lower Tier Local Authorities) level. This allowed them to show how prevalence varied across the UK with clear visualisations, eg the below.
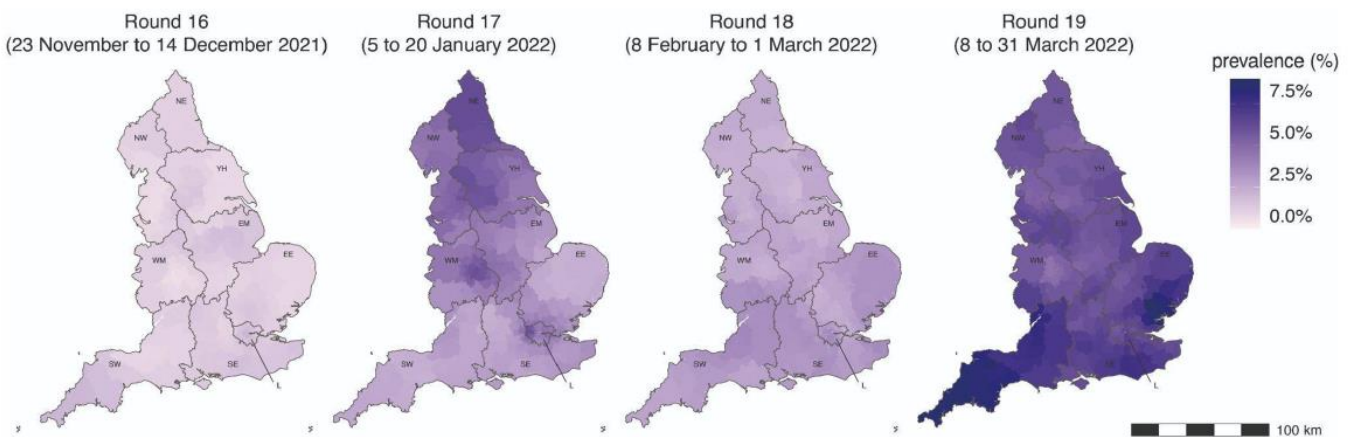
This shows peaks in prevalence in Rounds 17 and 19. You can see in January 2022 that there was high prevalence in the north east, in Birmingham, and in London, whereas by March it was higher in the south west and east of England.

Finally, **Bodinier** detailed how important REACT-1 was for tracking variants. In January the increase in cases was mostly driven by Omicron, which has been dominant in England since. REACT data showed it taking over as the most common variant.
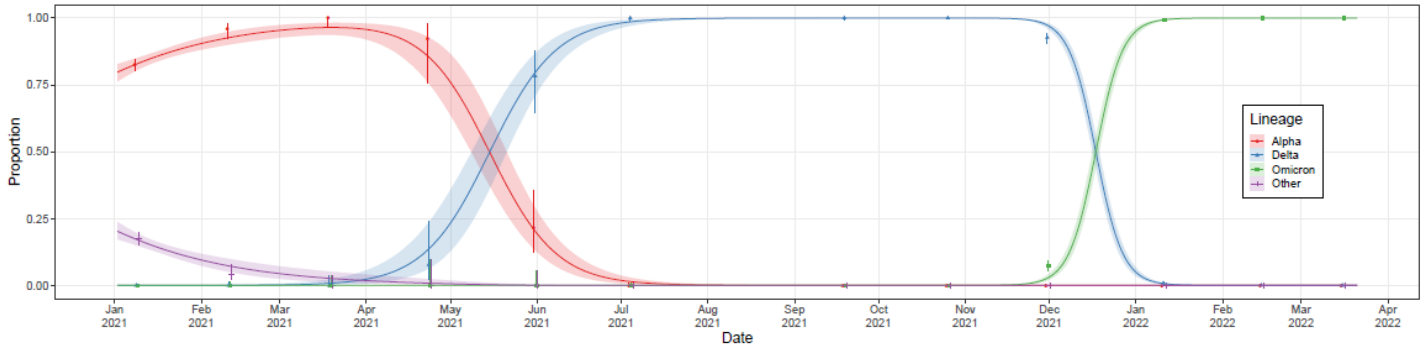
REACT also tracks sub-lineages. In the image below we can see that the proportion of BA.2 (a sub-lineage of Omicron) increased in February and March. Using the daily prevalence of the two sub-lineages, the team could estimate that it would take around 55 days for BA.2 to go from being responsible 5% of infections to 95% of infections.
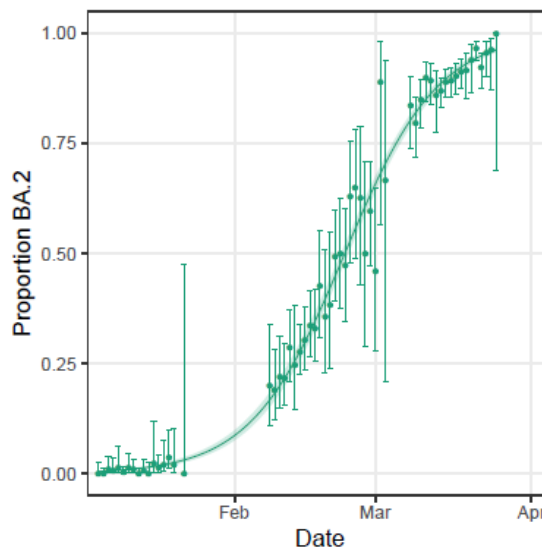
As a comparison, this is a slower than the Delta to Omicron transition, which took an estimated 29 days, but faster than the Alpha to Delta transition, which was an estimated 69 days.

As well as providing information in the three areas outlined, REACT was also helpful in evaluating vaccine effectiveness. **Bodinier** reported on work that was conducted during rounds 13 and 14 (finishing in September 2021). REACT researchers estimated that vaccine effectiveness against infection at that time that was around 66%. This figure was calculated using logistic regression, with swab positivity as the outcome, and vaccination status as the predictor. They could not properly estimate vaccine effectiveness in later rounds, due to the smaller number of unvaccinated participants and their special characteristics in terms of behaviours, comorbidities and so on.

Earlier in the pandemic, during rounds 2 to 8 (ending in January 2021), REACT also looked at the symptoms people experienced. They explored 26 possible symptoms, and sought to identify which were most common. The

team used a multivariable logistic regression model, with swab positivity as the outcome, alongside the symptoms that had been experienced. They used LASSO penalisation in a stability selection framework to identify the most relevant and nonredundant symptoms, and derived a list of the seven most common symptoms (including the four symptoms that had previously been listed by the WHO): loss of smell or taste; fever; a new and persistent cough; chills; loss of appetite; muscle aches; and numbness/tingling.

Sam Clemens, who is based at Ipsos MORI, was also involved in the REACT study (Ipsos was the logistics partner for the study). Clemens set out how market research firms supported the response to Covid. The pandemic highlighted the need for high quality and timely data, and the need for research agencies, who are able to use existing products and tools – such as existing online panels – to help set up new studies. Research agencies helped to ensure that the big surveillance studies could actually take place. Ipsos provided face-to-face field work teams that helped ensure a strong response rate. But it wasn't just the big surveillance studies that Ipsos were able to help with. There was a lot of smaller scale research that helped people to make decisions, at a slightly smaller or lower level than the big major decisions that were going on. For example, Ipsos conducted social media research that assessed the effectiveness of public health communications, and conducted a longitudinal study looking at attitudes and behaviours to vaccination. This focused on people who are nervous about vaccines, to try and work out how to address their concerns. Ipsos also performed digital ethnography, producing 'life under lockdown' video diaries that enabled policymakers to hear stories from real people. Market research companies are well set up to provide timely and high quality data of the sort that policymakers need. During the pandemic, they have shown that when the need arises, they produce data extremely quickly.

Tony Dent argued that the CIS did not provide value for money – partly because the data was not made widely available early enough. There are alternative surveys and CIS should only continue, he said, in a reduced form. The ONS subcontracted the work to collect CIS data to an organisation called IQVIA, and the response rate to the survey has only been around 13%. This is despite the fact that there's been a very high incentive for contribution – £50 for each person registering, plus £25 each month that they continue to do testing. The incentive has cost something like 25-30% of the total cost. It's surprising that with such a large incentive, there should be such a poor response rate. Recently the UK Statistics Authority published a [survey on public confidence in official statistics](#) conducted by NatCen. This is a very interesting document because it demonstrates that the public have a lot of confidence in the ONS – confidence has increased in the past two years to 87%. The NatCen survey also had a better response rate (24%), with a lower incentive and shorter survey. It is odd that for a trusted organisation, on an important matter routinely in the news, that the response rate should be so low.

5. **Open data and transparency:**

    How might greater transparency around the data and research used in policy- and decision-making have improved outcomes? What could have been done to improve transparency?

Scott Heald explains that, in Scotland, PHS were very clear with ministers and government officials that if they were going refer to data in public, then that data had to be published and accessible to the public. This was important, so that people could see where information came from. It was also important so that other groups or people can use the data – the UK Covid dashboard used data from Scotland and there was also an individual called [Travelling Tabby who created his own dashboard using PHS data](#). His dashboard was perhaps better than PHS's, **Heald** says. It provides a great argument for open data – Travelling Tabby was able to lift the PHS data every day and bring it into his own dashboard, and that helped get messages out about what was happening.

PHS also had a joint data intelligence forum that was co-chaired by the government and PHS. This helped ensure that organisations were joined up in making changes to reporting – and that all decisions were made by statisticians and epidemiologists. Statisticians had the final say on what was published and when. **Heald** recalls watching one of the First Minister's statements when she was pressed on a particular data set that had not yet been published – her response was that she would have the data at the same time as everybody else, when the statistician said it was ready to be released. Having the final say was very important.

Sheila Bird discussed her experience of chairing the RSS-NHS Test and Trace panel – through which a group of RSS fellows raised epidemiological and data-by-design perspectives with Test and Trace.

Throughout, there was a strong focus on transparency, because analysis of data held in the public interest should be in the public domain. Back in July 2020, the RSS's Covid-19 Task Force differentiated two types of high-risk contact of Covid-infected persons: those living in the same household, versus external close contacts. The task force advocated for record linkage, to discover how many of each type of identified contact tested PCR positive within 14 days. And they recommended two random visits to offer PCR testing to contacts, to record adherence to self-isolation. By September 2020, the panel discussed experimental statistics based on record linkage. Release was not imminent, so **Bird** wrote to ministers in October. There was no response until early 2021, and transparency took considerably longer. The statistical team had done its job – but the results were not in the public domain.

NHS Test and Trace was designed to enable infection to be tracked – but, **Bird** said, statisticians were kept distant from tracking the performance of infection control. Infection control is influenced by the age group of the infected case, and the number, age, and type (within household or external) of their identified contacts. Official statisticians could have shed light on the effectiveness of control measures and it is disappointing that they could not do so.

Bird also reports that the RSS panel asked repeatedly for a map of the NHS Test and Trace data sources, each with specified data fields and how record linkage was operationalised, which is not easy across those data sources. Such a data map is essential for understanding data acquisition and spotting gaps in the data that may need to be remedied ahead of new policy initiatives, eg, in care homes or for interlaboratory comparison. This would have been helpful for identifying issues such as the Immensa problem in September 2021 – where a lab was producing PCR negative results that should have been positive – but it was the public (as discussed at the first RSS Covid evidence session) that alerted the UK Health Security Agency to this issue. Even without PCR lab identifiers, the NHS Test and Trace statistics showed a highly significant decreasing trend over September in the percentage of PCR positive adjudications, which was perverse because the infections were increasing.

Finally, **Bird** says, design and timeliness in monitoring the performance of new policies are handicapped if official statisticians are afforded little lead time. An example of this is the Department for Education's failure to monitor the performance of three assisted lateral flow device tests within the first two weeks of English secondary pupils' return to school in March 2021. The RSS's Covid-19 Task Force warned that due to the low prevalence of infection and only 40% sensitivity of the lateral flow device for asymptomatic testing, half of the lateral flow positives would be negative at PCR adjudication. And indeed they were, but it took another couple of months before we were shown this data – and even then, data acquisition had not been designed to count pupil school days lost.

Denise Lievesley discussed of transparently monitoring progress towards meeting policy goals to deliver vaccines to poorer countries. Covid is a global pandemic. There are two statistical aspects to our international role. The first concerns the measurement of what we have contributed to other nations. One heard the mantra 'no one is safe until everyone is safe' repeatedly. Our government pledged to deliver vaccines to poorer countries but it is not clear that these promises were delivered. Numerical targets are too often treated as if they're an end in themselves and too rarely is there adequate monitoring of them. There is not clear data around how many vaccines the UK donated to other countries and whether this was achieved in a timely way. It was reported that some richer countries dumped vaccines close to their use-by date on countries without adequate mechanisms to use them quickly. Is this true? The regular UNICEF COVID-19 vaccine market dashboard certainly paints a picture of a very uneven world when we should be ashamed of.