HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: Global Disease Outbreaks, HC 136

Wednesday 17 February 2021

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Dawn Butler; Chris Clarkson; Katherine Fletcher; Mark Logan; Carol Monaghan; Graham Stringer; and Zarah Sultana.

Also present: Meg Hillier, Chair of the Public Accounts Committee.

Questions 1970 to 2102

Witnesses

I: Professor Dame Angela McLean, Professor of Mathematical Biology, University of Oxford, and Chief Scientific Adviser for the Ministry of Defence; and Professor Mark Woolhouse, Professor of Infectious Disease Epidemiology, University of Edinburgh.

II: Professor Sir John Bell, Regius Professor of Medicine, University of Oxford; and Dr James Rubin, Professor of Psychology & Emerging Health Risks, King's College London.

III: Dr James Hetherington, Chief Data Science Adviser, Joint Biosecurity Centre; and Dr Johanna Hutchinson, Director for Data and Data Science, Joint Biosecurity Centre.

Examination of witnesses

Witnesses: Professor Dame Angela McLean and Professor Mark Woolhouse.

Q1970 **Chair:** The Science and Technology Committee is today taking evidence on the scientific context in which the decisions on the next steps in handling the pandemic will be made and announced to Parliament by the Prime Minister next week. This follows the extraordinary achievement of vaccinating 15 million of the most vulnerable people in this country against covid.

We have three groups of scientists as witnesses this morning, and I am very pleased to welcome the first of those. Professor Dame Angela McLean is co-chair of the SPI-M modelling sub-group of SAGE, a member of SAGE, a professor of mathematical biology in the department of zoology at the University of Oxford, director of the Institute for Emerging Infections of humans, and Chief Scientific Adviser at the Ministry of Defence. We are delighted to welcome Professor Mark Woolhouse, who also sits on the SPI-M group, and the Scottish Government COVID-19 Advisory Group, and is professor of infectious disease epidemiology at the University of Edinburgh. I thank both of you for appearing before us today.

Perhaps I can start with a question to Dame Angela. As I said a moment ago, the Prime Minister is going to make a statement next week on the next steps. Would you give us the scientific context? What should be the main criteria to govern the release from lockdown, from a scientific perspective?

Professor Dame Angela McLean: From a scientific perspective, I think all of us—scientists and non-scientists—are agreed that we do not want another big wave of infection, and all of us therefore want to balance the unlocking of society with the continued roll-out of the vaccines that have been so brilliantly acquired for us. I would say that is the major scientific issue: how fast can we do those two things in order to be as sure as we can that we do not get another big wave?

Q1971 **Chair:** Thank you. Do you have a clear view of the objective of the current range of non-pharmaceutical interventions—in other words, the lockdown measures?

Professor Dame Angela McLean: Yes, I would say that at the moment our objective is to keep the R number below 1, so that each infected person infects fewer than one other person, so that overall, the numbers of infections and then cases, hospitalisations and deaths are falling. I think that that is our clear objective at the moment.

Q1972 **Chair:** So, in terms of contemplating the criteria, the triggers, for reversing out of that, does it follow that the impact on the R number, or the performance of the R number, is the key?

Professor Dame Angela McLean: As soon as you get an R number that is bigger than 1 for a long time, you will start to have an exponentially increasing number of cases. I think we are all absolutely delighted at the

way the vaccine roll-out has gone, but there are still a lot of people in the country who have not been vaccinated and not had covid yet, so there are still a lot of people who could catch it. So we would definitely not want to have a long time with R a lot bigger than 1.

Q1973 **Chair:** Do you have a view—again, from your scientific discussions—on whether the requirement is that R is just less than 1, so 0.99, or is there a level of R that gives you confidence that we could proceed with regard to lockdowns?

Professor Dame Angela McLean: Actually, I think the timing is probably a more important issue. It's how many of the people who are at more risk—that's a mixture of older people and people with underlying conditions—have been vaccinated before we do more unlocking. The idea that we can manage things so that we can keep R at 0.99 is incorrect. Fundamentally, roughly speaking, we can have R a fair bit less than 1 or a bit more than 1, and sometimes much too much more than 1. We do not have some beautiful machine that we can tune in that way.

The important issue is to watch very closely what is happening, so that if infections start to increase, we detect that—we have beautiful community surveys that will detect it for us—and we do everything we can to decide, from what we observe in terms of infections, whether it is a good moment to take another step in unlocking, say. This is a mantra that I think you have already heard, which is: let's use data, not dates.

I am not going to say, "It would be fine if R was 1.1," or something like that. The important thing is that we watch what is happening in the real world and do our best to make judgments, probably in real time, about, "Is this going too fast now? Do we need to pause for a while before we take the next step?" It has been stated pretty clearly that each step should be irrevocable, and that means we have to be extremely careful before we add another unlocking on to something we have already done.

Q1974 **Chair:** Dame Angela, you did not mention the impact on the NHS, yet the current lockdown restrictions were brought in in January explicitly in recognition of that. The alert level was moved to level 5, "meaning that if action is not taken, NHS capacity may be overwhelmed within 21 days." We know that at this point, thanks to the level of vaccination, groups accounting for 88% of deaths and 55% of hospitalisations have been protected, at least through a first dose. Does that mean that we can now safely start to remove some of these restrictions?

Professor Dame Angela McLean: Certainly I would count hospital occupancy as one of the things we should be watching as we undo restrictions. The thing that was really startling for me when I first saw calculations about vaccine impact was the calculations about just how many people are left unprotected, because we know we will not be able to vaccinate every single person. Of course the news is fantastic about how many people in the oldest age groups have taken the vaccine, but we will not be able to vaccinate everybody. We know that there are certain groups

in society who are much more hesitant than others to take the vaccine, and the vaccines are fantastic, but they are not perfect.

Even though we are getting this fantastic vaccine roll-out, we know that there will be people in older age groups left unprotected, either because they were not vaccinated or because the vaccine does not give them perfect protection. We need to think really carefully about how those people will be affected if there is a large epidemic among young people who are themselves at less risk. That is the difficult scientific question about balancing ever more vaccination of people versus ever more social activity.

Q1975 **Chair:** Is that a permanent state of affairs? There will always be some people who have not been vaccinated and there is no 100% efficacy in any vaccine; there will always be some people who are liable to be infected. Is the implication that we can never release entirely the lockdown measures?

Professor Dame Angela McLean: I do not think that that is the implication, no. The vaccines are really, really good. There are still things we do not know about them, and the No. 1 thing we do not know about them still is how infectious you are if you catch covid even though you have been vaccinated. We talk about its impact on transmission, and there are two ways the vaccines can impact on transmission. Suppose I got vaccinated and the vaccine did not protect me completely. One thing is, how much does it protect me? Of course, if I do not catch it, I cannot pass it on. The other thing is, if I do catch it, am I just as infectious as I would have been if I had never been vaccinated, or a bit less? That is a difficult thing to measure.

As time goes by, we will get much better estimates of it, but I would say that that is probably the biggest remaining unknown with the vaccines. It will probably be different for different vaccines, and it might be different for different age groups. If that is really high—so if people who are vaccinated, but catch covid anyway are hardly at all infectious—then we might be in a great space, but we do not know that. There are reasons to think it might be a bit smaller but not extremely low; vaccine failures might still be quite infectious. If that is the case, then vaccination alone will not be enough to allow a complete return to how we used to behave.

I think it is quite unlikely that we would return completely to the way that we behaved in, say, February 2020, because there are things that we used to do that I suspect we will not do any more. For example, I suspect that you just will not go to work if you have a respiratory illness.

Q1976 **Chair:** Do you think that that will be mandated or just people changing their behaviour voluntarily, as it were?

Professor Dame Angela McLean: That is an interesting question. To be honest, I think it would be most powerful if it simply became socially unacceptable to go to work with a cough. There are certain illnesses at the moment; you would not go work if you had a tummy upset or something like that. That would be very powerful. Certainly, we will want people not

to be going out if they know they have covid, which will make a big difference to transmission.

Q1977 **Chair:** Perhaps finally to Dame Angela from me: what is the best way to think about the infection risks relative to other risks, such as the loss of education for children and students?

Professor Dame Angela McLean: Well, I am an epidemiologist, so when it comes to making those comparisons, I am on the same footing as the man and woman in the street. Those are incredibly important questions. I think the point that we have got to—where we say that education is actually our top priority after stopping the NHS from collapsing—is a good qualitative statement.

Q1978 **Chair:** You are an epidemiologist, but you sit on SAGE, which brings together the disciplines to give expert advice to the Government on this. How do you balance those considerations, including others such as impact on mental health? How does that happen in SAGE?

Professor Dame Angela McLean: First, I think that the balance on things other than scientific issues is not SAGE's job. Decisions about how you balance the economy and health are ministerial decisions, so we do not do that. Looking at balances between different health harms, the Department of Health did a nice piece of work balancing the four harms.

Very early on, the Chief Medical Officer defined four categories of harm: direct health impact from getting covid; impacts from getting covid if the NHS is functioning very poorly because there are so many people infected; the changes that come about because of other things that cannot be looked after; and mental health impacts. A very careful piece of work has been done, balancing those four. As you can imagine, some of them are much easier to quantify than others.

Q1979 **Chair:** The impact on university students, for example—is that something that SAGE would weigh in the balance, or is it entirely for Ministers?

Professor Dame Angela McLean: In terms of how miserable the students are, I would say that, being a health impact, that is a science issue and would come to SAGE. It is in those four categories of harm. I do not believe that the last time this calculation was done there was very much quantitative information on mental health impacts.

Q1980 **Chair:** Do you think that there will be, in order to inform the decisions that are going to be made?

Professor Dame Angela McLean: We have the information that we have to hand, and we can consider it. Again, I would say that, rather than doing finely balanced calculations on imperfect data—I completely agree with what you are driving at, which is that this is an important part of the decisions about what we do next—but in the piece of work that is being done so far, which was up to December, before the big January wave, the overwhelming health impact is the deaths and morbidity directly from covid infection. Let us not forget how huge that has been.

Q1981 **Chair:** It might not be finely grained, but one would hope that the scientific advice would include an assessment of the balance of impacts to make use of such evidence as is available.

Professor Dame Angela McLean: And it has—

Q1982 **Chair:** That is being provided to Ministers, I hope. Is that assessment of impacts on other measures being provided to Ministers?

Professor Dame Angela McLean: As I say, we have the four harms framework that largely comes out of the DHSC.

Q1983 **Chair:** Thank you. I am sure my colleagues will want to follow up on some of those questions. Perhaps I will ask Professor Woolhouse a couple of brief questions specifically on schools. Do you think they needed to lock down during this January and February lockdown? Was it necessary to include schools, in your estimation?

Professor Woolhouse: There is a mixed view on this in the scientific community. We are all clear that school-age children are at very low risk from this infection. We also have good evidence now that teachers and other school staff are not at any elevated risk from covid-19 compared with other working professions, so the discussion is all about the contribution that schools make to the R number. We have discussed this at length in SPI-M and other committees, and there is a range of views.

If you are of the view that schools make a large contribution to the R number, you are into the territory that Angela just described. I might embellish the comment, if I may, Chair, that Angela made. The way to look at it is that we don't want to get into a race between the R number greater than 1 and vaccinating. That is a very dangerous balance to try and make, which is akin to what Angela was trying to say.

But, that said, the whole point of a vaccination programme is to reduce the number of people who get severely ill, the hospitalisations and deaths, and therefore it does weaken the link between the R number and incidence and the burden on the NHS. So, while Angela is absolutely right that we are constantly trying to find this balance, it is a little easier now because there is more space. The link is weaker between those, and that applies to schools as much as anything else.

I think there is a case, certainly for children under 16, up to 15, that having them in school does not make such a big contribution to the R number that we could not consider lifting it in the reasonably near future. What does the reasonably near future mean? I completely agree that we do not want to be overly focused on dates—not at all. We want to focus on data. But the point I would make about that is that the data are going really well. The vaccination roll-out is exceeding most people's expectations. It's going very well.

Angela made the excellent point about coverage, particularly of the most vulnerable groups. That is key. We did not know what that was going to be when the roll-out happened. We did not know what the take-up of the vaccine would be. It is turning out to be very high. It has to be very high

for the reasons that Angela gave, but I think we should aim for the high 90s, literally a record for vaccination coverage. It looks like that is achievable.

The third thing that is very good about the data is the actual performance of the vaccine. As Angela said, the transmission blocking potential is key, but so of course is its actual ability to protect against death and disease and to keep people out of hospital. And all those numbers are looking really good, so my conclusion is that if you are driven by the data and not by dates, right now you should be looking at earlier unlocking because the data are so good.

Q1984 **Chair:** Thank you. So, the data are pointing in the right direction. You have said that "there's never been a surge in cases when schools have reopened, not just in the UK but across Europe." Is that still the case, from your scrutiny of the evidence?

Professor Woolhouse: Absolutely it is the case. One of the stated reasons for keeping schools closed was to avoid some surge in cases when they opened, but the surge in cases has never happened, as I say, across western Europe. I can illustrate this very well. There was a different prediction when the universities went back. A surge in cases was expected, and we saw a surge in cases. We know what a surge in cases looks like. We saw it in September and October in the universities. We have never seen that with schools, and I do not expect to.

We do have to make a distinction though. There is an issue about the oldest children, who are more adult-like in the biology of the virus infection within them. What other countries in Europe have done—Sweden is a good example—is keep their schools open to children up to 15 years old. The older children are more of a challenge, but for many of the children I think the contribution that they are making to the course of this epidemic has been proven by the data not to be that great.

Q1985 **Chair:** So you think that they can, with that caveat, open with confidence. In Scotland, they are beginning to open on Monday, and you are on the Scottish advisory group. Is there any reason why they should not be able to open in England on the same timetable? Is there a difference between Scotland and England in terms of the epidemiology?

Professor Woolhouse: No, the epidemiology has been relatively similar all along. Scotland, as you know, actually opened its schools back in August, so before the rest of the UK did. We have constantly monitored what has happened in Scottish schools, and the blunt truth is that we have not had major covid problems. Of course, we have had outbreaks. Of course, we have had cases, but I do not think that any of my colleagues in Scotland would interpret this as schools in any way driving the epidemic. It is quite the reverse: they seem to reflect the epidemic around them by having the infection brought into schools.

Q1986 **Zarah Sultana:** My first question is looking at lessons that we have learned during the course of this pandemic, and across the world at what kinds of best practice could be adopted here. In terms of lessons learned

from easing the first and second lockdowns, what can be done differently or what was good, I guess, is my first question. That is to Professor Woolhouse.

Professor Woolhouse: In terms of easing the first lockdown, one of the things that we did not have then was as much confidence in the scientific data as we have now. In my view, we were a little slow to learn from that scientific data and I will give you two examples. One we have already had: actually, schools were not making a big contribution and children were safe.

I think there was a lot of uncertainty in the wider community and policy-making circles about that back in April/May, but the evidence was there. My group and many others did systematic reviews of it. Schools were not involved, so I think we probably could have considered reopening schools much sooner in the first lockdown. The other thing, quite clearly, is outdoor activities. Again, there was evidence going back to March and April that this virus does not transmit well outdoors and there has been very, very little evidence of any transmission outdoors happening in the UK. Those two things I think could have been relaxed sooner in the first lockdown.

My own feeling is—sorry, Chair, but I will just do a slight mathematical digression. The value of a lockdown goes down with time, and it goes down because of a phenomenon called exponential decay. You remember the idea of the doubling time—that the epidemic might be doubling in size when it is going up. Exactly the same thing happens when it is going down, so if, for example—I am not suggesting this as a policy—we had planned a very long lockdown to try to drive incidence as low as possible and we had a halving time of, let's say, two weeks, which is about where we were in the first lockdown, you get half the public health benefit of that six-month lockdown in the first two weeks. The next two weeks is only half the benefit again, and then half the benefit again, so the actual public health benefit you are getting from lockdown diminishes over time, if the R number is constant.

I think that changes your view of how soon you should be trying to get in lockdown, because it becomes ever harder to justify in terms of the public health benefit you are getting. I think that lesson right now is underlined by the fact that we now have a much weaker link between the R number and incidence and who is going to end up in hospital dying. That lesson is even more clear.

The third thing about this is that we have heard many times that when the incidence is going up the number of hospitalisations and deaths is, as the expression goes, baked into the system. That is quite correct, and I think my colleagues at SPI-M have been absolutely excellent in bringing it to the attention of Ministers that you have to act early because the long-term effects are already baked into the system. I think that is tremendously important. It is the same on the way down.

The decline in hospitalisations and deaths that we are seeing now is baked into the system in exactly the same way, so we can have confidence in the short term that those are going to continue to fall, and the latest SPI-M projections say exactly that. For those reasons, I think we can be more confident that we can move out of lockdown swifter than we could have done out of the first one.

Q1987 **Zarah Sultana:** I would just like to expand on the point around schools. Of course, schools were seen as a vector of transmission by some within the scientific community, and while they might not lead to an immediate surge in cases, that transmission could feed into the community. It could affect vulnerable teachers and teaching staff, as well as vulnerable children themselves. Is that not good enough reason to be more cautious when it comes to reopening schools?

Professor Woolhouse: No, that is absolutely right. Any activity that you open up is going to contribute to that, including having people at work or whatever. It is not a surge: it is a general contribution to the rate of infection—the transmission rate—within the community, and as I have just said, all those signs are pointing down.

I absolutely agree with Angela that we do not want an extended period with a R number greater than 1, but it is not clear at this point in time—I am not saying it is not, but it is not clear at this point in time—how much of a contribution schools will make to that.

The big concerns about a large contribution to the R number come more from the modelling side than from the data side, and there have been a couple of reports published this week that have conflicting views on this. When the modelling is uncertain, I have to say that although I am a modeller, my instinct is to go with the data, and the data do suggest that there is not a huge impact. However, you are quite right: there is not no impact at all, and that is absolutely something that Ministers have to be aware of and take cognisance of.

Zarah Sultana: Thank you, Professor Woolhouse. Dame Angela, would you like to add anything to that?

Professor Dame Angela McLean: The first thing I would point out is that we need to think both about the direction in which things are changing and the level at which they stand. Professor Woolhouse is correct that things are all moving in the right direction: the number of infections is falling, as are the numbers of cases, hospitalisations and deaths.

However, we still stand at a high number of infections. There were, I think, about 20,000 people in hospital earlier this week; by comparison, in early May, there were about 15,000 people in hospital. There are still a lot of people in hospital, and the most recent estimate of prevalence—that is when we go to these households and take swabs from everybody in the household on a repeated basis; it is a really beautiful study design, because it is the same people every week or every few weeks, so they do not have to worry about "Oh, do you want to get a swab this week?"—is

still standing above 1%, and that is high. That is 1% of people getting infected in the last week or so, so I share everybody's optimism about how fantastic these vaccines are, but I would say we need to be optimistic and cautious. There are still a lot of infected people out there.

The thing I would add to that is that the question of the infectiveness of children has been contentious. We have very good data—again, from this beautiful household survey—about how likely children are to bring infection into their home; and particularly when schools are open, children are quite often the first person infected in a household. I think I would agree with you that schools do not have to be a massive driving force of the epidemic to nevertheless play a role in the epidemic.

Q1988 **Zarah Sultana:** Do either of the panellists think that we eased the first and second lockdowns too early? Could you give a yes or no answer, and then maybe you will want to expand on that?

Professor Dame Angela McLean: I would have said that the thing we learned from the easing of the first lockdown was that caution was our friend. We did actually ease it pretty slowly, and I would say that things went very well. Numbers started to increase through August, but really very slowly, and it was only in September that numbers started to increase quite quickly, so from May until September, I would give a big tick and say that that was well managed.

In November, we were hit with that new variant. We would all have said, "One day, there might be a new variant and it might be quite a lot more infectious." With hindsight, we came out of the November lockdown too early, but that was really because of the new variant. I think that would have been very difficult to foresee.

Q1989 **Zarah Sultana:** Thank you. Professor John Edmunds told our joint inquiry with the Health and Social Care Committee in October that the three-tier system logically led to "a high level of incidence everywhere". Do you agree with this assessment of the tier system? If so, what were the major drawbacks of the strategy?

Professor Woolhouse: Yes, I do. We can look at that retrospectively and decide whether it was a good idea at the time. I guess the question is whether we are considering going back into a tier system as we come out of lockdown.

If we are, I would say there is some very important additional data to throw into the mix, which is the vaccine roll-out in any given area and the crucial variable of coverage, and especially the coverage in the most vulnerable. For the first 15 million that we are rolling out, if the vaccine is effective in that group and the coverage is high, that will really bring deaths down. The next 15 million, which brings you down to 50 years and over, should do the same for hospitalisations. So once both those sets of 15 million are vaccinated, that should really reduce the pressure we see on the NHS at that point in time. But that may vary from region to region and city to city, and that does need to be taken into account. If there are areas where the coverage is lagging behind and too many of these most

vulnerable groups are still unvaccinated, those would be very important criteria on what it is possible to relax in a given area.

Chair: Thank you. Zarah, perhaps a last one to Dame Angela.

Q1990 **Zarah Sultana:** Do you think the tier system was effective? If we are going back to a tier system, what can we do differently?

Professor Dame Angela McLean: I would say it was the way we used the tier system. What we did with the tier system was we waited until prevalence—the number of people in a place[1]—was high before putting it into a more restrictive tier. We should have said, "Ah, look, in this part of the country the number of infections is starting to grow"—we have a rather exquisite tool for measuring that—and put it into a higher tier while its prevalence was still low.

I can see why that is politically difficult, but it goes back to the issue that we are trying to manage a system with the potential for exponential growth and rather long delays between when we take an action and when that action has an effect—in particular on hospitalisations, which is the thing we are worried about. In those circumstances, you do need to be cautious. Personally, I think it was the way we used the tier system that we need to do differently this time, which is to use the tiers to act when prevalence is low but growing.

Zarah Sultana: Thank you.

Q1991 **Chair:** That links to what Professor Woolhouse described as his mathematical digression, which is essentially that it is more important to act to early than to act long with restrictions. Is that a fair summary?

Professor Woolhouse: That is absolutely right, in my view—but when I say early, I do mean very, very early. Angela quite correctly said that if you get any signs of an increase in an area, the moment you are confident that that is the true trend, you should act. My assessment is that the earlier you act, the less drastic you have to act, and if you can come out, you can come out earlier as well. I absolutely agree that early action is crucial.

Chair: Very good, thank you. Dawn Butler has a question of clarification.

Q1992 **Dawn Butler:** Thank you both for coming in today. Professor Woolhouse, Professor McLean said that children are often the first to bring the virus into the household. How will you monitor and model data for infection of the virus via children?

Professor Woolhouse: Angela will correct me if I have misremembered this study, but I think it was carried out over a period when there were restrictions in place—possibly even lockdown—and children were at school. They were almost one of the very few segments of the population that was

[1] Witness clarification: When referring to the prevalence and the number of people I was referring to prevalence and the number of infected people.

behaving normally, so it is not at all surprising that there were higher levels of infection among children at that time.

That does not mean that they are driving the epidemic. It does not mean that if you open schools now, there will be a surge in cases. It simply means that that was the state of the epidemic at the time. We saw that in the data. Prevalence studies showed that there were higher levels of infection in older-aged school children and young adults than there were in others. Again, that is not surprising because the children were in school and—compared with the rest of us—behaving relatively normally.

Q1993 **Dawn Butler:** You said earlier that children are not vectors of the virus. We know that children can catch and spread covid. Are you specifically monitoring this? When children go into households, especially multi-generational households, surely there is a huge risk.

Professor Woolhouse: There is. I haven't personally done work on multi-generational households. In Scotland—I don't know about England—it is actually very hard to get data on multi-generational households. There may be more data elsewhere.

What I would say about multi-generational households is that if you want to protect somebody in that household—I completely agree with that—and if that is a reason to keep the children in that household away from school, that needs a lot of talking about. If that is a reason to close the entire neighbourhood school, that needs a lot more talking about. If it is, it also means that everyone else in that households should be thinking about protecting the multi-generational element of it.

It is not just children who bring infection into households—of course it's not—so I don't think that argument, correct though it is, applies just to schoolchildren. It applies to how you protect vulnerable people in multi-generational households, and indeed elsewhere, more generally.

Q1994 **Dawn Butler:** Are you going to model the data?

Professor Woolhouse: In my group, no, we don't do that, but Public Health Scotland have been looking at that and other groups in SPI-M look at that. Of course, we will continue to keep you updated on what those studies show, as Angela and I have done.

Dawn Butler: Professor McLean wanted to come in, I think. I saw her raise her hand.

Chair: We will go to Dame Angela on that, and then we will go to Graham.

Professor Dame Angela McLean: I wanted to talk to you again about this beautiful thing called the ONS household survey. It is the survey that swabs everybody in a home, which I was just talking about. Children are an excess risk to bring infection into the home, both when society is in lockdown and when it is not. This is not about children being the only people who are outside the home. That data is very beautifully modelled by colleagues on SPI-M, who keep an eye exactly on this.

I want to make one thing very clear. I think Mark and I disagree about the role of children in the epidemic. I think we would probably both agree that schools need to be open. I would say that schools need to be open with caution about what is happening with infection there, and I am sure Mark would agree. It is not that we end up with a different conclusion; we just get to it a different way.

Q1995 **Dawn Butler:** Thank you. I understand that. What can we do to make schools as safe as possible when they open?

Professor Dame Angela McLean: Keep infection down in the rest of the community.

Q1996 **Graham Stringer:** Professor Woolhouse, I agree with you that it is better to look at the data and the evidence, rather than modelling. You said that there was no elevated risk for teachers. Are there any statistical comparisons of teachers' death rates or morbidity rates, compared with similar cohorts? I have seen stats for shopworkers that say that women shopworkers are 65% more likely to die than their comparable cohorts, and for men it is 75%. Are there statistics like that for teachers?

In terms of real evidence, just before the first lockdown there was a large horseracing meeting at Cheltenham. Is there any evidence that that led to significantly more infection? You said, Professor Woolhouse, that you thought—I can't remember your exact phrase—that the threat of infection from outdoor events was exaggerated.

Professor Woolhouse: No, I did not say "exaggerated"; I said that there was very little evidence of outdoor transmission occurring. Mass gatherings are absolutely a special case for all sorts of reasons, even outdoors. They do not involve social distancing. They also involve pinch points like travel, refreshment facilities and so on. Those are clearly higher-risk than normal outdoor activities.

But, for example, over the summer we were treated to all the pictures on the television and in the news of crowded beaches, and there was an outcry about this. There were no outbreaks linked to crowded beaches. There has never been a covid-19 outbreak linked to a beach ever, anywhere in the world, to the best of my knowledge.

We have to understand where the risks are and are not, so that we can do as much as possible safely without overcompensating. I have forgotten the first half of your question; I am sorry.

Q1997 **Graham Stringer:** It was about whether teachers who have taught in schools are more likely to be infected.

Professor Woolhouse: Public Health England did a very nice study of this. They looked at a range of professions. I cannot give you the full list off hand, but they highlighted teachers. Secondary school teachers were somewhere in the middle ranking, and primary school teachers were somewhere in the bottom 50%, so there was no evidence of elevated risk to teachers.

Q1998 **Graham Stringer:** Finally, was there any evidence after that large horse racing meeting that it led to greater infection in the community?

Professor Woolhouse: I do not know so. At that stage, I think it would have been quite difficult to trace. I have not seen that, so I should not comment.

Graham Stringer: Thank you very much.

Q1999 **Chris Clarkson:** Thank you to the witnesses. My first question is for both of you. It has been suggested by Professor Chris Whitty that we might have to start moving towards a situation where we are effectively living with covid, a bit like we do with flu. If that is the case, what sort of assessment do we need to make of acceptable risks, rates of death and so forth before we devise a strategy around that?

Professor Dame Angela McLean: Other infectious diseases that we put up with are probably a reasonably good starting point. I think it is reasonable to say, "Let's not have covid winters that are any worse than bad flu winters," but bad flu winters can be quite bad. I will be honest with you. One of the things we have cried out for again and again is this: could somebody in a position of political power tell us what is an acceptable number of infections?

In 2020, when it was all so difficult and the number of infections and deaths was so high, perhaps it was understandable that nobody would say that. But I think I am agreeing with your question: going into the future, we do need to decide what level we feel is acceptable, and then we can manage our lives with that in mind.

Assuming that we are going to keep on doing at least some kind of community testing, we do get warning. It takes a couple of weeks for somebody to need to be admitted to hospital, so if we know how many people are getting infected in the community, we can tell how many people are going to be going to hospital in two weeks' time. We could have a really sensible discussion about what is acceptable and what we would need to do to avoid breaching what we think is acceptable. But that question of what is acceptable is not a scientific question; that is a question for the whole of society, I would say.

Q2000 **Chris Clarkson:** Thank you, Professor. That is very interesting, because I was going to follow up and ask whether you would say that that is an epidemiological decision or a political one. It sounds like it is somewhere between the two. As grown-ups, we probably need to sit down and decide what that has to look like going forward. Professor Woolhouse, do you have anything you would like to add?

Professor Woolhouse: I agree very much with what Angela said. I would add that, whatever the answer is, it is not zero, because if you take the view that no covid death is acceptable or something of that order, you are writing a blank cheque to do any amount of harm by the measures you implement to try to control it. You cannot arrive at a sensible, balanced way of managing such a crisis as this if you load the dice entirely on one

side; you have to take a balanced view of it. Even if you do not want to call it "acceptable risk", it is going to end up being managed in that way, one way or another; it has to be.

Q2001 **Chris Clarkson:** That is really interesting. Thank you, Professor Woolhouse. That brings me to my next question, which is whether we should be looking at a zero-covid strategy, like New Zealand, or whether we need to be a little more pragmatic in how we deal with it, but I think you rather neatly answered that, unless you want to add anything to that.

Professor Woolhouse: I do, because I think it is about being a lot more pragmatic, not a little bit more pragmatic. There has been a lot of talk that the UK should somehow try to be like New Zealand, and some of my colleagues—not on SPI-M, but more broadly—have been claiming that, for example, border closures is a route to be like New Zealand. I point out that the difference between New Zealand and the UK actually happened in February and March last year.

There doesn't appear to be a route to a New Zealand-like position from where the UK is—there certainly was not last year—because no country in the UK's position got anywhere near avoiding a second wave. In fact, almost all had bigger second waves than the first. Every country in the world with half as bad a problem as the UK did not get anywhere near avoiding a second wave. Every country with a tenth the size of the problem of the UK did not get anywhere near avoiding a second wave. There is no route to that, or there was not last year.

It remains to be seen how good the vaccines are and whether they can be used as a tool to head off in that direction. We simply do not know that for sure now. I would guess it is a long shot. We should not completely rule it out in the long term, but as part of a short-term, pragmatic approach? No. We need to learn to live with this virus, as we needed to do from the outset, in my view.

Q2002 **Aaron Bell:** I thank both our witnesses for their time today. I want to ask a bit more about the vaccination programme, but before I do that, could I just ask what your understanding is, and what the modelling understanding is, of the seasonality of the virus?

People have often said that there is some seasonal element to it, but that does not seem to be particularly well modelled, and models out recently seem to predict significant second waves over the summer months, which I find a little surprising, based on the experience both here and in the southern hemisphere.

Professor Dame Angela McLean: While there are so many people who can catch it, we might not expect to see seasonality that would become very important later on once it is an endemic infection. I would expect it to become a seasonal infection. My guess is that it will become one of those horrible things that hits us in the new year. That does not mean that we cannot have a summer wave. I think the reason we did not have a

summer wave last summer was mostly because of the interventions we put in place.

It is pretty difficult with something this new to measure how big the seasonal effect is. There are two things. First of all, we are still collecting epidemiology. Of course, all the epidemiology we see is with many different, rapidly changing interventions in place. You can imagine that that makes it really difficult to untangle what changed because it was a different season and what changed because the way people were mixing was different. It is currently summer in South Africa, where they are just coming to the end of a horrible second wave. I think that tells us that it is possible to have a horrible wave in the summer.

Q2003 **Aaron Bell:** Professor Woolhouse, do you have anything to add on seasonality from your angle?

Professor Woolhouse: Yes. It is an important question. I agree with everything Angela says. A paper was actually just published looking at the effect of seasonality and climate in America. It is the middle ground between your question and Angela's answer. According to the paper, the non-pharmaceutical interventions overwhelmingly drive the epidemic there, but climate does play some role. I agree with Angela—I do not think we are at the point of understanding enough about how big that role is to really rely on it to drive policy. I am optimistic, like you, I think, about the summer, but I do not see the quality of evidence there to allow it to drive policy at this stage.

Q2004 **Aaron Bell:** On the vaccine programme, you both set out that it is obviously the answer, so much as there is an answer. What do we currently understand about the impact that the vaccination programme is having so far on the number of cases in the UK and the pressures on the NHS? A lot of people are trying to read little lines into data about the rate of over-85s hospitalisations and so on. What is your best understanding of the current position, rather than where we hope to be in a few weeks' time?

Professor Woolhouse: There are signs in the survey data of antibodies that we can pick up. The over-80s are now showing collective signs of having antibody protection from this. Some have argued that we are beginning to see the signs of a decrease in the death rate—and it is the death rate that will come down first because of the way the priorities have been aligned. The group that we are concentrating on, the first 15 million, are those most likely to die. We will not see the biggest impact on the hospitalisation rate until we have gone all the way down to the 50-year-olds.

Although all of that will have some impact on transmission, even in Israel, which is the country most far ahead with the vaccination programme, I think they are still discussing whether or not they can see an impact on transmission. One or two papers have come out where they think that they can start to see that, but it is a difficult thing to get a handle on. It

will be deaths first and hospitalisations next. In the slightly longer term, we will have a handle on whether we are impacting on transmission.

Q2005 **Aaron Bell:** We are trying to look for a second-order effect, aren't we, because those are falling anyway because of lockdown? We are then trying to pick out a second effect overlaid on top of that within certain groups.

Professor Woolhouse: Yes. Just to give you a hint of the sort of data, my group does a weekly monitoring of the rate of growth of the epidemic in Scotland, and we have just begun to see a signal where cases—not hospitalisations and deaths—are not growing so fast in the over-75s. For the first time, in the last week or two, we have just seen a signal. I would want to wait a little longer to be confident that that was a strong signal, but there is a hint.

Q2006 **Aaron Bell:** Professor McLean, let me ask you the same question about what we currently understand, and what data you might have seen.

Professor Dame Angela McLean: The place we look is the proportion of deaths in the over-80s. That is the first place where we would expect to see a sign. In that raw data, the straight proportion—because of course that factors out the point that you just made about how all cases are falling—if we just take all the deaths and say, "How many of those are in the over-85s?" has not budged yet. We are expecting it to budge any minute now.

Aaron Bell: You are still on tenterhooks, then.

Professor Dame Angela McLean: You have no idea.

Q2007 **Aaron Bell:** Finally, you both talked about the need for the vaccine programme to get the greatest possible coverage, and obviously the Government are doing a lot to try to reach people who are reticent. I also mentioned earlier those models.

There was a Warwick model that suggested that we could have 2,000 deaths a day by August if we got the vaccination programme out but there were still people who were not accepting it and we took off all the NPIs. Likewise, there was an Imperial model reported on ITV yesterday forecasting a significant summer wave of deaths. Isn't the logic of those models that covid will get us all eventually, so the key thing is to get the vaccine programme out there and hopefully get that effect on transmission, so that we get the herd immunity that protects those people that the vaccines cannot reach?

Professor Dame Angela McLean: I think those of us who use models, as sensibly as we can, are worried that there could be a situation where with vaccines alone we will not get to herd immunity, so there will be another wave. When that happens is, I think, almost impossible to predict, because of the issues about seasonality, and we do not know how people will respond to unlocking. I think we can say very clearly, "Don't unlock too fast," because if you unlock a lot while a lot of the most vulnerable are still unvaccinated, genuinely we risk disaster, frankly.

Q2008 **Aaron Bell:** The vaccination models and so on often talk about the efficacy of the vaccine, whether it is 90% or 70% or whatever, but it is my understanding that all the vaccines are nearly 100% effective against death and very effective against severe illness, so the waves that you are hypothecating would be solely among the unvaccinated. I am not minimising that; I am just getting some clarity.

Professor Dame Angela McLean: Yes, a wave among the unvaccinated could be very bad. As we all know, there are certain groups in society who are particularly hesitant to take the vaccine, and some of those groups are groups that we know seem to suffer disproportionately severe disease when infected. That set of people is a real worry, because none of us wants a situation where there is a wave of infection, mostly among people who are not terribly ill, but that spills over into deaths and very serious illness that is very focused on some bits of society.

Professor Woolhouse: My group has modelled this too, and I take the spirit of your question, because, as I said right at the beginning of this session, the numbers are better than we expected. When we run those simulations, we are still seeing peaks, and peaks that we should avoid, but they are not of the scale that was feasible – not that were realistic scenarios – a few weeks ago. So the numbers have improved, and the models should reflect that. Ours certainly do, and I am sure the other ones will as well.

As I said at the beginning of this session, I really do not think we should ignore good news. I think that does change our thinking. It may not change it enough to translate into a huge change of policy, but it absolutely has to be something to consider. We cannot go with our old, more pessimistic scenarios when the numbers are demonstrably better.

Q2009 **Aaron Bell:** Finally, on that point I just made to Professor McLean, if it is going to be a wave among the unvaccinated that we are worried about, should we not be getting that message out more clearly? I do not want to frighten people, but that is another reason for getting the vaccine. The concern at the moment is that people are not taking the vaccine. If that is the risk and the vaccine gives you basically 100% protection against death, more or less, should we not be getting that message out more clearly?

Professor Woolhouse: Absolutely, I have been banging that drum—

Chair: I think Professor McLean was going to come in on that.

Professor Dame Angela McLean: Absolutely. We must get out the message that it is quite likely that there will be more infections. Let us hope it is a wave of infections with very few hospitalisations. People who are unvaccinated and in vulnerable age groups or vulnerable for other reasons will be at high risk. We must get the message out, and we shouldn't say that the vaccine protects 100%. With the large populations that are in these high-risk groups, 94% or 95% is different from 100%. I am not being gloomy; I am being cautious. I think it is correct to be

optimistic and cautious. In 2020, we got into real trouble on several occasions when we were not cautious enough.

Q2010 **Carol Monaghan:** Professor Woolhouse, can I take you back to something you said earlier? You said that there was no surge when schools returned back in August in Scotland and September in England. The difficulty is that you are not really comparing like with like. At that point, we were not in lockdown and businesses were open.

At the moment, when schools go back, we are looking at increased opportunities for transmission. Is it true to say that we need to be very cautious about how we open schools in a way that we possibly were not thinking about back in August and September last year?

Professor Woolhouse: I think Angela has correctly underlined the need for caution in everything that we open up, but I do not think we should also plan and assume that there will be more of an effect than we have seen in the past.

There is one caveat that I think is important, and it particularly applies to Scotland, where we have been looking closely at the data, and that is the role of the new variant. It is clear in Scotland that although we have suppressed infection very well, that suppression is less evident for the new variant, and that brings us a little bit closer to the threshold that you are worried about, where opening schools may just push us over the R=1 threshold.

I come back to what I said at the beginning: the link between the R number, incidence and hospitalisation deaths is now weaker, and it will be much weaker than it was, because of the roll-out of the vaccination programme. Even if the vaccine is not 100% effective, it will still—

Q2011 **Carol Monaghan:** To be clear, you have talked about children, particularly younger children, being very low risk, but the difficulty is not necessarily the children, but increased interactions with parents and increased use of public transport.

It is also about parents who, once they have their children in school, may actually return to work themselves rather than working from home. Are you anticipating an increase in the R value as a result of these particular instances?

Professor Woolhouse: That is quite correct—a very legitimate concern—and it is of course very difficult to tease out. If there is a concern about that among policy makers, I don't know how many parents would sacrifice the opportunity to have their children back at school for the sake of socialising at the school gates. It may be that very clear guidance is needed about what the parents should do, and let the children go back to school without carrying that added risk on their shoulders.

Carol Monaghan: Professor McLean, do you want to come in on that?

Professor Dame Angela McLean: I completely agree with Mark that vaccination changes the relationship between infections and

hospitalisations; I just wouldn't use the word "weaker". We absolutely expect what we would call the infection-hospitalisation rate to be very different in a vaccinated population. I personally would not use the word "weaker". It is still the case that some people who get infected, particularly those in the higher risk groups, will end up in hospital.

Q2012 **Carol Monaghan:** Professor Woolhouse, you have mentioned the new variants in schools. What kinds of models have been drawn up at the moment, and how do we think the new variants might differ in terms of infection rates within schools or beyond schools?

Professor Woolhouse: I have not seen data on new variants in schools specifically. Back in December, there were some data on the prevalence of the new variant in different age groups. After a little uncertainty at the beginning, the proportion of the infections that were of the new variant across the different age groups settled down to be fairly even, so I don't think there is a special role for schools with the new variant. My view of schools is that, as much as anything, they get caught up in what is going on in the community, not the other way round.

Q2013 **Carol Monaghan:** That seems to be what the evidence is showing at the moment, so thank you for that. Dame Angela, how carefully are you watching what is happening in Scotland next week, when our youngest pupils—the primary one to threes—return to school?

Professor Dame Angela McLean: Very carefully, but we would not expect to see a signal in that first week; it will be as the weeks go by. I know I am a bit of a cracked record on how fantastic the ONS household survey is, but it runs in Scotland and all of us will be watching incredibly carefully what happens to infection rates in school-age children as different parts of the country have their children go back to school. My personal opinion is that that is the right thing to do.

Q2014 **Carol Monaghan:** Are you talking four weeks' time, for when we might have a better idea?

Professor Dame Angela McLean: The reason we say act on data not dates, is so that there is time to understand the impact of one step before you take the next. We very much hope that there will be time to understand the impact of school returns in our various nations over the weeks that follow those returns, and we won't see anything for a week or two. If you have a class full of children where no one is infected, you cannot have a signal of the role of mixing in schools. It is only if it gets covid at the school.

Q2015 **Carol Monaghan:** Scotland is returning in a very limited way, with a very cautious approach. Is this the right way, or should we be getting everybody back to school as soon as possible?

Professor Dame Angela McLean: That's such a balance of harms question. Epidemiologically, yes, it is better to go cautiously. As I said earlier, I think Mark and I would both agree that children need to be back at school as soon as is sensible. I have to admit that I am more interested in a long gap after the children go back to school before any other step is

taken, so that we can see what happens, than I am in who goes back first. That is my concern.

Q2016 **Carol Monaghan:** May I move on to universities? I will stick with you, Dame Angela. In January, SAGE said that a staggered return of university students would have a limited effect on transmission. I have two questions: how limited an effect; and how should universities look at reopening?

Professor Dame Angela McLean: Wow. I don't have exactly that number in front of me. If you would like, I can go away and dig that paper out. If I remember rightly from that very beautiful analysis, the sense was that there were other things; there was clearly a lot of variability in what happened in different universities, and some were much worse hit than others.

I think there was a sense that a better thing would be to learn from the universities that seemed to manage to keep the initial bumps that they had rather firmly under control after a couple of weeks—that that would have more impact. I am sorry that I cannot answer that in detail. I would have to go away and re-read that paper.

Q2017 **Carol Monaghan:** Finally, and sticking with you, Dame Angela: SAGE has previously said, "No intervention, other than a complete, pre-emptive closure of borders, or the mandatory quarantine of all visitors upon arrival" can get close to fully preventing the importation of cases or new variants. We have seen in Scotland a mandatory quarantine of all arrivals, and in England we have seen the mandatory quarantine only of arrivals from the so-called red list countries. Is that a sensible approach? Surely we are leaving a loophole where people can come in from countries and bring in infections.

Professor Dame Angela McLean: Yes, and I do not think that it is a loophole in the sense of people doing it deliberately. It is a fallacy to think that we know where the risk of dangerous new variants lies. I point you to the very beautiful study that was done by COG-UK, the big genomics consortium that runs here in the UK. It showed very clearly that this time last year, our initial wave was seeded right across the country from people returning from holidays in Europe; it was not people coming from China. I wish we would learn from that.

Q2018 **Carol Monaghan:** So should we have a mandatory quarantine for all arrivals—if it were up to you?

Professor Dame Angela McLean: I would say that if you're going to have a quarantine, it is a mistake to think you know which countries have the big issues.

Professor Woolhouse: It is very well accepted and understood, not least by the World Health Organisation, that even the measures that you are suggesting, such as quarantine for everyone, delay but do not prevent. That is fairly clear. The question for me, then, is: if the strategy is to try to

delay the arrival of new variants, what is the exit strategy? I have not heard one yet. I am very concerned about that.

I would also point out that these border closures are most unlikely to help us with the problems that we have spent most of this session discussing—the quick unlocking. If they have an impact, it is in the long term because they are supposed to delay rare events. They are not at all for managing the day-to-day spread of the infection, and they will make minimal contribution to that; it will not be detectable. We do have to be very clear about what we expect border closures to achieve, and I really think we need to be clear about how we exit them if we are going to implement them.

Q2019 **Chair:** Thank you. I think Dame Angela wanted to come back briefly, and then we have one final question.

Professor Dame Angela McLean: Very briefly, I think what we are worried about is new variants coming in where our vaccines have much less efficacy. I completely agree with Mark that we might steeple the gates to slow that. Viral evolution happens in the country as well. I would have thought that a much more important thing to focus on is making sure that we can be as ready as possible with new vaccines as we need them; as the virus evolves, we need to be changing our vaccines.

Chair: Graham has a follow-up question before we end this session.

Q2020 **Graham Stringer:** I have a couple of pretty simple questions. Professor Woolhouse, if the Prime Minister had been listening to your contribution earlier, he would be opening up the parks and beaches immediately. Is there a pecking order whereby opening up beaches, parks and open spaces would be the easiest thing to do, and opening up nightclubs would be the last thing to do? Do we have the evidence for shops, pubs, restaurants and schools that would tell us which are the most dangerous for spreading the disease and which have almost zero impact?

Professor Woolhouse: Yes, we do to some extent. There are detailed studies of very fine decisions—for example, whether we should allow people to queue for takeaways—but there simply isn't the granularity in data to make those sorts of policy decisions based on direct evidence. But we do now have a very good understanding, backed up by a lot of science, on when and where this virus transmits, and it transmits best when adults are gathered in a confined space, unventilated, in close proximity, and particularly when there is talking or vocalisations. From that very clear menu of risk, you can identify all sorts of activities that might tick one or more of those boxes and that they will have risks.

On outdoor activities—we have discussed this—there is very little evidence about transmissions. With children not at all. With adults, of course, you can deploy various forms of social distancing to try and reduce an already very low risk. Obviously, things like intimate physical contact outdoors is a risk, so it is not a carte blanche, but you can provide a much safer environment by meeting or carrying out activities outdoors. No question about that.

Q2021 **Graham Stringer:** I think this is best directed to Professor McLean. If our focus is on the R number, are we an international outlier in making the reduction of the R number the objective of our policy?

Professor Dame Angela McLean: I do not know how other countries set their policy. I know that a lot of other countries spent a lot of time looking at the R number. When you want to make the R number less than one, which has often been what we were trying to do, all we are saying is that we are trying to get the numbers of infections to be decreasing. I don't think we are an international outlier in doing that.

Have we used the R number quite a lot? Yes, we have, because it is a way of looking at lots of streams of data at once, rather than relying on just one. It is a way of getting a consensus both across many data streams, and—the way we do it—we also get a consensus among many different research groups. So it is a way of giving a consensus view.

I was thinking about this the other day. I think that has been a useful thing to do because it means we don't spend hours and hours—well, at SPI-M we spend hours, but the country does not spend hours and hours every week or every day saying, "What size is the R number?" I think it is more useful to analyse the data, come up with the consensus number and decide what we are going to do. We have sad examples from other places where we tried to control biological systems. We spent so long arguing about it that terrible things happened while we were arguing. So I would stick up for the R number.

Q2022 **Graham Stringer:** It's just that, to take an extreme example, if you get twice the number of infections the week after you record a number of infections, but all those infections have taken place in a hospital or a care home, the R number isn't very useful for looking at community transmission or what is really happening. That is what lies behind my question. Isn't it better to look in detail at what is happening rather than focus on the R number? I read a paper that said that we were unusual in focusing on the R number. That is what lies behind the question.

Professor Dame Angela McLean: The R number is useful for looking things at some scales, but not all. For example, at the moment the R number across the country is well below one, but there are still pockets of places where the number of infections is increasing. It is a way of taking an average, and some averages are useful but not all.

Q2023 **Chair:** We have talked a lot about social distancing, non-pharmaceutical interventions, as they are known, and vaccination, but we have not talk about test, trace and isolate. I don't propose to do that now, other than perhaps to ask you, Dame Angela, whether the test, trace and isolate system currently making a big impact on the spread of the pandemic.

Professor Dame Angela McLean: I think by their own estimates, they are making a very good impact through the number of people who are isolating after having symptoms and then getting tested. Obviously, that is incredibly important. You will have heard many scientists say again and again how extremely important isolation is, and how important it is as a

society that we set things up so that everybody can isolate when they need to. It's all very well for me to say, "I can isolate," but I get paid to isolate.

Q2024 **Chair:** In September, SAGE said that it was making a negligible impact. What has changed between now and then?

Professor Dame Angela McLean: I think the difference is how much impact it is making over and above the isolation of cases. By Test and Trace's own estimates, 90% of the impact they make is through the isolation of people and cases.

Q2025 **Chair:** You said, "by their own estimates". Has SAGE or the TTI modelling group,[2] that is part of or feeds into SPI-M, made an assessment of Test and Trace's own estimates?

Professor Dame Angela McLean: No, we haven't reviewed what they do. I think the best way to act would be with some data. I think it would be really great if we had regularly published data. Whenever somebody goes to get tested, they ought to be asked, "Have you been contacted by TTI?" so we know what proportion of people who go for a test are doing so because of TTI, and in particular what proportion of people who are infected already knew they were at risk because of TTI, and we would like to know the same thing for people who are hospitalised. That would be the data that would let us check how much impact TTI is having. We all know and said all along that TTI has much more of a chance of having a big impact while the number of infections is low.

Q2026 **Chair:** Has SAGE requested that information?

Professor Dame Angela McLean: We have certainly said that it would be a good thing to measure. I am not sure which of those things TTI actually collects.

Q2027 **Chair:** Should SAGE perhaps be more muscular in asking for things that would help it make decisions that aren't currently available?

Professor Dame Angela McLean: I think that would be a good thing for us to ask for. I suppose we might get told, "Oh, that's operational." I think I might then reply, "Yes, it's operational, but with epidemiological implications, so I feel empowered to ask." But yes, that's a great idea.

Q2028 **Chair:** Do you want to add anything to that, Professor Woolhouse, before we conclude?

Professor Woolhouse: The role of TTI is crucial, so I completely endorse what Angela said. The self-isolation of cases and contacts is at the heart of controlling this epidemic. The extent to which we fail to do that is contributing to the need for other restrictions. There is a direct trade-off through the R number and other things, so it is crucial.

[2] Note from witness: To clarify the "Test, Trace, and Isolate (TTI) modelling group" is an alias for the group of academics and researchers funded by the UKRI/NIHR COVID-19 Rapid Response Rolling Call grant MR/V028618/1. This is an independent academic group and is not officially organised by HMG or officially affiliated to SAGE or SPI-M.

It is hamstrung in two ways, in my view. One is the isolation, and the enforcement of it or adherence to it. Several studies have suggested that that is not perfect, but they seem to give very different views as to what fraction of people are failing to self-isolate. The fraction that goes through the system and fails to self-isolate does seem to be quite small.

So it is the other end, then: what cases are found. There are a number of studies now—my group has done work on this and many other groups have done it too—suggesting that we are actually finding fewer than half the cases that are out there. More than half of them don't get into TTI in the first place. TTI can't be fully effective if we are missing so many cases.

There are a number of explanations for this, and again, there is a lot of work being done on this now. One is that some of the cases are asymptomatic entirely, so people generally do not know they have the infection. That is a good argument for more mass testing, to try to pick those up. REACT did a very nice study published last week, and there is some more work being done by SPI-M, on the fact that there may be some people who do have symptoms but they are the wrong symptoms—they do not trigger in that person's mind the need to report to NHS. That needs looking at. There is a divergence of opinions as to how important that is, but it is certainly playing some sort of role.

And then, it may be—I do not know, because I do not have the data—that some people are just choosing not to go into the TTI system, even though they have recognised symptoms. My medical colleagues have confirmed that they see, anecdotally, instances where people have got very ill but have not gone into the TTI system. TTI has to start with finding the cases in the first place, and this brings us back to testing, and particularly mass testing. That is a weakness in the system at the moment.

Chair: Thank you, Dame Angela and Professor Woolhouse, for your comprehensive evidence this morning. We are extremely grateful. There are decisions made by policymakers, and we understand the difference between scientific advice and policy decisions, but the context of the science is extremely important in this, and you have been very helpful in shedding some light on it. Thank you very much indeed for your evidence.

Examination of witnesses

Witnesses: Professor James Rubin and Professor Sir John Bell.

Q2029 **Chair:** I am pleased to welcome Professor Sir John Bell, who is the Regius Professor of Medicine at the University of Oxford and the Government's life sciences champion, and Dr James Rubin, who is professor of psychology and emerging health risks at King's College London and co-chair of the SPI-B group, which gives behavioural advice to SAGE, but he speaks in a personal capacity today.

I will start with a couple of questions to Sir John. On 9 November, Sarah Montague on the BBC asked you whether we could say with confidence that life should be returning to normal by the spring. You said, "Yes, yes, yes. I'm probably the first guy to say that". That was before any vaccine had been approved. Do you still have that optimism and confidence?

Professor Sir John Bell: There have been a lot of people trying to trip me up over that prediction, including a number of variants and a whole variety of different things that have happened to the virus that have made this a lot more complicated. But I was not a million miles off. I guess it depends whether this is English spring or Canadian spring; I will probably make it over the finish line if we call it Canadian spring.

We are headed towards a world where things are returning gradually back to a much more normal set of affairs. Vaccinations are going extremely well. Numbers are falling. If we are cautious, it will not be completely normal, but things will start to look much more normal by spring.

Q2030 **Chair:** You said that we should be returning to normal; you did not say that we would have achieved perfect normality, to be fair.

Let me ask you briefly about the vaccine. We want to talk about the backdrop to the lifting of lockdown restrictions, but since you have played such a key and magnificent role in securing vaccines with the Vaccine Taskforce and Kate Bingham, would you briefly distil some of the lessons that you draw from that that might have an application in the handling of the rest of the pandemic?

Professor Sir John Bell: It is a really interesting story. In fairness to the UK—and there have been a number of people involved in this, but particularly Kate and her team—the UK is in a unique position globally. The level of vaccination is extraordinary, and much credit to the NHS for getting us there, because it has been a remarkable story.

When I look at the decisions that were taken all the way back to last spring, there are a couple of really key elements to how vaccines have succeeded so well in the UK. One of them is that Kate focused on creating a decision-making body that was clearly led by her. Those of you who know Kate will know that she is a very executive person—she takes decisions, and that is what she does in her career as a venture capitalist. She brought together a very small group of people, mostly from industry and not populated with a lot of civil servants and academics, and they took some very crisp and clear decisions in quick sequence, thoughtfully. They

were given autonomy and accountability for making those decisions, and a budget, and that kind of efficiency in terms of decision making has not been widespread during the course of the pandemic.

I think that if you just look at the nature of the decision-making body and their ability to get on and do things, you can see why by the autumn of 2020, we were in a very unique position globally. We had secured very large volumes of a number of different vaccines to give us backstops if things did not work. We had moved some manufacturers onshore to manufacture—Novavax came onshore to manufacture.

We had a terrific network for clinical trials, all set up so that people could come and trial their vaccines here. It is a really interesting model, and it is one that we should be thinking about for antivirals now, because in the antivirals space, we are not in good shape. Again, I think we need that kind of decision-making group to progress the antiviral discussion in the same way. It is a very key point.

Q2031 **Chair:** Is that being taken up in Government, as far as you are aware?

Professor Sir John Bell: Yes, I think it is. Patrick Vallance and I had a conversation a week ago about this, and I think the idea is to get a very focused group on antivirals, set up clinical trial capabilities, bring manufacturers onshore and test and evaluate antivirals very early, so that we are ready to go with those in case something goes wrong with the vaccine programme.

Q2032 **Chair:** I see. We will go into a bit more detail on this, but what is your headline view on new variants? How worried are you about the new variants that have been revealed?

Professor Sir John Bell: It is a complexity that we have anticipated for a long time, and great credit to the UK for having a genetic sequencing capability that allowed us to identify them—I wouldn't say "early", but allowed us to identify them in a way that other countries, such as the US, could not. The US had no capability of knowing which variants they had. We have done well to get in that place, but what has become clear is that as we do more sequencing, we see more variants.

We are in a world of continual evolution of the virus, and the virus is evolving in two ways. One is that it has moved species, so it is sort of settling into a new species and it is making mutations that make it more effective in humans. Most of the variants we have seen so far represent that kind of adaption to a new species. It is a bit like moving into a new apartment: you know, you are shuffling the sofa around and making sure the TV is in the right place. That is what the virus is doing with most of these mutations. Between now and the end of the year, we will see a number of variants that are driven by immunological selection, largely by the vaccines, and that will add another layer of complexity.

Having said all that, the evidence is that some of these variants do produce quite profound resistance to existing immunity. That existing immunity can come from having a previous infection: we have seen what

we assume to be multiple reinfections in Brazil, and we have also seen that in South Africa, in the trials in the placebo group for people who have previously had the infection, they are not at all resistant to getting the South African strain as a second infection. That is a real issue.

The good news is that it looks like in that context, the vaccines are still able to stop severe disease, which is not perfect, but it is a big step in the right direction. I think we need to be conscious of the new variants and ready to make new vaccines if we need them, but I am pretty clear that our existing vaccines are going to work to some extent to prevent severe disease with all the variants we know about at the moment.

Q2033 **Chair:** Can we defend ourselves against new variants from outside this country coming in, or is it their nature that they will find a way through even the most stringent of defences?

Professor Sir John Bell: There are two things going on, one of which is there will be migration of variants into the country. This is a point I just need to remind people of, in case they have never been there: the UK is not New Zealand. Everyone says, "Ah, New Zealand; it's all terrific," but as I have pointed out before in the media, they have quite a lot of sheep in New Zealand, and they are a million miles from anywhere. If you want to put up border controls, it is a lot easier in New Zealand than it is here. I think the Government have rightly focused on how they can reduce the flow of the virus across borders.

I am reminded of a conversation I had with George Gao, who runs China CDC and is an old student of mine, very early on in the pandemic when they were just getting a grip, in China, on the disease. He pointed out to me that, I think, almost all their outbreaks were due to incoming people travelling in by air and that they were going to try to stop that happening, because they saw that as one of the biggest problems.

But the UK is also not China. We are quite a small country. We are very closely hooked up to Europe. There are people going back and forth. We can do a certain amount of stopping inflow, but that, I think, will be impossible to completely prevent, and we will be generating our own variants onshore. People don't often remember that a number of these variants probably occurred onshore.

Q2034 **Aaron Bell:** Thank you both for your time today. If I may, I will continue with Sir John on the Test and Trace system, which we touched on at the end of our previous session today. Sir John, what role do you think mass testing should play in our long-term strategy for covid-19, with regard to both managing the disease and getting back to normal in terms of what people can do?

Professor Sir John Bell: As you know, I have been pretty closely involved in that. I set out in July to try to work out whether lateral flow tests would be a solution. At that stage, there was a real conundrum, because there was a set of laboratory-based tests but the problem with tests done in laboratories is that there's quite a substantial lag between somebody having a sore throat and getting an answer back. It also means

that you have to get samples into labs, and you have to develop a workflow to handle them.

I had always felt that some kind of self-testing methodology in the form of a pregnancy-style test might actually be the answer to that. And thanks to the team at Porton Down and a couple of colleagues from Oxford, we have been rather assiduously working our way through a large number of lateral flow tests. At the moment, I think, we have about eight or 10 that look like they work really well. We have about 80 that don't work very well, but there are now a number of tests that work well.

We have also been able to demonstrate that—this is a crucial issue that people don't understand—these tests are very good at identifying people who are infectious, not people who have a bit of RNA up their nose or had an infection a week ago and all that stuff. These are people who, on the day they get tested, are infectious. In that regard, the tests are about 90% sensitive and they are 99.9% specific—in other words, you get very few false positives.

We have done studies in universities and in schools; we have done field studies. The field study in Liverpool was a really interesting early experiment as to how this would work. And of course, healthcare workers around England have all got a box of lateral flow tests and they test themselves a couple of times every week, before they go into hospitals, which I think has had a massive effect on the spread of disease in hospitals.

In fact, when I last looked, which was about a month ago, we had detected 25,000 healthcare workers who had an infection up their nose and who chose then not to go into work that day, because had they gone into work, they would have almost certainly given the disease to multiple patients, and you would have had to multiply that number multiple times to tell you how many—*[Inaudible.]* So this is really powerful data, which suggests to me that mass testing using those devices, and using those devices repeatedly—because a couple of times a week is much better than just once a week—could be a very powerful bit of the story as we start to go away from lockdown. As you can see, I'm a bit of an advocate, but I have spent nine months trying to work out how they work, so—

Q2035 **Aaron Bell:** There have been some suggestions in the papers that these could be posted to more or less everybody or that they could be used as a means to get into a sports stadium, for example. Are all of these what you suggest, or is there a particular route that you would like to see them used in?

Professor Sir John Bell: As with all these things, we have to be a little bit cautious. Just to be crystal clear, for most of the things we do in this pandemic, we have no evidence whatsoever. We do stuff because we think it's a good idea, but the truth is that the evidence base is very weak indeed. At least for this we have a pretty strong evidence base about what the numbers should look like. The variant is the behavioural stuff, and I think Professor Rubin could probably help us with that.

What people do behaviourally after they have got a test result is, I think, probably the central issue in this. We have used them most successfully, I have to say, where they have been self-tests but in a semi-supervised environment. There is somebody there to take the results. You have logged the result. You know who has had what test. You know who has had which results. You can make sure that people who are positive do isolate. That is what has largely gone on in the school pilots and in the universities that have used them. I have to say that that works extremely well. It also worked pretty well in Liverpool. Liverpool did not really do supervised self-testing; they really did the tests themselves, but I think you could move to a semi-supervised environment.

If you start posting them out to people, that gets more complicated, because again you do not really have a tracker to know what people are doing, but I think if we had digital tools to capture the results—you could capture the results on your camera, for example—that would go into a database. It would mean that somebody was overseeing the results that people were getting. It does not mean that you could not get your partner to stick a swab up their nose.

Q2036 **Aaron Bell:** Let me bring Professor Rubin in, because you have moved on to the behavioural elements and that is his bailiwick. Professor Rubin, what are your opinions about how a mass testing system could work? What are the incentives, the risks, and the behavioural implications?

Professor Rubin: It obviously has a lot of potential. Behaviourally, I think there are few things that we need to factor in. The Liverpool pilot is really interesting and gives a lot of really useful data on this. As Sir John was saying, that is one thing that we need: more data. We need to understand better how these things work. The thing that caught my eye about the Liverpool data is that, first of all, uptake was not great. The whole population of the city was invited to take part and I think uptake was about 25% of the population. There was obviously something going on there.

Within that there is a bit of nuance as well. Uptake in the most deprived parts of the city was 17%, and uptake in the least deprived was 33%, so you have half the rates in those areas of the city that actually need to benefit most from the technology. I think that is quite telling. It tells us something deeper—a deeper problem about the system as a whole—which is: why do people not want to do this? Sir John was involved in this more than I.

I think the core barrier, which comes out in that report, is actually people not wanting to do the test for fear that, if the test result comes back positive, they need support to self-isolate—their concern being: "I won't have sufficient support to do that. If I can't engage in the behaviour, if the test is positive, there's no point in taking the test at all." That is a crucial part of this. Perhaps we will come back to this later in the session. All of these things will fall apart if we do not support people to engage in the core behaviour that they are all directing people to, which is adhering to self-isolation at the end of it.

The other thing that I would flag up is the issue around what people do if they have a negative test result, because the one thing that we do not want people to do is to assume: "That's fine. I definitely don't have covid, and that means that I can go round to Grandma's house and give her a hug, go and see my mate, or not wash my hands when I get to work today." That also is an issue that needs exploring.

The data from Liverpool are actually reasonably reassuring about that. They asked people who tested negative what they did. I think 17% said that they were more likely to go to the shops, and 7% were more likely to go to work, but I think we need a bit more data to understand properly how people react to the negative test. From my perspective, those are the two things that we need more data on: what people do with the test results in terms of not adhering to the behaviours that we need them to and not self-isolating.

Q2037 **Aaron Bell:** Does it follow that you support the fact that we have reduced the self-isolation period to 10 days, and do you agree with the approach of having regular tests as an alternative to isolation, for contacts rather than people who have had a positive test? Also, on what timescale do you want to see that rolled out?

Professor Rubin: I think the reduction in duration was driven by concerns that people would be less likely to adhere to a longer duration than a shorter duration. I am not sure what the full evidence base for that decision is. I think if you look at the reasons that people give for not being able to adhere to self-isolation, duration does not really crop up as one of the major ones. It could be an issue if longer duration means that your friends and family are less able to support you throughout that isolation period. That could be a factor, but I have not really seen what I would consider a compelling argument to reduce it from 14 days to 10 days—at least, not in a behavioural respect. Sorry, I have forgotten the second part of your question.

Q2038 **Aaron Bell:** The second part was on testing as a way out of isolation, as a contact, using rapid tests on day 2, day 8 or whatever it might be. Do you support that as an alternative to isolation, from a behavioural perspective?

Professor Rubin: It would certainly make things easier for people. It does depend on whether people feel comfortable doing it and whether they are able to use the lateral flow tests properly and understand what they are supposed to do. We have some studies ongoing on that, and the early results are relatively positive in terms of how people are doing it. I do think it should be a choice for people: they should be given the option of doing the test or, if they prefer, self-isolating. And if they prefer to self-isolate, I think they need to have that support package in place to help them do that. But certainly in principle I think it is a good idea.

Q2039 **Aaron Bell:** Finally from me, you mentioned the possible implications of a negative test for undesirable behaviour. Does that apply to the vaccination programme as well? How concerned are you about the impact

of having had either both doses or a single dose of vaccine on people's adherence to NPIs such as self-isolation and social distancing?

Professor Rubin: It is something that we have had a look at. Certainly it is possible that you might see a decline in adherence to some behaviours. The first thing I say is that adherence generally across the board throughout the pandemic has been very good, and everything I say has to be nuanced on that main message.

When you look at survey data about what people say they would do following vaccination, there was one survey out in December in which 29% of people said they would adhere less strictly once they had been vaccinated. The closest analogy we have got at the moment is people who believe they have already had covid and therefore believe they have some kind of immunity already—that is 16% of the adult population of the UK at the moment—and you do see adherence to some behaviours being lower in that group than in others.

Also, Paul Hunter, a colleague, has re-analysed some Israeli data on covid incidence following vaccination and found an interesting spike in incidence of covid in the first eight days following vaccination. There is a range of possible explanations for that. One of them might be that, immediately following vaccination, people start to adhere less to various behaviours because they feel they are protected. Like I say, there are other explanations as well, but it is a possibility, and that would be the one that would worry me the most at the moment. There is some effort going on to communicate with people who have had the vaccination that actually it is not going to kick in for at least two or three weeks and you do still have to be careful. But if anything at the moment, that is the focus of concern for me.

Chair: Thank you. Can I bring Carol in? We will come back to Aaron a bit later in the session.

Q2040 **Carol Monaghan:** Sir John, some evidence suggests that the new Kent virus may be an increased risk for children under 15. Is this going to impact on the opening of schools or other activities that children might be involved in?

Professor Sir John Bell: I am not familiar with that evidence. I think there is an existential issue here about whether we are going to philosophically say, "We're going eliminate the virus completely and then go back to normal," or whether we are going to accept that there will be transmission and viral activity in the population, probably over long periods of time, and we have to reduce harm from that virus in a way that means we stop people from getting seriously sick and we stop people from dying. That is a big question.

It is important to remind everybody that there is no respiratory virus on the planet where you achieve herd immunity and you eliminate it from transmitting—it is true with the betacoronavirus, it is true with RSV and it is true with flu—so we have got to get used to the fact that there is going to be a virus circulating in some populations. With regard to

betacoronaviruses, you only have to go into a nursery in the winter and half the kids have got coronavirus spewing out of their noses. So it is the world we live in, and we are going to have to get used to that.

Q2041 **Carol Monaghan:** Probably not just in the winter in nurseries, to be honest. Considering that when we left lockdown last summer we did not have these new variants that we are aware of, and now we have a number of new variants with increased transmissibility, do we need to look at different measures or possibly emerge from lockdown in a different manner from last time?

Professor Sir John Bell: Again, there is a mammoth lack of evidence as to what is the right way to come out of it. A feature of these emergency situations is that people make decisions and there is no data on which they make them; they just try to make their best judgments. It is hard to judge people on that, because somebody has to make a decision, and that is probably the right thing to do.

You could have argued that the onset of the second wave last autumn was predicted by me and many others in March of 2020. All you had to do was look at the history of pandemics and you could have predicted roughly what was going to happen. Certain things were predictable. Did it come a bit earlier or later, based on people's behaviour in the summer and the speed at which people went to back to schools and universities? What we definitely saw were local flares in the disease. Some of the universities had a terrible problem, because students were living in halls of residence. As the cold weather came, the kids were all together, and that was that.

I think we learned a bit from that, but on whether we could have really made a significant difference by changing that overall pattern of returning kids to schools and universities, I don't think we have any evidence one way or another. To get to the point about degrees of harm, one of the very big harms that is emerging from this epidemic, and that becomes more evident every day, is depriving students of getting a decent education in either the universities or the schools. It is a very big problem, and we have to do everything we can to make sure that that does not go on forever.

Q2042 **Carol Monaghan:** What are the possible mutations in the virus that could hamper the UK's progress in easing restrictions? What should we be looking out for?

Professor Sir John Bell: Here we have quite a good little system going. In honesty, we did a lot of sequencing, which has been hugely helpful. We were not that great at identifying the variants when they were there. The South African variant had been floating around in the database since about October or November before we actually spotted it. We are going to get a lot better at having algorithms that identify variants that could be important. The way you do that is you hook up the genetic sequences to the structural biology of the virus, so that you have the molecular detail of what the surface of the spike protein looks like. That work has been going on at Diamond. It is really important, because you can tell by the nature

of the variations how the surface of the spike protein changes and whether that is likely to impact where the antibodies bind that actually neutralise the virus.

We need to be quick and efficient at doing that, because you can then make some pretty good predictions about whether the variants will have a big or small effect. In fairness, it was that group who really told us that the South African and Brazilian variants were a step more serious than the Kent variant. The Kent variant was likely to be okay and looks like it is okay. I think most immunity is cross-reactive across the Kent variant, but South Africa and Brazil is much more serious. It was they who really pointed that out. We need to get good at that, so that we get that data very quickly.

Q2043 **Carol Monaghan:** What other countries are doing this genomic sequencing?

Professor Sir John Bell: The countries that were doing it before everybody got excited about variants were fourfold. Australia was doing a bit. Denmark was doing a lot. South Africa, interestingly, was doing some, as were we. Interestingly, the US was not doing very much at all. Some of the dramatic differences in the type of disease they had regionally in the US were probably because they had variants and didn't know they had them. We have done well in that space, and it is something we need to continue.

Q2044 **Carol Monaghan:** My final question: do you have access to these variants that are popping up in other countries, or are you able to do the sequencing only for variants that we are seeing here in the UK?

Professor Sir John Bell: One of the things that is happening now is that we are trying to tie together a global network, so that we can get access to everybody's sequences. That is very important, and work is going on—it was going on yesterday—thinking about how you get a cloud database structure, so that people can populate it with their sequences from around the world.

The second thing is that it is really important, once you have a variant, that the structural biologists say to you, "Ooh, that doesn't look so good," like South Africa and Brazil. You can make a virus that is what we call a pseudo virus, which is a virus that has some of the variants in it, but what you really want is the real virus that is circulating in those environments, because they also have multiple other mutations in other bits of the viral genome. That proved to be quite difficult with South Africa and Brazil.

Having said that, those are now very much onshore. The immunology has now been done by Gavin Screaton and others in that setting. We have been able to access them, but we need a better system for shifting new variants around, so that they can be properly studied by the groups that have access to the reagency and need to study them. It is an important part of the puzzle. To be clear, we will need this for years to come, so we might as well just get used to it and get it set up.

Q2045 **Zarah Sultana:** Sir John, I would like to ask a question about your earlier point that it is easier to have border controls in New Zealand. Is that because of how many planes and ferries are travelling into New Zealand? Could it be argued that the UK could have taken a similar border restriction measures, but it was simply a question of political will?

Professor Sir John Bell: Have you ever flown into Auckland, and have you ever flown into Heathrow? You are in a completely different world. I think it is unreasonable to think that the UK is going to look like New Zealand. Does that mean that we might have introduced border controls earlier? We might well have.

As you know, that was discussed even during the first wave. China introduced them to some considerable success. That is a big country—the airport in Shanghai makes Heathrow look like a small regional airport—so there are places that have been able to do this, but again, I hesitate to make retrospective judgments on people. People are trying to make decisions on the hop.

I think it will be challenging to keep all external viruses out of the UK, because people come in on ferries, through the channel tunnel—we are linked up to Europe; we are only 30 miles away. I think it is a very different situation from either Australia or New Zealand. To be clear, New Zealand has not been successful in keeping it out completely: as you know, they had a lockdown last week. I just think it is really hard.

Q2046 **Zarah Sultana:** On fatalities and economic consequences, people obviously look at New Zealand, Vietnam, Taiwan and other countries and make those comparisons. Do you think it is feasible for us to have a zero-covid strategy in the UK?

Professor Sir John Bell: I do not think anybody is going to have a zero-covid strategy—the UK or anybody else. Be very, very, very careful about how you interpret prevalence data in these countries.

For example, India was going to be the big road crash for covid. Their disease is very different from here. The famous epidemic, which should have spread—it has the right ethnic population for severe disease, with a lot of comorbidities, and they have massive populations living very close to each other—it should have been the perfect storm of an epidemic, but it isn't. Their epidemic has essentially vaporised before our eyes.

Rwanda, for example, had a massive covid peak three weeks ago. It has completely disappeared without social distancing or lockdowns or anything—it has just gone away. There are lots of things that we do not know about this virus, and one has to be very careful in assuming that, because Vietnam has not had a massive death rate, they have been doing something clever that we have not been doing, because the reality is that I do not think there is evidence to support that view.

Vietnam, incidentally—this is an interesting point—is very close to the heart of the world's major crossroads for bats. They have more species of bat in north Vietnam than in any other place in the world. There is an

interesting hypothesis that lots of people in Vietnam may have cellular immunity to SARS-like covid viruses, which makes them relatively immunologically resistant to the disease. We do not know things like that, so I think it is very difficult to beat ourselves up too badly. Could we have done things better? Of course we could. I am not pretending that this has been a perfect run. However, I also think that comparisons between countries are quite tricky.

Q2047 **Zarah Sultana:** Thank you. My next question is to Professor Rubin. Baroness Harding, in one of our sessions, outlined communication issues and practical limitations such as requiring food and being unable to afford time off from work as reasons for poor compliance with self-isolation.

You previously mentioned inadequate financial support, which makes it difficult for people to take time off work, leading to a reluctance to even take a test in the first place. Would like to expand on what you think would be good to improve adherence within the general public?

Professor Rubin: I do not think there is a single magic bullet to this, because there is not a single reason why people find it difficult to adhere to self-isolation. There is a whole host of different reasons, which means that if we are going to get on top of this, we need a comprehensive package of support, and it is probably going to need to be tailored to different people. When we have looked at the reasons people state for not being able to adhere to self-isolation or what is associated with poor adherence, you do get a range of different things, as you mentioned.

I think you can break it down into four different pots. There is a pot that is all to do with knowledge and motivation: things like people simply not understanding what the rules are, and what they are and are not allowed to do. You still get people who think it is okay to leave your house to go and get some food in if you need to self-isolate, and even a subset of people who think it is okay to go to work as long as you take precautions.

Simply understanding what the rules are is an important part. There are also aspects that seem to crop up around motivation. I am not sure whether that is quite as big as some of the other aspects, but you do see things such as people who believe they have had covid before, and you can quite understand why they think, "Why should I need to quarantine if I have already had covid?" That takes a bit of explanation, and I think that will become an issue when the vaccine starts to roll out as well. People will have that question, and it will need to be answered.

There are practical issues, which is the second set of reasons. Food is certainly an important one: if you do not have enough food in, you are going to need to leave home to get that food, particularly if you cannot get an internet shopping slot or do not have the internet, or if you are not comfortable using the internet to get shopping in. Taking care of others seems to be another big reason among the practicalities. Maybe you look after your neighbour who lives down the road; who else is going to do that if you are self-isolating? Maybe you need to care for livestock, or it might even come down to, "Someone needs to take the dog for a walk for 10

days. Who's going to do that?" Resolving those practical issues involves some sort of proactive outreach to households that are in isolation, to find out what the barriers are and how we can help them through that.

There is a bit around emotion, which is important, and I would include boredom within that, particularly for younger adults—young men—who are being asked to self-isolate. Well, what do you do for 10 days? Something needs to be done to give people something to do. Worries about mental health are another reason why people leave the house, and again, mental health support—phone lines, outreach—is required for that.

Finally, as you said, the financial aspect is quite a big one. To give you a sense of this, there was a really interesting study in *The Lancet* last week looking at the outbreaks in care homes, and looking at data from 9,000 care homes across England. They compared care homes that have had an outbreak of covid with care homes that have not, and one of the things that differentiates them is whether they pay their staff sick leave. Staff who cannot afford to take time off work are coming into work when they have symptoms, and are passing covid on to their clients and other staff members. If people cannot afford to self-isolate, they do not really have an option, so for a large part of this, it is not really whether people want to do it: it is whether they are able to do it.

I would say we need three things to get on top of this. First of all, we need decent data on the levels of adherence to self-isolation. Mark Woolhouse was quite right about that earlier: we really need to understand what the levels actually are.

Secondly, we need some imaginative approaches to develop that comprehensive package of support. And the third thing—I would say this, because I am a researcher—is that we need some research to see whether those packages work or not, and what the most effective way is to tackle this for people. I would see those as the four key elements of it: knowledge and motivation, practical issues, emotional support, and finances. That needs to be done as a comprehensive thing.

Zarah Sultana: Thank you.

Q2048 **Dawn Butler:** Dr John, I want to pick up on what you just said, which was very powerful. The countries where a zero-covid strategy has been undertaken have had that kind of attitude, in terms of stopping people spreading the virus by making sure we look after them and they can stay at home and not be a threat to the wider community. What role do you think clear messaging plays in compliance?

Chair: Who is that to, Dawn?

Dawn Butler: Dr John, or Professor John. Is it Dr John or Professor John?

Professor Sir John Bell: It's okay—it's "JB" to most people. There is a massive communication effort. As James has pointed out, we have done pretty well in getting people to be compliant with things that we have suggested over the course of this epidemic. It requires ongoing and

continuous communication, but also reaching in to communicate with the hard-to-reach populations. He pointed out the important discrepancy between the underprivileged populations in Liverpool, who largely did not step up to do testing, and those who are rather well off. You cannot solve that problem unless you have a specific strategy for hard-to-reach groups, because they are the ones who are most likely to be vulnerable and unlikely to participate in these programmes.

My focus would be to really concentrate on getting at the groups of people who are going to be hard to communicate with and making sure the messages are tuned to what is appropriate for them. They will have different concerns from people who have a good income and a nice house to live in, in a middle-class environment. They will have very different concerns, so that is a crucially important difference.

Q2049 **Dawn Butler:** Dr James, as the behavioural expert, what is your view?

Professor Rubin: I would agree 100% with John on that one. It needs to be tailored to the audience. Different people have different concerns, different preconceptions and different worries. You see this with vaccine uptake, in terms of the misinformation that different sections of society are getting. That is a key thing.

As we start to come out of lockdown, messages are going to get more complex. At the moment, it is, "Stay home," which is quite a simple message to get across to people, but it is going to become more nuanced. We saw this when we came out of the other two lockdowns. As the messages get more nuanced, they become more difficult to communicate.

At the moment, we are still in quite a rules-based messaging system—"Do this. Don't do that." What is actually more helpful is to help people understand the principles that underlie those messages: why should we wear a mask, why is 2 metres effective and why should I quarantine if I have already had covid?

Once people understand why these things are being recommended, first, they are more likely to adhere to them because they get it—they understand it—and, secondly, when they find themselves in a situation that the rules do not quite cover, they are able to make a decision about what they should do in that situation that will be less risky. That is where I would like to see messaging going—focusing more on the principles that underlie the strategies we are taking and trying to convey those, and then people will internalise it and understand why we are recommending these measures.

Q2050 **Dawn Butler:** That is vitally important. Do you think that we can police our way out of this pandemic?

Professor Rubin: No. The police have a vital role to play in this—obviously they do. There are some people who are not adhering to various bits and pieces and will require some element of enforcement. The problem with relying on enforcement as a way to get people to do things is that it relies on people thinking that there is a high likelihood that they will

be detected by the police and that penalties will apply to them. I am not sure that that is true.

The other thing is that it misunderstands the motives people have for adhering to the rules. Most people are doing this because they want to, because they see the benefit to it and because they are trying their hardest to comply with what is necessary. They are not doing it because they are being forced to by the police. If we focus on enforcement as a tool to get people to adhere better, we are missing the reason why people are not adhering, and that comes back to what I said before about support. If we do not understand what the problem is and we simply apply enforcement to it, we are missing a lot of tricks—we are missing the real reasons why people are not adhering when they want to.

Q2051 **Dawn Butler:** Do you think that if people were allowed to get tested without feeling that they had to give all their information, that would increase the uptake of testing?

Professor Rubin: Potentially. We have done polling on this. We asked people whether they would be willing to give contact details of people they had been in contact with to Test and Trace.

One of the key barriers is data privacy and people's concerns about what will happen to their data once they hand it in. If that was not necessarily a barrier to them, I imagine that it might increase uptake. Obviously, that will then have implications in terms of how effective the system is, so there is a trade-off that you would need to talk to the epidemiologists about, but simply in terms of getting people through the door—potentially that would help, yes.

Dawn Butler: Thank you; I think JB had his hand up.

Professor Sir John Bell: Just to add to that, one of the interesting things that we got out of the university studies of the lateral flow tests was that in Durham, where we started these originally, there were a lot of students who declined to take the test. They declined to take the test not because they would not have confined themselves if they were positive; what they did not want to do was implicate their 12 best friends, who would then all be quarantined for a 10-day period just because they had been in touch with them.

This goes to a point that was raised earlier, which is that one of the most inefficient bits of this whole process for Test and Trace has been the quarantining of contacts, because you have to lock up people for 70 days to prevent one infection. Everybody knows it is hugely ineffective. That is why I think a system whereby you can test your way out of being a contact by just doing a lateral flow test every day for seven days would be a massive step forward. I think you would find that people would be much less reluctant to participate because they would know that there was a way out of the door. That is just an interesting observation on your point.

Q2052 **Dawn Butler:** Great; that's interesting. This is my last question. We heard in our previous evidence session about this culture of "keep calm

and carry on" if you've got a cough or a cold—"if you can walk, you can make it" and all this sort of macho culture that we currently live with. Do you agree that we are going to have to rethink that going forward? I will start with JB.

Chair: Briefly if you would, please—both witnesses.

Professor Sir John Bell: Yes, is the answer. We have a corporate responsibility to other people. If people want to suffer themselves and put up with stuff, that's okay. But as soon as that has wider implications for other people, it is our societal responsibility to try to manage it in some way.

The real challenge is going to come, though, when we have vaccines that are widespread. There will be a question, which is actually a civil rights question, about whether an employer could insist on everybody having a vaccine if they wanted to come to work. That is going to be very tricky.

Q2053 **Chair:** We might just come to that. Professor Rubin—on the macho question.

Professor Rubin: Fundamentally, yes. We need to stop people coming to work when they are febrile. We needed to do that anyway, before the pandemic. It was a big issue. I do not think that it is a macho culture. There are loads of different reasons why people do go to work when they have a fever or when they are ill. We have looked at this and done a review. It is things like feeling that you have a responsibility, so healthcare workers are very bad for this; they often go in because they feel that they have a responsibility to their patients to go to work.

There are also things like you are under pressure from your employer to go to work, you are worried about losing money, or you are worried that you might lose your job because you are on a zero-hours contract and do not know whether they will keep giving you work. The aim is definitely there. We should reduce people going to work when ill, regardless of whether it is covid, flu or whatever else it might be, but again we need to understand the reasons that people do that and then we can tackle those reasons. I do not think that it is just people being macho; it is more complex than that.

Chair: And that is a permanent thing, rather than just this pandemic, by implication.

Dawn Butler: Thank you.

Q2054 **Katherine Fletcher:** As someone who has had the virus and also had to do the 10 days of quarantine, I understand the difficulties of the individual who puts a group of people, including the Prime Minister, into quarantine; he will stop having the mick taken out of him in approximately five years' time. There are difficulties, but it was nice to see the leading from the front that went on there as well. This is not actually do to with my question.

I am going to start with Professor Rubin on the theme of behavioural

adoption and behavioural engagement. Way back when—obviously, we have been running this inquiry since February/March last year—right at the start of the first wave, we heard some evidence about behavioural engagement with lockdown, which speculated that people's adherence to it was likely to be measured in months. We are now quite a distance over that. Could you reflect on what has kept us going despite onerous measures and what lessons we can learn for future measures, should they become important?

Professor Rubin: You are absolutely right that the level of adherence that people have shown to these behaviours, which are costly and difficult, has been remarkable. We have been tracking various different behaviours over time, and some of them are incredibly stable and incredibly high—washing hands and wearing a mask, for example. Regardless of what the pandemic does, there seem to be very high levels throughout. Other behaviours such as not seeing your friends and family are tracking reasonably well in terms of what the restrictions allow and do not allow people to do.

In terms of why, there are various different explanations for that. One key explanation is that people understand the responsibility that they have to protect other people and they want to do it. We started off talking about people's level of altruism and civic duty, and we are seeing that—it is very important. I think there is an element of social norm within this as well. You tend to find a virtuous circle. With something like wearing a face covering, if everybody else is doing it, it is more likely that you will feel comfortable doing it yourself, so it becomes this self-perpetuating thing, which is a good thing.

In terms of what keeps people going with these things—I heard Angela talking about being a stuck record, and I am in danger of doing the same myself—again, I think it is support. People are quite willing to do these things and are happy to help where they see the need, but where we don't get support for that and where pressure starts to build from elsewhere to do something else, you start to see problems. I would expect, as we start to relax or change restrictions in the future, that those are the areas where we will start to see difficulties, where people are having pressure put on them from outside sources or where there isn't support on adhering to the restrictions. I think that is where things will start to come off.

Q2055 **Katherine Fletcher:** I will not put words in your mouth, but if you were giving marks out of 10 for the British public and their adherence, you would say it is quite high up the scale, but we need to be very careful that we don't just completely take the brakes off as we start to step out of these very simple restrictions. Is that fair?

Professor Rubin: Yes, that is fair. In terms of marks out of 10, I would go for 11. In terms of things changing as the restrictions change, it comes down to messaging a bit as well, and I get slightly anxious when we talk about changing restrictions in terms of "relaxing" or "easing", because I don't think that is actually what we are talking about. We are talking about changing certain restrictions. We are not saying that people can therefore

relax from all the other behaviours that we are talking about. They need to be maintained. But, yes, I think you are right that we can't just take the brakes off.

Q2056 **Katherine Fletcher:** Understood. Thank you so much. Professor JB, I am going to do a slight change, but again on the theme of looking back at early evidence that we heard and making sure we apply it to these changes in restrictions and our ongoing approach, we have heard a fair bit, even in the previous session, about the number of seeding events that occurred from European travel. Could you talk about what the latest analysis is of how many covid infections we ended up with in the first wave and whether that has anything to do with the pattern of disease that we have seen in the UK over the last 12 months?

Professor Sir John Bell: The answer is that there is documented evidence of a lot of seeding events, particularly after the February half term last year, when most of the initial events were tracked back to. There was quite a lot of stuff going on. It wasn't just us; as you know, Iceland could track back their entire epidemic to a football match in northern Italy, where people came across, and a couple of French visitors some months later.

The transmission of this virus across international borders is well known. We can't really judge the size and scale of that because, as James has already alluded to, a large number of people in this pandemic are asymptomatic and you don't know who has got what. The genomic sequencing has not been happening at the scale where you can actually do proper analysis of which subvariant was present where. All you can say is that it has clearly been a problem.

It has been a problem anywhere people have looked. In China, it has been a problem. In the UK, it has clearly been a problem. It has been a problem in Iceland where they look quite carefully, and it has clearly also been a problem in Canada, where they closed the borders quite early and it has still been an issue, so I think it is an issue. How you fix the issue is another question because it is quite a complicated problem to fix.

Q2057 **Katherine Fletcher:** How might we address it and move forward? To give us a ballpark, are we talking a planeload of 200 people or are we talking five planeloads? Do you have any idea of the ballpark of the number of seeds that were occurring after that February half-term?

Professor Sir John Bell: No, and it would be a complete shot in the dark, because most of them were not detected. Just to remind you, if you go back to the SARS-1 epidemic that started in Hong Kong, it took about a week for it to be spread, particularly across Canada, because the flights flew into Toronto and Vancouver and it did not take any time at all before it became more than just a Hong Kong problem. Again, it spread relatively quickly in other SARS epidemics to Singapore and South Korea. That is a feature of this virus. It has an asymptomatic period at the beginning, even if you have symptoms, during which you are infectious—*[Inaudible.]*

Chair: We have lost Professor Bell.

Q2058 **Katherine Fletcher:** I'll let Professor JB hold on. I was going to turn to Professor Rubin on the implications for people. On that idea of pent-up demand, I have a lot of people saying, "I want to go on holiday; I can't wait to go on holiday." We are introducing quarantine. There is a hope, if not an expectation, that we can start to engage in a different way. To what extent does our experience of the seeding events post the February 2020 half-term need to be incorporated into the messaging to help people make choices about going on holiday?

Chair: Briefly, Professor Rubin.

Professor Rubin: The messaging around holidays is going to be complex. I am not sure messaging around the complexities of the epidemiology will be helpful in a public-facing messaging campaign. I think what is really needed is simply clearer guidance as to what expectations are. There needs to be in the background a rationale for it, as I said before. I think people need to have their expectations set a little clearer as to what they can expect in the future.

Q2059 **Katherine Fletcher:** Understood. I was trying to tie it in with your point on how you need to give people the reasons why when they are desperate to do something, but if you get too complicated the message is lost. It's a trade-off, isn't it?

Professor Rubin: It is, and with something like that there is an issue of complexity. It needs to be laid out and spelled out. It could be communicated, but, for something like this, more important at the moment is setting that expectation and making sure it is clear.

Katherine Fletcher: Understood. Thank you.

Chair: Now we have Graham Stringer; we are hoping to get Sir John back.

Graham Stringer: My questions were for Sir John. Is he back?

Chair: I don't think he is just yet. We will work on that. I have a question for Professor Rubin if you don't, Graham.

Graham Stringer: I don't.

Q2060 **Chair:** Professor Rubin, you give behavioural advice to your colleagues on SAGE, who in turn give it to the Government. As more and more people get vaccinated and we get up to the first nine groups covering 99% of deaths, is it not the case that people are going to make their own assessment of risk and follow their own interpretation of the rules rather than what might be the official rules?

The police often advise, when it comes to speed limits, that there is no point in putting a 20 mph speed limit on a dual carriageway, because people have a feel for the road. Is the same not going to occur here? If we have very low levels of deaths, are people going to basically decide that it is safe to proceed? What advice are you giving that reflects people's behavioural instincts?

Professor Rubin: This comes back to the point I was making earlier. We have seen in the polling data that people expect that they themselves will adhere less strictly. You can see it in people who believe, rightly or wrongly, that they have already had covid—you can see lower levels of adherence. It comes back to the point about messaging.

It would be wrong to say that that is just the way it is and there is nothing that can be done to mitigate that. With adequate messaging, and with people having an explanation as to the rationale for the need to adhere, those effects could be mitigated. To what extent? I don't know. That is an empirical question, and I'm afraid I do not have an empirical answer for you.

Q2061 **Chair:** Perhaps I could put it this way: is the messaging going the other way? Are you advising your scientific colleagues and Government that there is a certain acceptance on the part of the public, if they can see it is reasonable, but that they need to operate within the margins of that? Clearly, that was quite important in the first wave. A lot of the timing of the advice was to how long people would adhere. Is this a two-way process of advice and determining what is reasonable?

Professor Rubin: I think the advice that we have given has been around looking at the likelihood that people's adherence will change and emphasising that, if those changes are not desirable from an epidemiological point of view, there are steps that could be taken to mitigate that, primarily via communication.

As I said before, the key one that I am focused on at the moment is the issue of adherence, particularly in the first couple of weeks after people have had their vaccination, because that is a particularly risky issue. That is exactly where we are working on the kind of communication that needs to be given out in the vaccination centres to prevent people from thinking that they are suddenly immune on day one after they have had the jab.

It boils down to this: these are the behaviours that you are likely to see following vaccination, and here are steps that could be taken to mitigate that or to communicate with people and explain what the risks are or aren't. Then it is up to policy makers to decide what to do with that.

Chair: Thank you very much indeed. Happily, we have Sir John back, so we will finish the session with Graham Stringer asking some questions of Sir John.

Q2062 **Graham Stringer:** It is good to have you back, Professor Bell. I have a double-edged question about the future. You mentioned, right at the very beginning, that we really should have a Kate Bingham-style taskforce to look at how we could develop antivirals. Do you think we should have a similar sort of taskforce to deal with antimicrobial resistance, and where would your priority be between those two things? Finally, are the messenger RNA vaccines a complete game-changer, and do they make it more likely that we will be able to get universal vaccines for flu and other viral infections?

Professor Sir John Bell: Let me start at the back end. I think the mRNA vaccines are a game-changer. They are going to make quite a difference in terms of what we can generate better vaccines to. It is interesting, because this pandemic has brought on a whole set of new vaccine platforms that are not messenger RNA platforms but have very variable characteristics.

There is a very good platform that has been developed by David Baker at the University of Washington, which can array a whole set of antigens at the same time and will generate neutralising antibodies to up to eight or 10 different proteins on the surface of the same vaccine. It can be made in yeast, so you can make it in your garden shed. You can make it in a two-week time period very fast, and it is heat stable. It is not just messenger RNA; there is a whole set of new vaccine platforms that I think will quite dramatically change our approach to the management of infectious disease.

The second question was really this issue about microbial resistance and antivirals. The two problems share one common theme: there is a market failure that affects innovators and companies that rely on selling things to reward their shareholders. It prevents them entering the area of antimicrobial resistance and, to some extent, the area of antivirals. I was on the board of Roche when we got Tamiflu, the first flu antiviral. It was a nightmare drug, because when there is no flu around, no one buys Tamiflu, so you have no sales. Then an epidemic comes, and suddenly everyone wants billions of dollars-worth of Tamiflu, and the next year your sales go from £3 billion a year to nothing again.

These are complicated things, because we have not worked out a system whereby there is a stable market for people to put their products into, and that ultimately was the demise of the antimicrobial resistance strategy. Nobody in their right mind would develop one, because it would never be used on anybody and would just be kept in storage. We do have to fix that problem, and it is an issue for Governments to sort out, because I do not think anyone else can do that.

Q2063 **Graham Stringer:** Is it possible to prioritise between focusing on antivirals and dealing with antimicrobial resistance?

Professor Sir John Bell: At the moment, I would definitely concentrate on antivirals, to be honest. Antimicrobial resistance is clearly an issue, but it is a longer burn issue and we can take more time to get on top of it. The antiviral thing is quite acute, and we need solutions right now, and ideally we need to go to antiviral solutions that you might use between multiple sarbecoviruses of the SARS family of viruses as a defence against another pandemic that might come relatively soon after this one.

Q2064 **Chair:** Finally, Sir John, last time you were kind enough to appear before the Committee, you said "if I get two shots of the vaccine and people say, 'No, you still can't go to the football match,' I am not going to be very happy". Is that still your prospective reaction, and does that imply that we should be developing certificates to allow you, after you have had

your two doses, to go and watch the match?

Professor Sir John Bell: James is ultimately the expert on this, but given the fact that I said it last time, I will tell you what I meant. It is not possible to imagine a world where we vaccinate the whole country and everybody believes we are still in the place that we were in six months—it is just not reasonable. I think we are going to have to allow people to adapt their behaviours appropriately if they have actually had the vaccine.

The thought experiment I would like everybody to do is say you had a pandemic that was coming where nobody died, or very few people died, no one was admitted to hospital, and you did not have the problems of long covid. We are not very clear about how the vaccines will affect long covid, but we are going to find out quite soon.

If you didn't have those things, I think you would find a lot of people going to the football matches, wouldn't you? I just think that is the world we are headed for, so I think it is better to plan for that, rather than to assume you can hold back the water with a dam, because you will not be able to. People will feel—with some justification, in my view—that they would like to get back to a relatively normal way of life. I suspect we are going to have to get used to that.

Chair: Thank you, Sir John and Professor Rubin. You have been very generous with your time and we are very grateful for your public service during the past few months. Both of you have helped the Committee in the past, and we are very grateful for your evidence today. Thank you very much.

Examination of witnesses

Witnesses: Dr James Hetherington and Dr Johanna Hutchinson.

Q2065 **Chair:** We now come to our final set of witnesses. This is a follow-up to our last public session on covid. At that meeting, we were considering Test and Trace. Baroness Harding, the head of Test and Trace, told the Committee, as she had told the Public Accounts Committee a couple of weeks before that, that Test and Trace was having an impact on R. She said that by March that impact could be around 0.5 to 0.7, and up to 0.8 in high prevalence areas. However, the evidence behind those figures was not available, so we wrote to Baroness Harding and asked for it to be disclosed, which it was last Thursday.

To answer some questions arising from that analysis, we have Dr James Hetherington, who is the chief data science adviser at the Joint Biosecurity Centre and one of the authors of the paper, and Dr Johanna Hutchinson, who is director for data and data science at the Joint Biosecurity Centre. For this set of questions, I am joined by our colleague Meg Hillier MP, who is Chair of the Public Accounts Committee.

Thank you for appearing today. It is an important principle that when information is disclosed to Parliament, the evidence that supports any headline conclusions should be available to be questioned, but it was not

put before our two Committees. Had it been prepared at the time that Baroness Harding and her colleagues appeared before the PAC and our Committee?

Dr Hutchinson: The modelling was complete and included in the business case that was published on 10 December. However, to publish such models and analysis from Government requires rigorous qualitative assurance and review processes. In addition, for this particular piece of work, we were really keen to be able to release the code that goes behind the model. Releasing the code enables the model to be reproduced by other people across society, so we took the time to enable ourselves, with external advisers, to do the review process and ensure that what we released was accurate.

Q2066 **Chair:** Does that mean that you gave evidence to the Public Accounts Committee and the Science and Technology Committee without being satisfied that it was rigorous?

Dr Hutchinson: No. This was additional quality assurance to ensure that, when we published it, it was understood well, it was coherent in its format, and we had done all the bells and whistles on checking the code.

Q2067 **Chair:** Did anyone ask you not to publish that technical annex when it was available to support the estimates that you made?

Dr Hutchinson: No.

Q2068 **Chair:** No one made any representations that this should be delayed or held back. It was entirely your decision.

Dr Hutchinson: Yes, that's correct.

Q2069 **Chair:** Was it your decision or the decision of the head of Test and Trace?

Dr Hutchinson: It was the process that we, as analysts, go through in Government to ensure the rigour of the work that we have done, and the transparency of the data and the code that we wanted to release.

Q2070 **Chair:** Who does take the decision on whether or not to publish something that has been prepared?

Dr Hutchinson: That is the normal procedures of Government for any of the documentation that we produce.

Q2071 **Chair:** You are the analysts. You prepared it. Who takes the decision on whether or not it should be published?

Dr Hutchinson: We try to be as transparent as possible. The JBC has a long history of publishing as much information as possible on the pandemic as it has gone through. Some of that information takes longer to produce. Some of that information requires more rigorous quality assurance than others. When it is ready for publication, we suggest that it goes forward through the Government processes to enable it to be published.

Q2072 **Chair:** When did you suggest that it should be published?

Dr Hutchinson: When it was correct and ready.

Q2073 **Chair:** Which was when? Give us the timing of that.

Dr Hutchinson: We were comfortable that it was ready for publishing by the end of January, and we went through the ministerial processes that enabled it to come out last Thursday.

Q2074 **Chair:** So it was at the end of January that you, as it were, released it for publication to Government.

Dr Hutchinson: That was when we were comfortable that the code was correct and that we had the right understanding—the messaging—that would enable the coherence of what it was that we were going to publish in the technical annex, and the brief that we put out to ensure this narrative.

Q2075 **Chair:** My colleagues will have some further questions, but the technical annex is a fascinating read. Clearly, a lot of work has gone into it. One of the things that it notes and suggests is that the impact of the contact tracing side of test, trace and isolate—there is the chain, but the contact tracing aspect—reduced the R number by between 2% and 5%. It was not 0.2 or 0.5 on an R number of 1.5 or whatever, but between 2% and 5% of the number. The rest was down to testing and self-isolating. Did that surprise you, and does that give you pause to consider whether the investment in contact tracing is justified by that very marginal contribution?

Dr Hetherington: For me, the 5% before the objectives from the business plan were met, and about 10% once they are all met, is not an "only" 5%; it is a, "Wow, it is as much as 5%."

I sometimes use the following analogy. Imagine we have recently been in a period where R is about 0.8, and let's say there has been a 10% reduction due to the tracing activity. If that had not been the case, R would be about 0.9. That means that the amount of reduction we have had during the lockdown, for the same length of lockdown, would be twice as much due to that contribution.

The interesting thing about these phenomena where we are close to the flip-over point between a growing pandemic and a shrinking pandemic is that what can seem like quite small contributions can have quite a big impact on the dynamics of the epidemic. Of course, those figures I just gave were illustrative and not precise, but what prima facie seem like small changes in R can make a difference to our ability to change—and with pharmaceutical interventions, it can be quite significant.

Chair: Let me go to some of my colleagues, perhaps starting with the Chair of the Public Accounts Committee, Meg Hillier.

Q2076 **Meg Hillier:** Thank you for inviting me to the Committee today, Chair. As you know, Baroness Harding was in front of us on 18 January, and she has since written to us about the modelling—the detailed information that the Chair was referring to—which models on an October-like prevalence

environment and compares to a scenario with only social distancing restrictions and no self-isolation.

Referring back to some of the conversation the Committee had with the previous witnesses, self-isolation is a really critical part of this. So can you talk through, in layman's terms, how you can be sure that the model ascribed to the testing and tracing will work on its own without self-isolation? Because we know that self-isolation has been a challenge.

Dr Hetherington: This is the really interesting, deep question about the way the modelling works. What we were able to do, because of the data available to us and what we can reliably measure, was measure the impact of testing, tracing and isolation all together and then separate the component due to tracing.

What I think we would all love to be able to do is separate the component due to testing. It is A plus B plus C, and we are able to report on A plus B plus C and on C, where C is the tracing piece. We would like to know B—the piece due to testing—as well. It has not yet been possible to measure the information we would need to be able to characterise that precisely enough to make it worth doing that work. That is why the two quantities we are able to report on are the total due to testing, tracing and isolation and the component due to tracing alone. I would really, really like to be able to pull out that testing component as well, but that has not been possible to date.

Q2077 **Meg Hillier:** Can you give us any indication of people who have isolated, and their household has isolated, because they have got obvious symptoms, which means they perhaps have not even gone and got a test? That would not show up in the testing figures but would hopefully reduce the R rate over time.

Dr Hetherington: I have not got that information. People may self-isolate when they first get symptoms, but I think we would all love to know the extent to which they really stick to it once they have had a positive test when otherwise they would not really have done so. There are all those subtle behavioural parameters where we would need to tease those components apart. That is why the only components we report on in the paper are the ones that we can really characterise, which, as I say, are the whole thing and the tracing piece.

Q2078 **Meg Hillier:** That begs so many questions. We have also now got a lot of testing happening in workplaces, schools and so on, and schools have been very good at contact tracing of their known cohorts. Are you able to absorb that data? Is that data reflected in your modelling?

Dr Hetherington: No.

Q2079 **Meg Hillier:** So that element is not at all reflected in your data.

Dr Hetherington: This is the other piece missing from the modelling we did last term—I am still thinking in academic language—that we have just been able to publish. It is this question of the October-like environment.

Variants, asymptomatic testing, and against the background of the lockdown—all are elements that are not in the modelling that is published and that would be needed to produce reliable numbers for the situation that we find ourselves in now, which is not the situation that it was back when we did the work.

Q2080 **Meg Hillier:** Is there any way you can begin to build a model that captures that data? Workplaces have very clear data about who is self-isolating, for example: if they are not turning up to work or school, you can largely assume that people will be self-isolating. Is that something that you are able to factor in as data becomes more available, or is that outwith your remit? It is not outwith the direct remit of Test and Trace, but it might be outside yours. I just wonder where it fits in.

Dr Hutchinson: There is great interest in this type of modelling, as we have clearly seen during our appearance here today. We are keen to take that to the next stage, and indeed we are in the design process of looking at what the next version of this model will look like.

You are right: mass testing and daily serial testing have picked up in pilot studies across the December period; they were not available when we created the first model, and we are still seeing those roll out. Of course, while we are in full lockdown, there is not a full roll-out of these types of testing mechanisms, except in the manufacturing and construction industries, where work continues to go on. We are expecting to see a boom in this type of asymptomatic daily serial testing, which we will be able to monitor as it comes through.

Q2081 **Meg Hillier:** You are bringing it all together, but can you separate out the effectiveness of that? I see James nodding.

Dr Hutchinson: That is what we will be looking to do. James, did you want to come in?

Dr Hetherington: Yes, absolutely. Separating out all those different components and then linking them together is clearly the next stage of what we want the work to do.

Q2082 **Meg Hillier:** You are not an accounting officer, so it may be that you are unable to answer this question, but you are obviously assessing the data. I love numbers and they give us a lot of useful information, but are you looking at the effectiveness of the spend on, for instance, testing, and the impact that then has on the R rate? Is that anywhere in your modelling, or your insight into parts of the Test and Trace system?

Dr Hutchinson: No. The question we were trying to answer was how useful the levers of test and trace, contact and isolating are in terms of the effectiveness of the programme. We were not commissioned to look at the spend and impact of them.

Dr Hetherington: I really wanted to re-emphasise that point, because I think it is an interesting one. The reason we did this work was to find out the relative impact—is it more important to do more tests or to do tests faster, and so on—rather than see what is the impact and the value of the

programme as a whole, to help us decide how to attune our objectives to the programme.

The thing I found most interesting about the outcome is that the different levers help each other through synergy, so the qualitative result of that work was not that any one particular lever stood out, but each of them makes the other levers more effective, too.

Q2083 **Meg Hillier:** In your professional opinion, when do you think we will have enough data to understand what really is effective? How many months will it take, and how many different scenarios do you have to model, so that we can have an understanding of what we might need to do as we live through whatever this pandemic turns out to be, and we may have to have testing as a permanent feature of our lives?

Dr Hutchinson: That is a brilliant question. The answer will depend on what happens as we go forward. Just since we did the October-like effectiveness model, we have seen the new variant come through and we have seen vaccination take place within communities, which are impacts that we have to factor into a model. We have also seen a change in the testing regimes, as we have discussed, with mass testing and daily serial testing. Those need to go in, so every time there is a change—either in the operation, which is usually triggered by a change in our environment, or, as we have seen, the transmission of this disease—we have to recalibrate.

If we went into a stable period that we could model successfully, we would be able to create that model and then run it for a period of time. When we are in a period where we are constantly seeing changes in the variants that are coming through, the impact on vaccine uptake and, indeed, the operation changing to be able to meet the needs of society, we are only able to do snapshot models of periods of time.

Meg Hillier: Thank you, Chair.

Q2084 **Aaron Bell:** Thank you both for your time today. I think Meg Hillier has asked a lot of the things that I would like to ask, but what does the model tell you about the need for Test and Trace to shorten the internal timescales within the process? Obviously, there is the time it takes for test results to come back and the time it takes to reach contacts. Where is your focus? What has the model told you to focus on in terms of shortening those timescales?

Dr Hetherington: This was the thing that I was alluding to earlier. I think the overall finding is that if you only focus on one of those levers, the amount of push that lever can give you is dampened by the next one. It is one of those things where you push on one and then something else becomes the blocker and you need to push on that one.

In the end, I think, the qualitative outcome of the work is that you need to work on all those business objectives simultaneously, in synergy, because if you push really hard on one and not on the others, it doesn't make as big a difference. An alternative universe would have been one where the outcome said, "Just go hell for leather on one of those operational

parameters and don't worry about the others." That wasn't the outcome that we got.

Q2085 **Aaron Bell:** Relatedly, the initial criticism of the testing process was that there were not enough tests, so we built up that capacity. After that, the criticism for most of the rest of last year was about the tracing element of it and reaching contacts; we had a session on that with Baroness Harding and other witnesses.

You are telling me that the outcome of your study, the model, is that right now you think you have basically got the balance right between the investment in these things, the focus of the organisation and, I guess, also the impact that each of those bits has, because we are clearly spending a lot more on the testing than the tracing side, but that seems to be backed up by your numbers. Are you saying that we have got that balance of focus and investment about right in the organisation now?

Dr Hutchinson: From an investment perspective, I am unable to answer that. However, I would lean on the evidence that was given earlier in this session when a number of our professional colleagues were saying that earlier intervention is better.

The sooner we catch people—even before they have symptoms—who are able to transmit this virus to other people, the better it is in terms of reducing the transmission of the virus across the community and therefore the fewer cases that we see, so certainly that has been the focus of Test and Trace.

The data that we have on contact tracing from 3 February is that we are now getting those turnaround times down for pillar 2, so we are contacting 86% of people within 24 hours, and 87% of cases have been transferred to contact tracing, and that has been consistent for three months. I think what we may say is that the faster we can get it, the better those figures will be and the more impact that programme will have.

Q2086 **Aaron Bell:** In our previous session—I don't know whether you guys were watching—Sir John Bell gave us the number of, I think, 70 days' worth of isolation to prevent one case via contact tracing. First, is that a number that you recognise?

Secondly, are the costs borne by society at large and individuals in society recognised in your assessment of how the model, how your internal algorithm in testing and tracing, works? First, is the 70-day figure one you recognise? Secondly, is that something you take into account in terms of what you are doing, or is your goal simply to drive down R and that is the view as to what Test and Trace is for?

Dr Hetherington: I cannot on the hoof convert the way we have structured the numbers into a figure that is comparable with that 70-day one, so apologies for that. If you translate units of change in the R number to units of other NPIs that would have to have been done to achieve the same reduction in the R number, that's sort of the figure of merit in my mind as to how I would look at these things—so I would say how many

school years going back are equivalent to this? I don't have those units, either, of course, off the top of my head.

Aaron Bell: But that is the kind of consideration you are making when you work around these things. Thank you.

Chair: Dawn Butler, do you have any questions arising from the publication of this document?

Q2087 **Dawn Butler:** Dr Hutchinson, you spoke about the app and making some alterations to it in the next stage of what you are going to do. What will those be, and what do they look like?

Dr Hutchinson: I do not think the app has come up in this, but we did release some data on app uptake last week. The app has been a really positive tool in our toolcase of NPIs that have helped us throughout the pandemic. For example, we have just published that we have 21.5 million downloads of the app, and the research from the Turing Institute and Oxford University demonstrates that for every 1% increase in app users, we are seeing a 2.3% decline in covid cases. The assumption they make from that is that we have prevented 600,000 cases since its launch.

Clearly it is a tool that we would like to develop further. Currently it notifies people of PCR—symptomatic testing. We would like to take that into LFD—the asymptomatic testing that we are doing. There is work being done to make it easier to check into institutions, as we did with restaurants and shops over the summer, so that we can use that more fluently.

Q2088 **Dawn Butler:** The research also says that a quarter of people who downloaded the app have stopped using it. We have heard stories of many people even being told by their workplaces to turn off their app before they enter. What is the app's real effectiveness? From what I hear from my constituents, more and more people have deleted the app from their phones and will not use it. Have you considered that in your thinking and modelling?

Dr Hutchinson: That is considered. Of course, the app was developed a couple of times during last summer before this particular version was launched, and we worked through some of the teething problems of this kind of technology. Any tool that is used in helping to reduce transmission is generally not for the whole population. There are targets and focuses where it works best, and that is what we say here. There will be groups where this is very accessible and usable. We also know of groups who do not have smartphones, so this tool will not work for them.

We also know that there are concerns about the use of an app that is produced by the Government, and that goes back to the conversations earlier about behaviours and looking at what the motivations are behind each of those individual examples. I go back to the reflection from Professor Rubin about the proliferation of behaviours that we see around any of these applications. It is really about understanding individual motivations and looking at how different groups of people are behaving

and why they are behaving in that way, to understand how we can increase uptake.

Q2089 **Dawn Butler:** You talked about the teething problems. Do you mean the £14 million spent on the failed app?

Dr Hutchinson: I am not sure of the budget of that, but I am on the Isle of Wight, so I saw the first app come through.

Q2090 **Dawn Butler:** It was £14 million. The Northern Ireland app cost just £1 million. I am not quite sure that the app is worth the money. First of all it was central, and now it is the cherry on the cake. In terms of the changes that are going to be made to the app, it is being designed to keep people's data if they input it, but it will still be able to keep people's data. How long will people's data be kept for?

Dr Hutchinson: That is a good question. I do not have that off the top of my head. I am very happy to respond to the Committee with that detail if that is useful.

Dawn Butler: Brilliant. That would be really useful. Thank you very much. Thank you both for all the work that you are doing and for coming to the Committee.

Q2091 **Chair:** Thank you, Dawn.

Finally, the technical annexe that you published, which as I say is a thorough piece of analysis, was very clear that it was conducted in December, and it noted that conditions have changed since then; in December, it referred to the environment of October, which is even longer ago. Are you updating that technical annexe to assess the impact of the Test and Trace system now, which is obviously of crucial importance for the decisions that are going to be made? Has that work been done?

Dr Hutchinson: Yes, as we just said, there is obviously great interest in this work, and we are keen to be able to do that. Although we can't update immediately with the data, because we need to work on that going through, the framework model is now in place, which helps us be able to reiterate quicker. The design for that is under way, as we say, and we hope to have more details on that soon.

Dr Hetherington: What we can do with modelling also depends on what we can measure. The further work that needs to occur to enable us to continue to update this is not just additional modelling work, but additional work to gather, collect and measure things. To progress, we will need to do both those things.

Q2092 **Chair:** Dr Hutchinson, when can we expect the update of the technical annexe?

Dr Hutchinson: As I said, it is in design, so it will be dependent on the data, as Dr Hetherington stated, and the design process to determine the assumptions and the specific question that the model will be asking.

Q2093 **Chair:** Would you agree that it is slightly unsatisfactory to be looking through the rearview mirror at whether the operation was effective in an earlier time? It is not without value, for reasons that Meg Hillier has pointed out, in terms of value for money, but it would be very useful to know now what kind of impact Test and Trace can be expected to have, given current conditions. Is it not possible to make some modelling assumptions—after all, that is what models are about—to provide some information to guide policymakers now?

Dr Hetherington: I think that I would rather not use maths beyond its power. I want to make sure we are able to do these things with the right amount of care and precision. That means that, given the resources that we have, in terms of data scientists and modellers, that lag is always going to be there.

Q2094 **Chair:** You have £22 billion of public money. That is quite a lot, and some of us think that perhaps a proportion of it might be usefully deployed on having up-to-date information on its impact.

Dr Hutchinson: We will be working in a number of ways, taking the design forward. As we discussed earlier, we published the code and the parameters for that code. The model itself in its current form is able to be repeated by people across the academic and scientific community. We would really like people to do that and support the development of this model. That, of course, helps us as a community to learn, grow and enhance this model as it goes forward.

Another point that we brought up earlier was about the data that needs to be incorporated. We are still seeing a ramp-up of mass testing, and certainly on daily testing. As we open up the community, that will become greater. We need those data flows to come through to understand what they look like so that we are able to incorporate those in. I do not expect that it will be many months before we see the next iteration, but we have to wait for these certainties to be seen before we commence.

Q2095 **Chair:** But you will understand the frustration, I am sure, Dr Hutchinson, that important decisions are being taken, but the assessment that you are able to make of the impact is based on an October-like environment, and here we are in the middle of February. Have you considered whether it would be possible and useful to policymakers to have a more up-to-date assessment, rather than something that is from the early autumn, when we are in the early spring?

Dr Hutchinson: I understand the frustration completely. What we need to understand here is that we have used the most consistent data to be able to produce the model, and therefore we have confidence in the outcomes. If we had produced a model earlier, with data that was less robust, we would have less confidence in the outcome.

Q2096 **Chair:** Okay. There is a test, trace and isolate—TTI—modelling group[3]

[3] Note from witness: To clarify the "Test, Trace, and Isolate (TTI) modelling group" is an alias for the group of academics and researchers funded by the UKRI/NIHR COVID-19

that is associated with SAGE; I think it feeds into SPI-M. Have they assessed the model and the technical annexe that you published at the end of last week?

Dr Hetherington: We shared the assumptions and approach of the model with colleagues, some of whom are members of SPI-M and other academic colleagues, and we used that review to inform the working group that we were developing it. That has been the approach to getting review across the community of our work.

Q2097 **Chair:** Has the TTI modelling group[4] that feeds into SAGE considered the paper that you published and the model that you are working with?

Dr Hetherington: Not as that group with that name. The set of people who have had a look at the work and reviewed it include people who are members of SPI-M, but not with the hat of being in the group as that, if you see what I mean.

Q2098 **Chair:** Elizabeth Fearon, for example, is on the TTI modelling group. Is she someone who you have shared these assessments and modelling assumptions with?

Dr Hetherington: I do not think Elizabeth, in particular, is one of those individuals.

Q2099 **Chair:** You are responsible for the modelling within NHS Test and Trace. There is a test, trace and isolate modelling group[5] that feeds into SAGE. Just describe your interactions with that group.

Dr Hetherington: As I said a moment or two ago, we took the results of developing it and approached various members of the community, including some of the people who are part of SPI-M, and we asked them to help us review. That is how we sought review and input from the community.

Chair: Let me go back to Meg Hillier for some final supplementary questions based on some of your answers.

Q2100 **Meg Hillier:** Thank you very much. I want to know whether you provide the raw data internally to test, track and trace. Obviously, the publication comes once you have had it peer-reviewed and checked, but do you provide that on an ongoing basis internally?

Rapid Response Rolling Call grant MR/V028618/1. This is an independent academic group and is not officially organised by HMG or officially affiliated to SAGE or SPI-M.

[4] Note from witness: To clarify the "Test, Trace, and Isolate (TTI) modelling group" is an alias for the group of academics and researchers funded by the UKRI/NIHR COVID-19 Rapid Response Rolling Call grant MR/V028618/1. This is an independent academic group and is not officially organised by HMG or officially affiliated to SAGE or SPI-M.

[5] Note for witness: To clarify the "Test, Trace, and Isolate (TTI) modelling group" is an alias for the group of academics and researchers funded by the UKRI/NIHR COVID-19 Rapid Response Rolling Call grant MR/V028618/1. This is an independent academic group and is not officially organised by HMG or officially affiliated to SAGE or SPI-M.

Dr Hutchinson: Sorry, but I am unsure of the question.

Q2101 **Meg Hillier:** You have the raw data. You had this information in October, and you had it finalised and properly reviewed by the end of January, but then it had to go for ministerial approval and so on.

At which point are you providing that information internally to help shape the decisions of test, track and isolate, to make sure that the decisions that are being made in this moving scenario are being made with as much information and data as they can use?

Dr Hutchinson: I think what you are asking is when the data is available to the programme. Most of the data belongs to the programme or is in the systems already, so it is accessible.

As to the question of how we then advise the programme, it is not just this model that advises the programme. We use a wide evidence base, which enables us to advise both the Government on its decision making and the Test and Trace programme itself. A lot of those are national indicators that you have seen published throughout the course of this time and, indeed, other indicators that are coming through—as we just discussed, the app is an example of that.

There are a wide range of indicators that advise every element of the programme. The programme of test and trace and the operations that have been developed with that all independently go through the evaluation board, which is chaired by Susan Hopkins and has a wide range of external peers who look at those programmes and the impact that the pilot reviews, as they ramp up, have. There is a wide array of evidence bases that are used across the programme.

Q2102 **Meg Hillier:** So in essence, the lag is in publication, but there is useful data from this model, which is being used in real time by TTI. Yes? For the record, Chair, the witnesses are nodding vigorously. Thank you, Chair.

Chair: That concludes our session. Thank you very much indeed for appearing to answer what have necessarily been some technical questions about an annexe.

I think it is an important principle that when evidence is given—not by you, but by others in the organisation—that relies on such information, it should be available at the time. I hope that will be reflected by the organisation. I also reference the concerns of the Committee to ensure that important decisions are informed by an up-to-date assessment of your impact, rather than by one that lags substantially behind the current context.

We are very grateful for your appearing at short notice following the publication last Thursday of your paper. That concludes this meeting of the Committee.