HOUSE OF LORDS

Select Committee on Science and Technology

Corrected oral evidence: The science of Covid-19

Tuesday 21 July 2020

10 am

Watch the meeting

Members present: Lord Patel (The Chair); Baroness Blackwood of North Oxford; Lord Borwick; Lord Browne of Ladyton; Baroness Hilton of Eggardon; Lord Hollick; Lord Kakkar; Lord Mair; Baroness Manningham-Buller; Viscount Ridley; Baroness Rock; Baroness Sheehan; Baroness Walmsley; Lord Winston.

Evidence Session No. 16 Heard in Public Questions 159 – 180

Witnesses

Professor Dame Anne Johnson, Vice President, Academy of Medical Sciences; **Sir Paul Nurse**, Director, Francis Crick Institute; **Professor Baron Peter Piot KCMG**, Director, London School of Hygiene and Tropical Medicine; **Dr Sir Venki Ramakrishnan**, President, Royal Society.

USE OF THE TRANSCRIPT

Examination of witnesses

Professor Dame Anne Johnson, Sir Paul Nurse, Professor Baron Peter Piot and Dr Sir Venki Ramakrishnan.

The Chair: Good morning, all, and welcome to the final session of our inquiry before the Summer Recess. I particularly welcome our witnesses Professor Baron Peter Piot, Dame Anne Johnson and Sir Venki Ramakrishnan. Sir Paul Nurse will join us around 10.30 am. I remind my colleagues that they are paired for asking questions, so when they pass a question on to their buddy, so to speak, please mention their name so that *Hansard* can pick it up. If you do not, I will of course remind you.

Q159 **Lord Borwick:** What pieces or types of evidence have had most influence at different stages of the pandemic so far in the UK, and what scientific turning points have you have identified?

Dr Sir Venki Ramakrishnan: One of the key points was the discovery of asymptomatic transmission and the extensive prevalence of asymptomatic transmission. If we had known this earlier, other actions could have been different. The need to test extensively, for example, follows from the extent of asymptomatic transmission. A high level of testing was recommended anyway, but it became even more important when you had asymptomatic transmission. That is one key piece of evidence that it would have been nice to have earlier.

Professor Dame Anne Johnson: I entirely agree with Sir Venki. That was actually my first point. The second one would be to have a better understanding—they are aligned issues—of the clinical spectrum of the disease and the severe immunological problems that it caused in a small fraction. If we had understood that full spectrum better, that would have enabled us to think about clinical services more directly.

On the issue of asymptomatic transmission, the consequence of that is that in many countries, including our own, we were not aware of the large number of introductions of the virus into the country that we were having, particularly in February and March, or that there were multiple introductions all over the country. To that extent, we were unable to identify it early on, and clearly that goes back to needing wide availability of testing, a very strong surveillance system, and sentinel surveillance to pick up early cases.

Professor Baron Peter Piot: I agree with both Sir Venki and Dame Anne. The moment we realised that the virus was neither influenza nor SARS in its behaviour was also very important, because that was the basic assumption in the beginning—for understandable reasons, because you always try to build on what is known—but it is very clear that because of that assumption that the virus, SARS-CoV-2, was behaving like influenza or SARS nearly led to a number of erroneous decisions and assumptions.

One thing that we have learned from epidemics is that viruses do not spread at random, be it asymptomatically or symptomatically. It really follows the fault lines in society. That is where we came up with care

homes. When that was revealed, that was also a turning point. It was not a scientific breakthrough, but we finally had some data. The absence of data in the beginning was a huge headache.

Lord Borwick: Was the asymptomatic transmission not identified by the Chinese originally, or was it just not picked up by us until later?

Professor Baron Peter Piot: It was certainly mentioned very early, but the question was whether it was asymptomatic throughout the whole duration of the infection or for just a couple of days before people fell ill.

However, in both cases the consequences and implications are the same. Something that has not been mentioned yet besides testing is face coverings and face masks. The need for them and their usefulness is one of the consequences of knowing that there is asymptomatic infection, because you simply cannot detect everybody early enough and you cannot massively test everybody to detect all the asymptomatic ones.

The strategy in the beginning excluded asymptomatic contacts. I went through that myself when someone was proved to be infected and my wife was trying get tested but she was asymptomatic and not eligible. The fact is that we did not take that into account early enough when there was already evidence in February that was not totally firm but was good enough.

Professor Dame Anne Johnson: Could I add to that point about understanding the transmission? The consequences of not fully thinking through the transmission dynamics are that we have paid a great deal of attention to hand hygiene, whereas in fact this is a respiratory virus and of course respiratory hygiene is equally important. A lot of attention has been given to hand hygiene but less to the importance of social distancing and now, as we have seen, to face coverings.

There are considerable consequences of understanding viral transmission better. This point will come up later in relation to transmission in care homes and hospitals. We need better understanding of the route of transmission in that system among staff, patients and carers.

Q160 **Baroness Blackwood of North Oxford:** Professor Piot, you mentioned that we did not consider until too late that this disease was not following the model of influenza or SARS, and that this informed the decisions on policy interventions that we made. To what extent were the decisions that we made driven by evidence from previous pandemics or preparedness exercises? Did that slow us down in making the right decisions in this case? How could we change that in future responses?

Professor Baron Peter Piot: First, it is totally human and rational to build on what you know. We have a lot of experience of dealing with influenza, for example, which shows how important schools are as vectors for the spread of the influenza virus. It is far less the case for this coronavirus.

There is the whole area of testing, and the fact that in influenza you do not really contain it. This is not blame anybody, but that is what we are

building up in many countries, except in countries like Singapore, Hong Kong and Taiwan, which immediately had the SARS model more in mind, but then it turned out that this virus is far more contagious than the SARS virus.

Have we built on past experience? Yes, but each epidemic is a bit different; that is now very clear. The absence of online data and of enough testing from the beginning is hugely different from Germany, which probably has the best track record in Europe. It started testing very early on and had delegated—we will come back to that—action, authority, data collection and feedback at a local level. We could have done that.

However, it is very interesting to see the published rankings on how ready countries were to deal with the next pandemic. In the top three, we had the US and the UK. It is interesting to see that a country like Vietnam, which has done extraordinarily well with fewer resources, scored around 40 or 50; do not quote me, but the number was quite low. There does not seen to be a match between the box-ticking exercise of the preparedness index and the real-life response. How good we think we are in peacetime does not mean that we will be ready when the crisis comes.

Q161 **Baroness Blackwood of North Oxford:** Thank you. Professor Johnson, you have identified a number of areas where decision-making in response to a real-time novel virus did not keep up with the challenge and the data. Can you tell me how, in a future pandemic, we could be more prepared and able to capture the data early enough to make the right policy decisions?

Professor Dame Anne Johnson: As Peter just pointed out, I reiterate that we have a strong public health and surveillance system. We already had one, and we had a lot of pandemic planning. The issue is often one of planning for something that you have seen before; but this is entirely novel.

It is interesting to go back to Dame Hine's report on the flu pandemic in 2010. She raised organisational issues in response to the pandemic, but of course we did not see a very high mortality from that disease. She emphasised the significance of a strong surveillance system and not having overreliance on modelling.

You will be aware that at the start of an epidemic one is often trying to make not predictions but assessments against great uncertainty about what might happen and without all the scientific knowledge that one might need. One of the points she made is the importance of investment in a very strong surveillance and public health system to be able to do that.

We have seen as we have gone on, particularly recently, the huge importance of having a strong central organisation, aligned with a strong local organisation, to deal with the point that Peter Piot made about the great heterogeneity of the epidemic. That allows you to have greater

understanding of where transmission is going on, and granularity within the public health system and the surveillance system.

You cannot deal with that purely from models alone. You have to understand in greater detail what is happening. We have seen that understanding the complexity of epidemics and their variability has been hugely important in the Ebola epidemic and in continuing to manage the HIV epidemic.

That strong underpinning system is hugely important. We do have that, but we have also seen some disinvestment in those areas in recent years.

Baroness Blackwood of North Oxford: Thank you. Sir Venki, would you agree?

Dr Sir Venki Ramakrishnan: Yes, I would. I want to make a couple of points.

It is true that SARS is not the same as coronavirus; it has some features that make it different, especially the degree of asymptomatic transmission. However, it is not an accident that countries that had severe SARS epidemics were among the best responders to the current coronavirus epidemic.

I agree with Anne Johnson about the difficulty of modelling in the early stages of a completely new virus. You do not know what the parameters are, such as the incubation period and the rapidity of transmission. All these things are uncertain, so estimating them for any sort of prediction, let alone policy, at an early stage, such as deciding when or whether or not to go into lockdown, did not seem such a great idea to me.

It is a little odd that countries that are allegedly not as scientifically advanced, such as Vietnam, Thailand, Hong Kong and Taiwan, actually had a very good response to the pandemic. The US and the UK, which have among the best life sciences research and technology, have not fared so well. It goes back to what Anne was saying: that this is a matter of good public health measures, and less a matter of having the most advanced science at the early stage.

Where the most advanced science will help us is in getting out of the pandemic, through the development of vaccines and drugs, and an understanding of the biology and immunology of the virus. That is where the deep science will help us, but, in the early stages, good public health measures, such as surveillance and testing, turned out to be much more important.

Baroness Blackwood of North Oxford: Do you think that, had we had a good number of those with direct experience of dealing with SARS within the decision-making bodies, different decisions would have been made along the way?

Dr Sir Venki Ramakrishnan: I think so. For example, I am fairly certain that if we were to have another pandemic, given what we know now, we would act much more quickly and be more proactive.

Q162 **Lord Mair:** Care homes have already been mentioned. What has been

learned about the transmission of SARS-CoV-2 in high-risk environments such as care homes and hospitals? Perhaps Dame Anne would like to start.

Professor Dame Anne Johnson: You may be aware that we have recently produced a review through the DELVE committee, which is organised by the Royal Society. It is a multidisciplinary group that looked at exactly this problem. We know that, internationally, hospital-acquired and care home-acquired infection, and transmission in those environments, have been a very important part of the epidemic.

A large part of the surveillance that is going on has tended to focus on acquisition of infection in patients and residents in care homes. However, we highlighted the tremendous importance of infection among staff. You have to think of the set-ups in hospitals and care homes as a system, with transmission and movement between them, so you can get infection from staff to patient, patient to patient, patient to staff, and staff to staff. It is now emerging that this has been quite a significant fraction of the epidemic.

When we looked across the piece at what data were available, we found that data are emerging of significant levels of hospital-acquired infection and increasing evidence of infection in staff. You will have seen that there have been outbreaks this week in Hillingdon Hospital and others, where you can see the importance not just of PPE and infection control between staff and patients but of social environments for staff, where transmission can go on.

Because hospital and social care workers make up a very large part of our workforce, and considering the considerable increased risk that they are at, we estimate that together they are a considerable part of the epidemic. Overall, we estimated that the fraction of the epidemic occurring in late April and May in patient-facing healthcare workers in the health and social care sector was about 10% of the total epidemic. That would not all have been acquired in an occupational setting, but a significant fraction would have been. That is an important part of the transmission, and quite a high fraction was in care homes.

We feel that we now need concerted action to ensure that we really understand how transmission is occurring and have much better surveillance and outbreak control. As you have seen, this is being brought in in these settings. We need to think very carefully about how we separate out Covid cases from non-Covid cases in hospital to prevent, for example, discharge of Covid-positive patients into care homes, and we need to work hard on infection control procedures, which need to have the highest level of leadership in the health and social care system.

We are beginning to get data on the magnitude of the problem in social care, but if we can really get on top of this it could have a significant impact on future transmission and concerns about a second peak over the winter.

Q163 **Lord Mair:** In terms of getting on top of things, what changes do you think might be needed to the testing system to more effectively manage

transmission in these high-risk environments?

Professor Dame Anne Johnson: Testing is hugely important, but testing in its own right does not achieve anything. It is the actions you take as a result of it. That is the key point. As you know, at the beginning of the epidemic there was insufficient testing capacity to test staff, so we do not know how many got infected. Indeed, we could have done even with syndromic surveillance of things such as staff sickness absence over the period to get some assessment.

The ability to test staff is really important in hospitals, as is the ability to test patients before discharge and then act upon that. There are quite important consequences for this, because if staff test positive they obviously must self-isolate. Then we have the whole issue of contact tracing including contacts within hospital if they have been at risk. They also need to self-isolate. That could have significant impacts on the workforce.

The real thing is for hospitals to understand the extent of transmission, so that we understand where transmission is going on in the same way that we did for MRSA, for example. It is important to do root cause analysis. Is transmission particularly occurring in the A&E department? Is it happening within non-Covid wards where you have unknown asymptomatic cases? You need to understand the practices going on that may be resulting in transmission. Are you really working hard across the system on social distancing among staff, which could be really difficult in hospitals, wearing masks across the piece, as has been recommended by the Chief Nurse, and looking at every case? These are really important things.

We had a very interesting seminar yesterday at UCL, where I work, to hear from hospital control people. One element is that they are now putting screens in between beds and things like that to try to reduce transmission. It is not just handwashing and use of PPE but environmental cleaning and how you cohort patients and so on once you have a really good handle on your epidemic. This goes back to point that Venki and I discussed earlier about the critical importance of high levels of testing to understand where your epidemic is going on, and then taking action accordingly on the basis of where you understand transmission to be happening.

Q164 **Baroness Manningham-Buller:** Dame Anne, I did not hear all your evidence, but I would like to ask you about the management of the pandemic, which has been done centrally. Do you think we have the balance right between what is done centrally and what is done locally? Are there suggestions for improving it?

The Chair: Peter, would you like to comment before Dame Anne does?

Professor Baron Peter Piot: I would say that the balance is not there. Countries that have been successful have all had good synergy between strong national leadership, policies—providing tests and what have you—strong local health authorities and local action. For example, it is not

enough to test. It is the whole the system: the speed of reporting and the feedback on where the action has to be. We are doing better and better on the actual testing, but the rest of the system is not following.

We should also probably consider more integrated testing of both virus testing—PCR—and antibody testing in instances like care homes. Almost every European country had major problems in care homes, or whatever their equivalent is, but we have been doing much worse on deaths among healthcare workers. According to Johns Hopkins University's daily report, over 540 healthcare workers died from Covid-19 in this country. That is second only to Russia and higher than all other countries.

To strengthen and emphasise what Anne said, this can be avoided in hospitals, but it is also a major source of infection in the community. That is something we have not really understood early on. For me, the future is really to make hospitals, care homes and other health services safe places. That should be a top priority looking to the future.

But, again, coming back to your question, we need to invest more in local response capacity, local surveillance and local decision-making. I think that is now in the pipeline. Without that, we are always running behind the epidemic. If everything is going on and decided in London, local populations will be left behind.

Yesterday I participated in a session with Bill Gates on what he calls outliers—exemplars—and trying to learn from countries that have done well and better than others. This kind of strong interaction between a strong central system, but also an empowered, competent and resourced local system, seems to be the key in every country that has done better in all this.

Professor Dame Anne Johnson: I absolutely agree with Peter, but in a sense the triangle that needs to be joined up here is between the central surveillance and public health function—for example, through Public Health England, at least in England—the local system, which includes health protection and the local authorities, which link in to social care homes and directors of public health, which are critical, and the third piece of the puzzle, which is the NHS, where a lot of the surveillance and public health activity also has to go on.

We saw a separation of the public health function from the NHS some years ago. It was quite controversial at the time. Having public health in local authorities has had many advantages, but there has been significant disinvestment and, to some extent, disconnection between the NHS and the public health function through some of these changes. We really need to make sure that we begin to bring all these bits of surveillance together.

To go back to the issue that Peter just raised about hospital-acquired infection, surveillance of that is done through the NHS and put through to PHE. On the other hand, there also needs to be surveillance in relation to community transmission; as Peter rightly says, a lot of the infection in hospital care workers then leads on to infection in their families or, equally, going from hospital into social care.

All these pieces have to join up. Critically, managing the epidemic often needs to be done at a very granular and local level. That is the data that we need to put together in order to get a better understanding.

Dr Sir Venki Ramakrishnan: In countries that have done well, there has been a much greater reliance on local authorities and local agencies for identifying cases through testing or otherwise and following up on them, and then feeding the information back to a more central authority so that a more regional picture can be obtained.

India has been highly diverse in its response to the pandemic. Some places have been terrible, but I want to point to the example of Kerala in south-west India, a region with one-tenth the per capita GDP of Britain. It has done extraordinarily well by issuing strong directives from the state but then devolving all the actions to local authorities. This combination is very useful.

We may be underestimating the requirement for testing. We need regular testing in all sorts of scenarios: staff in schools, those in the performing arts, and we all know about the cricket team. We simply do not know where testing will be required on a regular and frequent basis, and we need to be a bit more ambitious about our testing capacity.

Q165 **Baroness Sheehan:** Surveillance has already been mentioned on several occasions and I want to delve a little deeper into that. From your analysis, what surveillance systems do we need to have in place to ensure that viruses with pandemic potential, including zoonotic diseases, are recognised and contained before sustained transmission can occur?

The Chair: Welcome, Sir Paul Nurse, who has just joined us. Thank you for arriving so promptly. Professor Piot.

Professor Baron Peter Piot: Thank you for the question, Baroness Sheehan. Surveillance and data in general should be the basis on which to make decisions. I totally agree with Venki that whenever we have modelling, surveillance and data, we go for the data, which can then be fed into models to make them work better.

On your question about zoonosis, I do not think that we can predict where the next disease will come from, but we can be more ready for it. With influenza, for example, integrated surveillance across poultry, pigs and so on works pretty well, and that work has been very valuable. Here, we do not know. When I gave my talks about whether we were ready for the next pandemic, I always thought that it would be a new type of influenza, but I was wrong. This is a totally new coronavirus.

At the national level, one aspect that we really need to get our act together on is data systems. We have too many different data systems. For example, why is the NHS number of the people who are being tested in the public health system not attached to the test? As Anne said, people can be tested in the community or a hospital and then go back to the community.

At the moment, there is no way of bringing that all together, so we are wasting a lot of opportunities to make interventions and increase our

understanding of how this virus is moving around. One of the Crown jewels in the NHS is the primary healthcare system, but we have excluded primary care and GPs from the response. We could argue about the reasons for that, but I come back to the fact that the battles are won in the community, at the local level, which is why GPs and primary healthcare are so vital.

At the global level and in our international development action, we have failed to learn a particular lesson from past epidemics such as Ebola in west Africa. Every report and every review has given as its No.1: "We must invest in surveillance systems for the most vulnerable countries". What have we done? Not much. Helping countries to build their public health infrastructures could be a top priority for DfID, while here in our country we should be investing in local responses. Indeed, there are Keralas in many other countries; areas that are not the wealthiest part of the country. It is a matter of leadership and investing where it can make a difference.

Baroness Sheehan: Sir Venki, would you like to add to this? I know that we have talked a lot about it, but please anything that you feel has been left out.

Dr Sir Venki Ramakrishnan: I agree with Peter that it is very hard to predict when and where a new virus will emerge. The only thing we can be sure of is that it will emerge somewhere. Even with Covid-19, after the SARS and MERS epidemics a lot of papers were written saying that a new coronavirus would pose an enormous threat to humanity, so this was not unexpected. But it is unpredictable, so we need good clinicians who are trained to spot new types of infection to ensure that they are not mistaken for the flu, bacterial pneumonia and things like that. We need people who have been trained to spot new symptoms and new modes of transmission. I think that is very difficult, but I am not an expert in the area.

Baroness Sheehan: That is an interesting point. We heard evidence earlier that people here and in all countries get sick with viruses all the time, but the viruses are not usually identified and we just assume that it is flu or something. Do we need to get a better handle on what viruses are happening already within communities here?

Dr Sir Venki Ramakrishnan: We need more work on zoonosis, and I know that question will come up later, but I am not a clinician so I do not think that I can say how to identify when there has been a new outbreak.

Baroness Sheehan: Professor Johnson, when you answer, could you address what gaps there are in our understanding of emerging infectious diseases?

Professor Dame Anne Johnson: I agree with what has been said about the huge importance of surveillance. One of the problems with detecting a new infection is that you do not know where it will turn up or what its nature will be, so being prepared for everything is difficult. Nevertheless, the point was made earlier about sentinel surveillance and having surveillance long term that looks at viruses by, for example, large cohorts

that you follow up. We have made attempts at investing in that, and there is a strong argument for maintaining the investment that is being made during the pandemic in investigating large population cohorts in order to understand where new viruses are emerging, while remembering that we very much need international co-operation on this front.

There are other methods that we are not using enough. I am very interested in the work being done by Professor Tim Spector at King's College London using the ZOE app. I think that over a million people have volunteered to log their symptoms for him. Gathering that data lies outside the formal public health system, but it is the kind of intelligence that ought to be brought in to improve our understanding of the epidemic. Professor Spector has been able to come up with some very interesting estimates that are not dissimilar to those found in large surveys.

These kinds of sentinel surveillance systems are one example, but a question for Professor Piot is how we build on international co-operation.

The Chair: We will come on to that question later, but I need to move on to Baroness Walmsley's question.

Q166 **Baroness Walmsley:** Do the witnesses think that viruses have been overlooked compared with other types of infectious diseases or other major concerns such as antimicrobial resistance?

Dr Sir Venki Ramakrishnan: A lot of the messaging in the last few years has been about AMR—that is, bacterial infections. You know about the O'Neill report. It is not that the risk of AMR has gone away; it is still there. We may face a double whammy where we have a viral pandemic and AMR outbreaks, so we should not ignore that. But No. 1 on the risk register was actually a viral pandemic. Many people, as I have pointed out, had even warned specifically about coronaviruses. So this should not have surprised us, although perhaps we had our emphasis slightly imbalanced.

Baroness Walmsley: Professor Nurse, would you like to come in on this question?

Sir Paul Nurse: Thank you, and thank you for the invitation to give evidence to the Committee. I agree with everything that Venki just said, so I will not repeat it. I think it is exactly right.

The main problem is probably that we have not taken pandemics seriously in this country—and that is across the board, not just viral but bacterial—and we were not prepared. We should have been prepared, again as Venki has emphasised, because it was obvious that this was eventually going to hit us. Why did we not take it seriously? We had the trial a couple of years ago of influenza that showed that we were not prepared, yet nothing was done.

Maybe we suffered from austerity, maybe we suffered from a lack of leadership, but I do not think it is so much a question of viruses being ignored over bacteria; I think that everything, to some extent, was ignored. That is, we were not taking pandemics seriously when it was so

clear that if we did suffer one it would be a major catastrophe. And what do we have? A major catastrophe. It is the lack of preparation across the board that I feel is the problem.

Professor Dame Anne Johnson: I agree that we need to have really good sights on control of all these infections. We have suffered from the delusion that we had got rid of them in the 1970s with antibiotics and vaccines. These are viruses that can cause very major damage, and pandemics have done that through the centuries. They will always be a risk.

Professor Baron Peter Piot: I agree with what Sir Paul said. It is not so much that we have discriminated against viruses versus bacteria. Every time there is an international crisis—think of the Ebola crisis in west Africa; there was serious mobilisation and attention to that before we had the influenza—when the headline news is no longer about it, we seem to forget about it.

I always say that you should repair the roof when the sun shines—in other words, between epidemics, because more will come. The only certainty we have besides the fact that we are all going to die is that there will be more epidemics. That is when we need to build the system. You do not set up a fire brigade when a house is on fire; you have it all the time, ready to go.

One way of knowing earlier is to have far more testing available for anyone who has been travelling, who has a fever and so on—Dame Anne called it sentinel surveillance—because they can be the canaries in the mine. That is how we can detect new problems. Hopefully, this time we will learn the lessons and invest not only in dealing with the current epidemic—it is not over; we are only at the beginning, unfortunately, so we have to be ready for the next waves of the outbreak—but for whatever comes next.

Baroness Walmsley: It is interesting that the development of fire brigades happened after Parliament burned down.

Dr Sir Venki Ramakrishnan: I want to address what Sir Paul said. Many of the earlier threats—for example, H1N1, swine flu and Ebola—did not materialise to the same extent in the UK but were contained in other regions and did not spread to the West extensively. That may have induced in us a sense of complacency or a lack of preparedness. That goes back to my earlier point that countries that had the SARS and MERS epidemics badly also did the best against this particular pandemic.

Baroness Walmsley: Sir Venki, can I stay with you for a moment? Earlier you wanted to say something about research into zoonosis. Do you think we need a lot more research?

The Chair: We are coming on to a question related to that, but please do comment.

Baroness Walmsley: Also, to what extent should we be concerned about the pandemic potential of pathogens that are held and studied in labs?

Dr Sir Venki Ramakrishnan: Both are interesting. We have good zoonosis research going on here at the Weybridge lab or Pirbright. One thing to keep in mind is that a lot of coronaviruses and other dangerous zoonotic viruses originate in bats and other species that are not necessarily farm animals like pigs. Perhaps we need to broaden our research. I do not think that can be done in the UK alone; it has to be part of an international effort.

There has been a lot of speculation about laboratories, the origins of viruses and so on. The one thing that I would say is that perhaps labs that deal with zoonotic viruses and other harmful viruses need to be internationally approved and inspected and be relatively open to other experts. That is the best way to ensure safety and compliance. One could think of the IAEA for the monitoring and safety of nuclear fuels. Perhaps something like that needs to be enforced. Unless we have an international effort and international agreement, I do not see how we can solve the problem of dangerous labs.

Q167 **Lord Winston:** This has been a tremendously useful discussion. Thank you all very much. It has been a really important summary. What systems and strategies should be put in place, both nationally and internationally, to better prepare for future pandemics in view of all the things that you have just said over the last hour?

Professor Baron Peter Piot: We could have a whole session on that. That is really what we should concentrate on: the next outbreaks, the next waves and the next epidemic. As we have now discussed several times, it is a question of investing in better surveillance, better systems at the local level, testing and better co-ordination. That sounds very boring—there is nothing sexy about it—but doing that groundwork is key.

I should also say that vaccines will probably nearly always be part of the answer, if not the only one to really bring it fully under control. That means that we also need to make sure that we become better at communicating uncertainty. If there is one word to characterise this epidemic it is uncertainty, not just at the beginning but even now. How to communicate that is not so clear.

We need to fix the system for local surveillance with better data and management, because again we sometimes we concentrate on testing and forget that it is the data and its management that will make a difference. At an international level, we need a better-equipped World Health Organization—for information sharing, not so much for doing research; it is more of a local convener.

There is progress in vaccine development. One bit of good news in this epidemic, in contrast to previous ones, is the enormous flood of information sharing and intensive investment in vaccine development and therapeutics. CEPI—the Coalition for Epidemic Preparedness and Innovations—was set up after the Ebola outbreak, driven by the EU and the European Commission, and I am advising Ursula von der Leyen on the ACT accelerator to accelerate the development of products and to make sure that there is equitable access.

There is a need for quite some reform. At the international level, there will be a review of the WHO, which is badly needed. It needs to be reformed in order to fulfil its mission better and to be useful to its member states. Regional bodies will also be very important. The good news is that the African Union has established the Africa Centres for Disease Control and Prevention, which have been playing a very good leadership role and are something that Africa did not have before. So there is some progress.

Lord Winston: Dame Anne, how would you improve international collaboration? Would you be prepared to address that issue?

Professor Dame Anne Johnson: Peter has mentioned some of that. Investment in the WHO is critical, as is the capacity for public health surveillance in-country of the kind that has just been described and which is mentioned after every epidemic.

There is another voice that we have not talked about much, and it is perhaps less about international collaboration and more about system strengthening. I was so pleased to hear the news yesterday about the vaccine, but there is a long way to go before we have a vaccine at scale that we know works. Hopefully we will have that, but in the meantime we are incredibly reliant on the public's engagement with this and their ability to hear messages and to act upon them. We need to find a way to communicate to people how they can minimise the disruption to their own lives and their economic and physical welfare while acting to suppress the epidemic. That is an issue across the world; we are seeing quite unclear messaging in places.

That work with the public is hugely important in epidemic control. Peter is better able to comment on this, but it was critical in the Ebola epidemic and very important in SARS. So alongside the international response we also need to get the local public response correct in many different environments and appropriate to the culture and risks in those particular environments.

Lord Winston: I read very carefully the statement that was once given to European policymakers. In it, the area of public engagement is very sketched over and I am not sure that it is at all adequate. When I visit schools, nobody in any school has ever thought about pandemics. They know about a number of climate change issues, but they always laugh when I mention pandemic being a real issue.

Sir Paul, can you suggest what we might do better in our educational system to get much better public engagement about what is obviously a major human issue?

Sir Paul Nurse: I completely agree with what you have said. The report for the European Commission that you mentioned was actually aimed at what the European Commission could be doing today. What you are pointing out is the need for proper education and better public engagement in order to put the right culture in place—culture might be the right word—a culture that is more receptive and more understanding of the risks here.

That starts in schools, as you rightly point out, in two ways. One is specific. Pandemics are important; in a global world, they are bound to hit us exactly as Peter said a little earlier. We have underestimated that risk, and we need to communicate it.

The second is more general. It is to take more seriously how science and medicine are communicated to our citizenship. Particularly in a pandemic, we do not understand the science well enough at the beginning. The problem in schools, as I think you would probably agree, is that science is often taught as if it is chiselled in granite. That is probably true of Newton's laws of physics, at least as long as you are not going too fast, but it is not true for a lot of science, especially when you are doing research at the frontiers of science and especially when you are dealing with an outbreak such as a pandemic. It is tentative and uncertain, it changes and evolves.

We have a problem if we have a citizenship who are taught that science is written in stone, yet when we encounter a scientific problem like the pandemic we dither around saying that we do not know what is happening. A pandemic evolves. It does not fit with certain knowledge.

So there are two things: one is pandemics, as you say, and the second is a more sophisticated understanding of the nature of science so that we communicate properly to the public. Increasingly, our society will get technocratic and dependant on science—across the board, not just in a pandemic—and we need a more sophisticated response.

Q168 **Lord Winston:** That brings us nicely to this question. Sir Venki, given that answer, do you think that the Royal Society could be doing more about this sort of issue and, if so, how?

Dr Sir Venki Ramakrishnan: There is no question that there is always more that we can do on public engagement, especially in reaching out to young people. As you know, we are trying our best. There is a possibility that we could try to collaborate with other institutions like the Royal Institution to extend our reach to the public even further. Those things need to be explored.

I would like to make a brief comment about international collaboration. One problem with international collaboration is that countries tend to get blamed, or feel that they will be blamed, if a pandemic starts in their region. We have seen this in the politics around China. This may have led China initially to be more circumspect in what it shared, although later on it shared the sequence and quite a lot of data. In the early stages, however, it was perhaps less forthcoming than it could have been because of the fear that it might be blamed, because many other epidemics, such as SARS and swine flu, also originated there.

We need to get to a system where countries or regions are not blamed because something emerged in their locality. Rather, we should look objectively at the conditions that cause these things to emerge. If wet markets are a source of infection, there is no cultural blame; it is simply a matter of science, and it should be dealt with in that way. I should point out that Hong Kong had a similar problem, and it emptied out its

markets once a week to do a deep cleaning. That dramatically reduced the rate of new infections that originated in its wet markets.

The WHO needs to be strengthened, but at the same time the political climate should be blame-free on the origin of new pandemics.

Lord Winston: They have wet markets in Vietnam, do they not?

Dr Sir Venki Ramakrishnan: They do, and I do not know enough about it. Perhaps Peter will be able to help on that.

Q169 **Baroness Walmsley:** Sir Venki, what do you think about the need for further research on zoonosis. You seemed to want to address that earlier.

Dr Sir Venki Ramakrishnan: I do not have much to add to what I said, which is that we have good zoonosis research here but it is focused mainly on agricultural animals such as pigs. Perhaps we need more research on species like bats, which are often the source of many coronaviruses, and other exotic species that may be responsible for harbouring disease.

The Chair: Viscount Ridley is a bat man.

Q170 **Viscount Ridley:** I would quite like to ask Sir Venki this question. We now know for sure that the wet market in Wuhan was not the problem because the Chinese have released data showing that no animal samples from the market were infected, and that the people who got infected at the market had already well adapted to the human version of the virus which was not evolving fast.

The Chair: A quick answer for all four of you, please.

Dr Sir Venki Ramakrishnan: From the evidence I have read, it is fairly complicated. I do not think we know.

Sir Paul Nurse: This is an important issue but it is confused. I do not know the answer. There are various hypotheses and conspiratorial theories. I hope the WHO can get there and illuminate what might have happened.

Professor Baron Peter Piot: We may never find out the exact origin, although it was definitely an animal. However, the way that I see it is that markets can be amplifiers, whether it is that particular market or not. The new outbreak in Beijing also started in a market but they could not identify the exact origin.

The Chair: I think there is a suggestion that it could have been from a lab, or has that been ruled out?

Professor Baron Peter Piot: I do not know what evidence there is, so that is hard to prove. For now, it has not been proven.

Professor Dame Anne Johnson: I do not have anything to add to what has been said. I think there is enormous uncertainty and we mainly just have to face up to what we have to do now.

Q171 **Lord Browne of Ladyton:** Baroness Hilton and I want to turn to another

aspect of public engagement. We have some specific questions, although to some extent they have been anticipated in the exchange about public engagement.

We start with the challenges for scientists providing scientific evidence during the pandemic, particularly where, as in this case, the virus pathogen is previously unknown to science and medicine, and consequently the science is developing. We invite you as witnesses to describe these challenges, how they have influenced and been reflected in that advice, and then invite you to answer a very specific question: in your opinion, has the uncertainty in the scientific evidence, which was touched upon earlier, been successfully communicated both from experts to our government and in turn from the government to the public?

Sir Paul Nurse: This issue is critical. I have already emphasised that a pandemic is a particular situation where the scientific knowledge is uncertain and evolves and changes. That makes it a particularly difficult topic to communicate and, if I may say, a particular challenge for communication professionals, who are generally trained to deal with memorable one-liners, which on the whole do not work very well with complex science of this sort. We have seen many examples in the last few months of trying to reduce things to one-liners such as "We are following the science", which is just really too naive.

I have several things to say. If I may borrow from Donald Rumsfeld, which I would not normally do, advisers need to be clear in giving advice about what is known, what is partially known, what is unknown and what is unknowable. These are complicated things that we need to disentangle. That is the first issue: this needs to be explained by experts to policymakers and then to the public. We just have to handle that complexity. Uncertainties will arise. There are limitations of data and analysis and the interpretation of the data, and differences in scientific consensus and conclusions. This is why it is so difficult: we often have to have binary decisions based on quite a wide distribution of ideas. We have to learn how to communicate that, and we have not managed to do so. As I said, having populist one-liners is probably not the best way.

We have already discussed trust in communication and public engagement. I think Anne mentioned this: we rely on the public behaving in particular ways, but they have to have trust in the system, in their political leadership and in their scientific advisers. That means that we all have to earn that trust and we have to maintain it. We need honesty and transparency, along with humility; it is no good being arrogant about it, and there is no point always being cheerful about it. Sometimes I listen to the advice that there is a new vaccine or new treatment around the corner. What we are dealing with is tough, and the public deserve honesty on all these things. I lost trust when 40,000 tests in the post were counted as tests. How can you trust a situation where that has been put out simply to reach a one-liner about a figure of 100,000? Many people wondered what on earth was going on there.

There is another point when it comes to communication and engagement, and this is complicated. When something is uncertain and the knowledge

is not clear, scientists deal with that by challenging each other to debate and discuss. Normally that occurs in a professional environment, but here it has to play out in the public arena. That means that scientists will disagree with each other, and maybe they have to do so because we are still trying to find the best way forward.

Lastly, in all this muddle, because it is a muddle, we expect our poor politicians to come to clear decisions. That will be difficult for them, but what is important is clarity in the governance. Who is making the decisions? Who is giving the advice? That is both a scientific advice issue and a political issue.

I am concerned more on the science side, to be honest. Although SAGE has open discussions—at least, they are open now; they were not at the beginning—many of the decisions that are critical, such as how and where we should test, are being made behind closed doors. There was the decision to have big lighthouse labs, which failed to help in the pandemic itself. We do not know where that decision was made or even how much it cost, but no alternatives were looked at. We need transparency in decision-making and governance to inform communication and public engagement.

Professor Dame Anne Johnson: This is a hugely important area. You asked about communication between experts and government, and clearly that goes on through SAGE. A key issue is where uncertainty and scientific advice end and policy begins—it is really important that scientists understand that, but also that they understand where policy is made; both scientists and the public are confused about that—and then communication by the Government to the public.

Another key issue is communication by scientists to the public. I would say that there has been a real effort by the media, or some of the media, to clearly communicate messages from scientists to the public. The Science Media Centre has done a good job there, at least across some of the media, and that has been important.

On the issue of clear messaging, I agree with Sir Paul that it is difficult to communicate, and be humble about, what we do not know. Early on, a lot was said about how the virus is or is not transmitted. The question is how we know that. You then go back and find that the evidence is unclear. So we have to be clear about uncertainty.

On the other hand, even in the face of uncertainty we can still give clear messaging to the public about how they can contribute, what they can do and what they might expect. In our work with the public through the Academy of Medical Sciences, the public said that they wanted clear messaging about what they were to do. That is a hugely important area that we really have to work harder on.

To go back to Sir Paul’s point about swabs and counting them and where things were and were not, a lot of these are operational issues. This goes back to how we do things better. The science advice is always uncertain to a degree, with its limitations, and then there are policy decisions, but the third leg is how you operationalise something that you have agreed

through a system that will achieve the public health goal that you are aiming for. That has produced some of the biggest challenges. We should not go over all that now, but we should make sure that we pay enough attention to it.

Q172 **Lord Browne of Ladyton:** Thank you. I have one very short and very specific question, and then I will hand over to Baroness Hilton. In your opinion, are there risks associated with preprint articles that have not been peer reviewed informing science advice and policy?

Dr Sir Venki Ramakrishnan: I do not see any alternative. We need this information at speed, but the normal peer review process takes weeks and sometimes months. I do not think it is a particular problem, because experts in the field can distinguish quickly between preprints that are just garbage, which I should say the majority are, and those that are actually worth something. Even with normal peer review, we have lots of papers that turn out to be complete nonsense. So I would not let that be an impediment. However, we should be cautious.

Professor Baron Peter Piot: I agree with what Venki said. The good news is that all this information is out, so I see that as a positive thing. However, it depends on how it is picked up.

I want to mention two things. First, in some countries the data and the facts about the epidemic are not presented by politicians. Here the Prime Minister or a Minister does it, so the politicians communicate political decisions while the scientists, or those in charge of surveillance, communicate the number of cases and the trends of the epidemic. That is [*Inaudible*] more with what Sir Paul said.

Another aspect that I would like to mention is that while we all hope that there will be a vaccine, recent data show that 14% of people in the UK emphasise that they will not take a vaccine against Covid-19 and another 10% were uncertain. It is not enough to go for technology. We need to look at trust, as that is an essential element of responding to pandemics, and that goes for anything else in public health.

Q173 **Baroness Hilton of Eggardon:** My question follows on rather neatly from that. Has sufficient weight been placed on the social, mental and behavioural aspects of dealing with a pandemic? Has perhaps too much been based on the hard science and the medical aspects? Do you think more could have been done on the behavioural front in communicating both with the Government and with the public?

Professor Dame Anne Johnson: Yes, we should pay more attention to that. That is the only thing that we can do at the moment, so it is hugely important. A lot more behavioural evidence has been brought to SAGE than in previous initiatives and innovations that have come out of previous reports. There is a large potential impact of the actions that we have taken on people's social and, in the end, long-term physical well-being—for example, through the delays in the NHS and the backlog of work that needs to be done.

We have to factor into this the overall health impacts of the epidemic, which are both direct and indirect. In the long run we are very uncertain about what the long-term economic, educational and other impacts are that will impact health. The mental health impacts have been relatively unstudied, although there has recently been funding for research in that area and it is something which the Academy of Medical Sciences has emphasised. We really have to understand the balance of public health actions that we take to reduce Covid deaths and the Covid impact, and balance that against the other impacts that we are having, and how we can minimise the damage across a whole range of activities.

Sir Paul Nurse: In dealing with complex situations, of which the pandemic is of course an example, we will always need multidisciplinary advice across the board. That will include the behavioural sciences and the social sciences, and it may include ethics and the humanities as well as the natural sciences. That is simply because frequently the outcomes that you have to discuss will impact on society and individuals in complex ways that we have to try to understand as best we can.

So multidisciplinary approaches are important. I mention that particularly because it has to be said that academics, who are largely providing this advice, do not always work well with each other when they come from different disciplines and academic territories. I suspect that we need to practise more of that and ask how we can get sensible advice across the board from those who range from the natural sciences through to the humanities, and have decent sharing of that to try to work our way through it. I am not saying that that has not worked here—I do not know enough about how advice has gone into government—but I am saying that it is essential that we have that, we need to work to get that to work well.

I have one more comment, which goes back to the question about preprints. It is a short comment, because essentially I agree with Sir Venki. I would use a metaphor. Normally when we report science, it is like reporting science in peacetime, but we are now in wartime. In peacetime you rely very much on peer review and so on. The Science Media Centre, which has been mentioned, has done a good job, but it has had a crisis knowing how to deal with the present crisis, simply because it feels that we now ought to be talking about preprints. However, for all the reasons that Venki gave, it is uncomfortable about doing so.

For me, the critical point is that we do indeed have to discuss preprints, but we have to combine that with immediate commentary on the information that is being given—preferably, in fact, from government scientists, who have the scientific support to be able to say when things matter and when things do not.

We have to go back to Peter Piot's point that the anti-vaxxers are getting very rattled and are producing a lot of stuff out there that we have to pay attention to. It will not only be about having a vaccine that works; it will be about having it accepted so that it will be used across the community. If it is not, we will not get the famous herd immunity in place, which can only come from vaccination, to protect our citizens.

The Chair: So you agree that the plethora of online publications has been a great disadvantage.

Sir Paul Nurse: I am a little more nuanced about it. Because we are in wartime, we need the information out there and we need it quickly, but we need to realise that significant parts of it may be fallacious, and we have seen that. That requires responsible scientists—hopefully those in authority, such as the Royal Society but also the chief government scientist and so on—to comment on that to try to sort the sheep from the goats, and to do so rapidly and very clearly.

Q174 **Lord Hollick:** Lord Kakkar and I will now look towards winter and what we can expect. To what extent does the scientific evidence appear to point towards a second wave of the pandemic in the UK? What might a second wave look like? Referencing Sir Paul's comments about the lack of preparedness, what are the key strategies that will help to mitigate against a second wave of the pandemic in the UK?

Professor Baron Peter Piot: First, there is no doubt that there will be further outbreaks. Even in countries like New Zealand or Australia, which are thought to have basically eliminated or at least contained it, there will be outbreaks. Whether or not the second wave is a tsunami will depend on how well we are doing. There I am relatively optimistic, because at least now we have experience in how to deal with it.

What will probably happen, as we have seen happening in every country that has been successful in bringing down new infections, is that outbreaks of the infection will flare up. Again, it is not really a random phenomenon; we can probably increasingly identify where the hotspots will be. We already know that high-frequency transmission is a driver of the epidemic, but it is not so much about individuals; rather, it is about high-frequency settings, locations, workplaces and so on, such as meat packing, as in several countries; workshops and sweatshops in the garment industry, as in Sheffield; social housing, as in Melbourne; night clubs, as in South Korea; and migrant dormitories, as in Singapore.

For me, it is key that we have the necessary intelligence in terms of data to act early and detect early. Perhaps what we could have for the country is heat mapping: where are the most vulnerable populations, spots, locations and professions that are likely to be hotspots in future? In addition, and this is something that we have repeatedly mentioned here, we should make hospitals, the health system and care homes absolutely safe spaces. That should be a top priority. In addition, we now know that there will be flare-ups in other places.

In the meantime, we have to continue to practise basic precautions such as social distancing and particularly masks. For me, it is hard to understand why the Government did not make masks compulsory months ago. The evidence was there. When you look at countries, particularly in Asia, that have been successful historically, masks are an important element of that. We need a combination of a continuation of what we have been doing—the baseline protection of the population as a whole—and being very granular and targeted in our interventions, and we have

to sure make that there is the capacity to do it, because that is often lacking.

The Chair: Are you suggesting that we should have face covering even in the streets?

Professor Baron Peter Piot: More and more countries have that, although, frankly, the risk by becoming infected just by going out without one is very limited.

Lord Hollick: Sir Venki has advocated very publicly and persuasively for the use of masks, so I would be interested in his comments.

Dr Sir Venki Ramakrishnan: The more general problem about winter is something that Peter has already addressed: no matter how successful countries have been in suppressing the virus, the moment that restrictions are released there is always a resurgence. We have seen that in China and other parts of the world such as Melbourne.

So there is no question that we have to remain quite vigilant if we are to avoid a winter wave, which will be complicated because people will be indoors more and it will be conflated with flu and other diseases going on at the same time. It is not inevitable that we will have a huge wave in the winter, but it will happen if we are complacent and stop being vigilant. That means that all the public health measures that we have introduced now—including the use of face masks, I should say—should be maintained throughout the winter and in other settings as the economy opens up.

Lord Hollick: So social distancing should be continued.

Dr Sir Venki Ramakrishnan: Wherever possible. It is not always possible—for example, in shops, on public transport and possibly in some work situations—so it has to be combined with other measures: you could have shielding between desks, for example, and you can use masks as much as possible. All these measures should be maintained until we see a way out of the pandemic—that is, until therapeutics emerge.

Speaking of therapeutics, I know there has been a lot of emphasis on vaccines, but let us not forget that HIV, hepatitis C, SARS and many other diseases have no vaccine. So although the signs are promising, we must not stop hedging our bets and should continue working on therapeutics. Like HIV, coronaviruses have both a polymerase and proteases, which represent very good drug targets. We must try to push those directions as well, partly because many segments of the population may not actually be able to be vaccinated or may not mount a good immune response. We need both.

Professor Dame Anne Johnson: I agree with what has been said. I remind you that we did a big report for the Academy of Medical Sciences on a challenging winter that had a lot of press last week. I agree that it is likely that we will see some resurgence of the pandemic, but I hope it will not be as bad as the worst-case scenario which we were asked to prepare for what might happen.

I would add a couple of issues to what has been said. First, this business of reducing transmission in health and social care is critical and would in its own right have a big impact on reducing the size of the pandemic, so that is a good place to start. We need to maintain the changes in behaviour such as mask wearing and maintaining social distancing, and the preparations that workplaces and commercial and retail places are already setting up to reduce transmissions, such as screens, is hugely important.

What we have not talked about is the potential for flu transmission, which happens each winter, and the requirement for increased testing capacity, because the proportion of people with symptoms that could be Covid will massively increase in winter, probably threefold, because other things start transmitting, such as cold viruses and flu.

The implication of that is that we have to greatly increase our testing capacity. We need to sort out whether people have Covid or indeed whether we should have multiplex testing for other viruses such as flu, where we would then benefit from using antivirals. We need concerted action on flu vaccination to optimise that in high-risk groups and in health and social care workers so that we get really high coverage with the flu vaccine to reduce the impact of flu.

I emphasise what has been said over and again: we need a granular, real-time surveillance system in small communities looking for those outbreaks and understanding the mechanisms by which outbreaks flare up, to get on top of them as fast as we can if we are going to reduce those winter pressures.

Q175 **Lord Kakkar:** To be clear, there is agreement from our witnesses that the key to dealing with a potential resurgence of the first wave in the winter is that the number of cases in circulation going into the winter is as low as possible. If that is the case, is current government policy consistent with that goal of reducing the number of cases to as low a level as possible before the winter, or should more be done now?

Dr Sir Venki Ramakrishnan: If you look at the situation today in Scotland versus England, you will see that the total number of cases per capita is roughly comparable. In the early stages of the pandemic the two countries had a very similar outcome, but Scotland's infection rate today is about 10 times lower than England's: it has about three to five cases a day, and for a week now no deaths at all. If you were to translate that to the English population, that would be fewer than 70 or 80 cases a day and only a few deaths—actually, about one death a day.

I think we should aim to suppress the virus more completely before we go into the winter. That would give us much more leeway in the winter. It would also make a lot of environments safer, such as schools and hospitals, which we were worried about.

I believe the Government's policy is to make the number as low as possible, but perhaps that should be a very strong message. Perhaps elimination, by which I mean one case in a million, ought to be a stated goal, or at least an aspiration.

Sir Paul Nurse: I do not think I have much to add to what Venki said. I have opinions on how we might handle a second wave, but I think that is a slightly different question, so I will pass on this one and maybe if we have time we can return to it.

Professor Dame Anne Johnson: We just need to be clear about what we are trying to achieve, and I do not think that we have quite decided what the endgame is. It is really important to suppress the virus as much as we can over the summer, when it is less easily transmitted and people are outside, because we then start from a lower base in September when people start moving indoors.

That has to be balanced against what behaviour changes and so on we can maintain in the long run, but we could put more emphasis on what people can continue to do to achieve this. We have to do this work in the NHS and social care over the summer. It is critical to get this right and be prepared for this winter and make the place safe and resilient. That is hugely important, and it is now that we have to act.

Professor Baron Peter Piot: I do not have much to add. We should optimally use the summer time and September to make sure that we are starting the winter with the lowest possible infection rate. Outbreaks will happen for the reasons that everyone has mentioned. It is not a time to relax to the extreme the measures of social distancing, wearing face coverings and so on. We need to make sure that we have the systems in place, because we still do not.

Q176 **Lord Kakkar:** One area where there may be the optimisation, and it has been alluded to in this session, is the test and trace strategy. What might be done in the few months before we come to the winter to ensure that that strategy is optimised, particularly as we start to open up different environments such as schools, and in terms of understanding the appropriate application of such a strategy to the asymptomatic and pre-symptomatic cases, as well as symptomatic testing?

Sir Paul Nurse: Testing is critical across the board for this. Until we have a vaccine, we rely on testing and proper social behaviours. We face some challenges going into the winter. The first is a very general one. We have to clarify the leadership—we have already discussed the Government—because I do not see coherence between Public Health England, the NHS, the CMO and the CSA. I do not really know where decisions are being made and how they are being implemented—Anne mentioned implementation, and I quite agree. We need to clarify the whole governance and decision-making. That is a general point but one that I think is important.

On testing, the way it was handled initially when it was clear that testing capacity was pitifully low was to set up the big lighthouse labs. That was not a crazy idea, but what was not wise was to think that we could do that in a few weeks, which was logistically completely impossible, and it failed. So those big labs did not help with the first phase of the pandemic, as far as I can see—I have to say "as far as I can see", because there

been very little analysis of the data that has come out of those labs and whether it has actually worked.

The testing matters. It is not just a question of numbers—a lot of fuss has been made about the numbers—but also of turnaround. We know that at the height of the pandemic only about 8% of the big lighthouse labs were getting turnaround in 24 hours. It is also a question of accuracy and false positives. We have to use this couple of months, as Peter has emphasised, to see whether we have the testing capacity in place, embedded in a proper workflow—that is, collecting the samples, getting the information back, getting everything connected, and dealing with the medical advice when that information goes back. Do we have that in place to deal with a second wave? That requires critical analysis. If our present structures say yes, that is fine, but someone has to take responsibility for that decision. We should see no parcels being passed around between Public Health England, the NHS and the CMO or whatever.

My view is that we probably need to put more capacity in place, and I would put it in place locally, as we did at the Crick, because many things go wrong: the IT does not work, samples go missing and so on. If you are locally embedded, you solve these problems by putting sticking plasters over most of them; you know the people involved, you pick up the telephone and you solve it. It is very practical.

What we missed first time round was the huge capacity, or at least significant capacity, in our university and medical schools, all of which had been shut down because of the pandemic—a capacity of machinery and expertise that could have supported and serviced for example healthcare workers from care homes through to hospitals but also local outbreaks, with a much more rapid turnaround. We at the Crick, for example, test everybody coming into work. We have a turnaround in nine hours; it is impossible for the big labs to do that. We send people home if we find anybody who is infected.

What we do in schools and other workplaces has been brought up. Not everybody will be able to afford the capability to test, but we have to realise that it is needed to protect environments if we are going to restart the economy.

I am not convinced that there has been enough imagination, enough thinking out of the box, to deliver everything that we can in dealing with testing. We have to consider local testing and what the facilities that have been lying idle could have delivered had more imagination been shown in this area.

Dr Sir Venki Ramakrishnan: As I have already said, we need to be more ambitious about the scale of our testing, because we do not know all the situations where testing will need to be done routinely and frequently to maintain the economy and activities. That is definitely an important part and there is no other solution than having it widely distributed so that it is easily accessible and has a rapid turnaround time.

Lord Kakkar: Perhaps I may pursue one point made by Dame Anne

about the risk of a usual or indeed more ferocious winter flu season alongside a resurgence of this first wave of disease and how multiplex testing should be deployed to ensure that the healthcare system can cope with it.

Professor Dame Anne Johnson: There would a big increase in the number of people with symptoms—that is the first thing—and we would not know whether it was Covid or flu. On multiplex testing, one can imagine someone getting a test—it would be really important in a hospital setting to do it really fast—and one saying, "Has this patient got Covid, in which case I'll send them this way? Have they got flu, in which case I'll send them that way?"

The clinical management would be different, including the early use of oseltamivir, which we have never been able to do at scale although it is in the NICE guideline, because we have never had testing. So there is an opportunity here. I am not a virologist, and I would turn to others who understand the complexities, but it is clear that we need to think seriously about that as an option in hospitals, in primary care and in the testing system more generally.

On testing, we need really good surveillance of who is getting infected. What we have now is a lot of results—there were so many positive results—but who are the people getting infected? I do not mean, "Who are they?" but what their risks are. Are they healthcare workers or are they infected in care homes, factories or other social settings? If we understood that better, we could really target the testing system, which is what the local people want to do, because this is a really heterogeneous epidemic.

We need to think seriously about whether we need multiplex testing, but also the symptom rate will be so much higher that you will immediately have to do more testing regardless of any policies about screening.

Professor Baron Peter Piot: I agree with everything that has been said. I would add one point about coherence and making better use of the testing. As I mentioned before, we do not even know the NHS number of everyone who gets tested. Massive testing without a data management system and feedback to those people is pretty useless. It may be nice for statistics, but it will not really have an impact on the pandemic.

In addition to everything that Anne said about clinical needs, it is also time to be more proactive about using antiviral therapy for influenza, which has never really been part of common medical practice here. That also means that GPs—that is, primary healthcare—will have a crucial role in all this. We cannot continue to exclude them from the Covid response, because people will show up at their practices.

Q177 **Baroness Rock:** I want to come back to the incredibly important discussion about the operation and logistics issues, which Dame Anne raised, while Sir Paul talked about being more ambitious and needing more outside-the-box thinking. We have seen in countries such as South Korea and Germany a bringing together of private sector companies

working in the public sector, particularly data experts and workflow experts. Could you talk a little more about how we could bring public and private sector working together better in this area, and what lessons we could learn as we come into winter?

Professor Dame Anne Johnson: To be honest, I do not fully understand, for example, how the lighthouse labs that have been set up, have used a large number of private services. I really do not have sufficient detail on what has been used there. Operationally, I would draw attention to the fact that we have probably not used the capacity of directors of public health or local authorities nearly enough throughout this pandemic; nor have we really engaged sufficiently with the social care sector. Remember that a large part of that sector is privately run. We need to make sure that we have a much closer alliance with them.

This goes back to complex issues about the funding of the NHS and social care and how they are integrated, and how we make sure that in the policies on infection control, support for outbreak management, support for staff and outbreak prevention we link these private systems up with the NHS and with the public health function. For me, these are critical elements of where we need to work together.

We have to be careful. There is a slight worry that if there is a big problem we have a slight tendency to invent an entirely new system without linking it into what we already have. There are huge information systems across the NHS and across public health locally and nationally that absolutely have to be at the heart and centre of linking into any new initiatives. We have to be very careful about parallel initiatives that do not join up. Peter has raised the issue of the NHS numbers, which is a critical link for all these issues.

Professor Baron Peter Piot: I agree, but other countries that have been able to bring testing to scale and use it for a local response have engaged with everyone, including private labs. Sir Paul mentioned university labs, and we were ready too, but the system just is not ready for that. We are used to a hypercentralised system controlled by the NHS and/or Public Health England, but we need to think beyond that. As Venki said, we need to be more ambitious and stop thinking within the framework of how we have done it and should do it, because that is what we have done all the time. At the same time, where there are systems we should use them, but that has not been the case.

Another issue that I would like to flag is that when it comes not only to testing but to bringing all the various systems together in test and trace, we have to look at the privacy issues. Some people will interpret data protection and so on in a way that makes it really difficult to use them for controlling an epidemic. That is a discussion that we need to have in practical terms, not just theoretical or legalistic ones.

Sir Paul Nurse: As several people have said, we have an opportunity in the next couple of months. We have to think outside the box. Frankly, we have to get anything that works working. Not only that, but we have to build on the basis that we have. I do not understand why our GPS have not been used, for example. We already have a system in place. Who was

thinking that we could just move out of that? We have to think about the occupational health issues, about feeding back information, which can be really quite difficult for people to assimilate. It is all just too remote at present.

From the very beginning, we at the Crick have worked with a private company that provides testing to UCLH, because that gets past all the legal and accreditation difficulties. I am not sure that the lighthouse labs are even properly accredited. I suspect they are not, but I do not have information about that.

Just to ignore the local solutions is wrong. We have structures in place and we should use them. We have laboratories, both private and public, that are desperate to help, but they have all been ignored. There has not been leadership here. There has been no thinking about how we can actually deliver it. We have two months to solve it, and someone somewhere has to take this on and seriously think about how we could handle a potential crisis in the winter. That has to happen now.

Dr Sir Venki Ramakrishnan: The problem of data integration is a very general one. Combining that with respect for privacy was a known problem even before this pandemic. The UK should try to sort out how you integrate data so that it is accessible. Part of the problem is that a lot of the data that we want—for example, in the DELVE group that I have convened—is not even available or accessible. Even if it were, it might not even be properly readable in a useful way. That is a general problem.

Q178 **Viscount Ridley:** I come back to the issue of preparedness for future pandemics, and in particular to the discussion earlier that all of us were asleep at the switch and unprepared for this pandemic. I have looked up the facts, and Public Health England was spending 2% of its budget on protection from infectious diseases before this. It was spending three times as much as that on obesity. Does the panel think that the number should have been higher and should be increased in future? I have a similar question about the World Health Organization, which a year ago was paying more attention to vaping than to infectious diseases. Is there a risk that these organisations have been neglectful of their day job? Sir Venki, do you want to go first?

Dr Sir Venki Ramakrishnan: Peter is probably more qualified in this area, so perhaps he should go first.

Professor Baron Peter Piot: Starting at a global level, it is true that until quite recently the World Health Organization was not prepared. It was so heavily criticised in reviews after the west African Ebola outbreak that it switched the budget. If I remember well, it has three big goals, one of which is pandemic preparedness and response. Budgets have slowly been moved into that area. It is not where it should be, but it is better.

Domestically, we should have invested more. However, it is not just about specific budgets for epidemic preparedness; it is also about making sure that there is local capacity and surveillance. This is not just useful for once-in-a-lifetime—let us hope so—epidemics such as this one; there

are constantly outbreaks of food poisoning and measles outbreaks, because vaccination goes down. All that requires a system that is embedded locally, and that will be important.

We need to come back to what everyone on this panel has said: putting systems in place that are locally functional, credible and resourced. I could not agree more with Sir Paul that we have two to three months at the most. Whether we have a major problem or a more controllable type of problem in the winter will depend on what we do now to put policies and systems in place and, frankly, on individual behaviour.

We may have to stress that as a message: that it is not just the Government, the policies and the systems; this requires the co-operation of everyone. That is why in Japan, for example, for more than 100 years since the Spanish flu people have worn masks. It is not to protect themselves because they are paranoid or germophobic but to protect the community. That is the kind of cultural change that we need for the future. Shaking hands is probably out for ever. Using face masks when you have what could be a common cold should become the norm.

Viscount Ridley: I wanted to make that point. Is there an opportunity here to crack down on what you might regard as our extreme complacency with respect to common colds and indeed even the flu? We treat them as a fact of life, when we could be doing far more to make sure that our children are not permanently infected with runny noses. As you say, shaking hands and other things may have to change if we are to do that. Is there an opportunity here to get rid of not just pandemics but the routine viruses that we have put up with for so long?

Professor Baron Peter Piot: I do not think it is an opportunity to get rid of them completely, but look at Australia, where they are in full winter now. There has been a major decrease in incidence of influenza and all kinds of respiratory infections. It is not a controlled experiment, but it is most likely because of all the measures such as social distancing, masking and so on.

Many of the cultural behaviours in other countries may have been determined by the need to avoid epidemics. That may be the origin of not shaking hands and what have you. That is the opportunity. We are also talking about the long-term view. We are in the middle of a crisis, but we will need long-term behavioural and culture change, systemic change and institutional strengthening. All that will be key for societies living with Covid-19. Even when we have a vaccine, we will probably have to live with it because it is unlikely that we will have a vaccine that is 100% effective in sterilising. It could come, but we are not there yet.

Q179 **Viscount Ridley:** Do Dame Anne or Sir Paul think that the National Health Service should develop more interest in in vitro diagnostic tests generally? The In Vitro Diagnostics testing association put out a report a couple of years ago saying how dismayed it was by how little use was made of in vitro diagnostic testing in the NHS compared with other countries. We all know the experience: you go to see your GP and they do not send a sample off to find out what it is. They just say, "Well, take

an aspirin and come back if it doesn't go away". Is that something that should and could change?

Sir Paul Nurse: I think Anne would be better at answering this, but I think diagnostics is critical, so I agree with that. We are rather limited. It is just not happening, though; many of us are routinely tested every year in our GP surgeries, but other countries certainly do it more regularly.

Just to comment on the other two questions about the WHO and Public Health England, we need to get the WHO working better. Peter has commented on that and I agree. It is politically complicated. We should look at what it is doing. What clearly is not a good idea is to withdraw from it. The fact that the US has is very unfortunate and does not help at all. That action is pretty naive.

Public Health England could have been more imaginative. It had warning. Influenza was different, but we had the Cygnus trial a couple of years ago. It indicated that we were not prepared, so there was some sleeping at the wheel there. I would probably blame austerity, but frankly we were just not learning the lessons.

There needs to be an overhaul of the relationship between Public Health England, the National Health Service, and the CMO to get this all working better together, because that is not working yet. Once again, I emphasise the occupational health issue in all this: you need connection locally to get information and data back in a proper, clinically sophisticated way.

The Chair: Is that why Germany was so much better: because it has such a well-developed occupational health system?

Sir Paul Nurse: I think Germany did better for several reasons, and we have lessons to learn from it. Its occupational health worked, which was important. It was more local, which is also important. It also had more industrial capacity to cope and respond, more private testing but also the ability to produce things such as chemicals and equipment—I understand; I have not looked into that in detail. I think it had a broader-based economy that just coped better with it.

Professor Dame Anne Johnson: I have a couple of points. First, on diagnostics. Yes, we should be increasing our investment in diagnostics, but we also need better regulation of that industry across the piece, and we need to look much more closely at rapid tests and near-patient testing.

On capacity more generally and locally, it is really important that when we think about what needs to be done to improve the spend on pandemic preparedness and that we remember that this is not simply about our laboratory capacity but about system capacity. Because what we have learned from epidemics—this has been repeated over and over again—is that the test tells you that somebody is infected, but that is all it tells you. It does not tell you anything about the time or place or person. That requires granular and empirical epidemiological investigation, which in a sense is the bread and butter of what public health specialists have always done. We have to invest in those two sides of this equation, aligning for example molecular epidemiology with empirical epidemiology.

On culture change, I remind everyone that contact tracing is not the thing that gives you the biggest benefit in the TTI programme. The thing that gives you the biggest benefit, reduced transmission, is what Viscount Ridley just said: if you have a cold or the flu, stay home, stay out of the way of everybody, do not infect your family, do not infect the workplace, and do all the things that he just described: less shaking of hands, less kissing, and all the things that people do not do any more. That sort of Japanese approach requires a cultural change, which is what we may have to see, but everyone can participate in that.

The follow-on from that is that we need to get communication experts in to really get on top of the relationship with the public. They can give clear messaging based on evidence as we go along that can help people to participate and improve public trust in what we can all do to contribute, because that is empowering in its own right. That has to be done in a culturally sensitive way for the many people in the country that do not have English as a first language or that have particular cultural practices that need to be built into that wider programme. That was recommended in the Academy of Medical Sciences report.

The Chair: Thank you very much. Sir Peter, you have been advising the President of the European Commission. What issues have you been bringing to the commission's attention?

Professor Baron Peter Piot: I am a member of the panel advising Ursula von der Leyen on policy issues—frankly, most are not technical issues but political, such as opening the borders and so on—and Paul Nurse and I are working on a report on epidemic preparedness in Europe.

However, most of my time has gone into setting up the ACT—Access to Covid-19 Tools—accelerator to accelerate the development of vaccines, therapeutics and diagnostics, as well as fundraising for it; over €10 billion has been raised.

I am also working on a governance system to make sure that we get the best of both worlds: those who are innovators in academia but particularly those who are innovators in business, from biotech to big companies. We are now at the stage—this is in the news a lot—of making deals with advanced market commitments, particularly with vaccine developers.

What I like about it is that it will ensure not only that citizens in Europe and the UK have access to whatever vaccine proves to be safe and effective but that there is an equitable-access component for low and middle-income countries in particular, because they have no voice at the table. In these discussions, the deal is usually a certain percentage for citizens of a particular country in Europe—it is at a European scale—and a good proportion is reserved for use in low-income countries.

Dealing with epidemics is all about communication, co-ordination and logistics—all very boring at first sight, but you need to get them right. Then, of course, at the level of Europe, with tourism coming, opening the borders safely is a very complex issue with lots of trade-offs.

That is basically what I have been doing.

Q180 **The Chair:** Thank you very much. A last comment from the other witnesses, please, on any issue.

Professor Dame Anne Johnson: I have nothing to add. You have given us a great deal of time. Thank you.

Sir Paul Nurse: Thank you for listening to us. I would just repeat that we have two months to get it right for the winter. Let us use it properly.

Dr Sir Venki Ramakrishnan: We should not forget what science has ahead of us. For example, we need to test whether vaccines work, including on older people and those who are compromised. I mentioned drug development.

We could work on the genomics and evolution of the virus. We also need to understand why children do not appear to transmit the virus, despite being infected to similar levels, and to understand the biology behind it, because that might have more general implications. We should understand why children and young adults tend to stay more asymptomatic. Is there an immunological signature of protection that could be identified and then used to identify vulnerable people and help with vaccine development?

We could bring in an array of tools like transcriptomics and CyTOF analysis to analyse age, gender, ethnicity and comorbidity to look at these sorts of problems. Science has quite a lot to contribute to finding a solution out of the pandemic.

The Chair: Thank you very much. I thank all four of you enormously for agreeing to give evidence today. It has been a fantastic session and it has been nice to have you all. We will call on you again, I am sure.