HOUSE OF LORDS

Science and Technology Committee

Corrected oral evidence: Lessons from the COVID-19 vaccine rollout

Tuesday 8 October 2024

10.15 am

Watch the meeting

Members present: Brown of Cambridge (Chair); Lord Borwick; Lord Drayson; Lord Lucas; Baroness Neuberger; Baroness Neville-Jones; Baroness Northover; Viscount Stansgate; Baroness Young of Old Scone.

Evidence Session No. 1 Heard in Public Questions 1 - 23

Witnesses

I: Professor Sandy Douglas, Associate Professor, The Jenner Institute, Nuffield Department of Clinical Medicine, University of Oxford; Dr Adam Ritchie, Senior Vaccinologist, The Jenner Institute, Nuffield Department of Clinical Medicine, University of Oxford; Professor Catherine Green OBE, Associate Professor, Wellcome Centre for Human Genetics, University of Oxford; Dr James Miskin, Former Chief Technical Officer, Oxford BioMedica.

USE OF THE TRANSCRIPT

1. This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Dr Sandy Douglas, Dr Adam Ritchie, Professor Catherine Green and Dr James Miskin.

Q1 **The Chair:** I welcome the witnesses to the committee's one-off session looking at lessons learned from the Covid-19 vaccine rollout. In particular, we are focusing on the scale-up of vaccine manufacturing, which enabled so many doses to be produced so very quickly in the UK.

We have a range of witnesses: Professor Sandy Douglas, associate professor at the Jenner Institute in the University of Oxford's Nuffield Department of Clinical Medicine; Dr Adam Ritchie, senior vaccinologist, also at Oxford's Jenner Institute; Professor Catherine Green, associate professor in the Wellcome Centre for Human Genetics at the University of Oxford; and Dr James Miskin, former chief technology officer at Oxford BioMedica.

The session is being broadcast on parliamentlive.tv, and a full transcript will be sent to you shortly after the meeting to make any minor corrections. If, after the session, you think of anything that you think would have been of interest to us that you did not manage to say, or any data that you think might be helpful to us, we would be delighted to receive it as formal written evidence.

Let me kick off by asking each of you to set out your role during the Covid-19 pandemic and the vaccine rollout, and what you felt made the UK's vaccine rollout ultimately successful.

Professor Catherine Green: I head the University of Oxford's Clinical BioManufacturing Facility. We manufacture medicines for early-phase clinical trials, and during the Covid rollout we made the very first batch that enabled the trial to start very early. The UK trial for the Covid Oxford AstraZeneca vaccine started in April, and we did the manufacturing for that batch, in conjunction with Sandy and others at the University of Oxford, getting that material ready to start the trials fast.

One reason why we were so effective at getting the Oxford AstraZeneca vaccine rolled out in rapid delivery time was that ability to start clinical trials quickly. A trial takes quite a long time to deliver the results that the vaccine is working, so the earlier you can start the better. In Oxford, we rapidly initiated the early stages of development of the Oxford AstraZeneca vaccine; we started conversations in January about getting the ball rolling. That is one of the key things we did well for the Oxford AstraZeneca vaccine.

Dr Adam Ritchie: In February 2020, during the pandemic, Cath, Sandy and I, and three other colleagues, sat together in a room

and discussed this thing that was happening overseas and whether we should pull the trigger on accelerating a programme to try to deliver a vaccine that might work for it—remembering that, at that time, we had no idea whether the vaccine candidate we had would work at all.

We agreed in that meeting to do that, and it was thought that it would run like a normal vaccine programme where we work as a small team and everyone does a bit of everything. A week or two later, we took on different responsibilities. Sandy and I took over the plan to deliver a large-scale manufacturing process. We obviously worked very closely with Cathy and her team, who were doing the initial manufacturing, but we were trying to address the question: how to make initially tens of millions of doses of the vaccine on a timeline that would make a difference to a pandemic that appeared to be emerging. That quickly scaled-up to billions of doses over the coming months.

Sandy and I primarily ran that programme from February to May 2020 out of our offices in Oxford. AstraZeneca took over, effectively, in the middle of May 2020, at which time we shifted to working closely with it to deliver the increasingly large-scale programme to manufacture as much of the vaccine as quickly as possible.

The Chair: What enabled you to do that? As you say, you got together very early on, before the pandemic had really hit the UK. Did something enable that to happen?

Dr Adam Ritchie: Some of it is luck, and some of it is making your own luck by design. We have people who are always looking for the next potential pandemic. We had a platform that was developed potentially to deal with a new unknown disease, and that became the basis of the vaccine. Those things were there by design.

There were a few personalities and a few people, and we were able—at significant professional and personal risk at times—to make decisions to go quickly in a way that a large organisation might not have been able to do. But we also had bits of luck. In 2017 to 2019, for instance, Sandy and I had been working to develop large-scale manufacturing for a similar vaccine but against rabies. The background to that is not overly important, but it allowed us, in 2019 at Cath's facility, to use part of that new manufacturing process—at a smaller scale, for the first time—to enable our rabies clinical trials to happen.

The fact that that work had taken place was what we built our large-scale manufacturing platform on in January, February, March 2020 and beyond. It was a little bit lucky that it happened on that timeframe.

The Chair: Thank you. We will come back to some of those issues later. Dr Miskin.

Dr James Miskin: I am the former chief technical officer of Oxford BioMedica. At the time of the pandemic, I was a member of the senior executive team in the company, with leadership responsibilities for a number of areas of the business. I stepped down from my role at OXB back in May of this year, so what I am saying today is my own personal opinion.

During the pandemic, as an individual company the first direct involvement we had was a phone call from Sandy and a colleague, Adrian Hill, from the Jenner Institute in February 2020, basically encouraging Oxford BioMedica as a company to get involved in some way. As a listed company, it was somewhat challenging to make a decision not knowing what you were going to do. So I spent the next several weeks working with my colleagues in the company to commit, in some way or another, to what had already been formed, which was the University of Oxford consortium.

You asked what made it successful. Adam has already touched on this. It was a group of like-minded individuals in the university who pulled together a high-concept plan that was built upon by members of the industry brought in following a survey that was conducted by the BIA early in 2020. OXB and other organisations joined that consortium and that plan. Again, as Adam said, AstraZeneca joined formally in May 2020, but by that stage quite a lot of progress, thinking and planning had happened, and AZ took the choice it had at the time, which was to take the plan and, if anything, accelerate it. One of my concerns was that AZ would look at it and say, "That's not right. We'll do something different". It did not do that; it accelerated what was already in place.

The Chair: We will also be interested, I am sure, in coming back to the impacts of some of the Government's actions on companies that got involved and as vaccines changed over time. Professor Douglas.

Professor Sandy Douglas: My background is as a medical doctor. I lead a research group in the Jenner Institute developing new vaccines. One of our interests is the development of new methods for making new vaccines. I will explain the relationship between my team and Cath's. Cath runs a facility that makes clinical-grade

vaccine that will go into people. My team figures out how to do that and how to transfer the methods to Cath.

Why was it a success In Oxford? There is no such thing as overnight success. We had a technical and an organisational capacity, both equally important, built up over more than a decade to address other problems— difficult vaccines against malaria and TB, principally. That proved to be repurposeable, including, very importantly, the facility that Cath runs, which, very unusually for a university, gives us the capability, autonomously in-house, to make a batch of vaccine that can go into people. I do not think that many other universities in Europe, if any, have access to that.

Beyond Oxford, in UK industry we were phenomenally lucky in February 2020 to have just enough connections to be able to put out essentially a distress call. Cath sent an email to the UK BioIndustry Association mailing list that basically said, "We don't know how to make vaccines at large scale. Who can help?"

We got a set of supportive responses from various small contract manufacturing organisations, and my team, with Adam, was able to stitch those together into a consortium that might plausibly be able to make the vaccine at large scale.

It is important to appreciate that that early stage of the work through to April 2020 not only was not backed by any meaningful government funding for large-scale manufacturing but did not involve big pharma. AZ played an incredibly important role, but the core of the plan for manufacturing the vaccine at large scale was formed by small contract manufacturing businesses and medium-sized ones like James's.

You probably already know some of the things that went well in government. Patrick Vallance played an extremely important role early on. We were very lucky indeed that he was the Chief Scientific Adviser at that time, given his background. He was instrumental in setting up the Vaccine Taskforce, which, from its inception, played a hugely positive role, and its portfolio approach—backing more than one horse—was critical; the UK did not have all its eggs in one vaccine basket.

Perhaps slightly less obvious but equally critical in government, we could not have done this without the MHRA. A core part of the reason why the UK could be innovative in this space was because we had a highly capable responsive regulator. Not only was it able to turn around applications and review things in real time as we sent them in, but it had the experience and the expertise to look at new ways of doing things and to say, "Okay, that's not how it's

been done before, but we can see that that would be safe, so go ahead".

That regulatory capability is absolutely pivotal to our ability to innovate, and a key responsibility of government, in my view.

Q2 **The Chair:** A general question. In our current inquiry, we are looking at engineering biology, and we have heard a lot about the difficulties that arise in scaling up projects, not so much in scale-up funding but in access to facilities for scale-up and to lab infrastructure, and that kind of thing. From your experience, have you any thoughts about what government policy should be doing to make that easier. I see James and Sandy nodding.

Professor Sandy Douglas: The first step in taking something from the lab into humans, to do a phase 1 clinical trial, is making a first clinical-grade or GMP regulatorily compliant batch. For that, you need a facility like the one that Cath runs. It is extremely important for people to understand that the UK does not have many such facilities. I do not know whether it is quite true that the majority of all vaccines that have gone into phase 1 in the UK in the past 15 years have come out of Cath's facility, but a substantial proportion have.

Also, those small-scale facilities, which are the first step on the road, are not hugely expensive. Cath's annual turnover is about £2.5 million a year to do everything. We have those facilities.

The Chair: Are they funded by UKRI?

Professor Sandy Douglas: No, there is no core funding at all. There is no strategic funding. We have never had strategic funding.

Professor Catherine Green: We have no strategic funding. All my projects are funded on a project-by-project basis. An academic at the University of Oxford such as Sandy will apply for a package of money to do a rabies vaccine, I will make that and it will go to trial. Then, another grant goes in for another vaccine.

The Chair: So your funding could just fall off the edge of a cliff and you would lose—

Professor Catherine Green: There is no strategic funding. There is an underwrite from the University of Oxford, but there is no core funding routed through any Oxford scheme.

Professor Sandy Douglas: And it is precarious. There have been big points in the last decade where one individual leaving post could have led to the facility falling over.

Looking at the next step along the pathway and the facilities that have the capability to make commercial-scale millions of doses, the UK has those facilities as well. The facilities at Oxford BioMedica, which exist normally to produce cell and gene therapies, a completely different type of medicine, can be repurposed to make vaccines, and there are other facilities that we can use for that.

However, vaccines are not hugely profitable; there are lots of market failures there that you probably know about. There is no strategy to pull the facilities that exist into the vaccine space and to make sure that teams at places like Oxford BioMedica can respond and repurpose in an emergency if they need to.

So the facilities exist, but there is no government strategy I can think of to get the most out of them for the public benefit.

Q3 **Baroness Neville-Jones:** During the early stage that you are describing, did you feel safe doing what you were doing, or did you have a strong sense of it being a pretty risky operation? What was your sense of the level of risk?

Professor Catherine Green: Are you talking about financial safety? Which type of safety are you talking about?

Baroness Neville-Jones: There are several, obviously. Money is one. Another is whether it is all going to be a busted flush and will not get anywhere, it being medically not good, and so on. What were your concerns?

Professor Catherine Green: As academics, we at least have permission to fail, so the idea that we might attempt to make a vaccine and it not be successful is not really a worry that we have. As scientists, some things that you try are not going to work. In early 2020, we were saying, "At least we'll have tried, and if it's not successful, hopefully one of the others on the Vaccine Taskforce route will be successful".

We always knew that there was a possibility of failure, and as academics we perhaps have more freedom in that than someone in a for-profit company.

Dr Adam Ritchie: That was a big conversation in the team at times. The committee might be able to appreciate—we were certainly not unique in this during the early stage of the pandemic—that, as it exploded, we gave up the rest of our lives to make this happen. We had people who had just moved here from overseas who were feeling very isolated and were working 18-hour days seven days a week and almost sleeping at the facility. We often had conversations about "What if it doesn't work?" The

upshot was, "We will do the best science we can do, we will do it as quickly as we can to the highest possible standard, and we will trust our colleagues in London and overseas to do exactly the same. And between all of us something will work". But you do not know that it will be your one.

Professor Sandy Douglas: There was enormous risk—not patient-safety risk, but huge risk—that we would not be able to deliver what we were very lucky to end up being able to deliver. There was a technical element to that risk. I can probably say—I think it is in your book, Cath—that Cath's team's first effort to make the vaccine failed. Then they had to go back to the beginning, which cost a number of weeks. That technical risk was there because we had not done it in a rush before, and we had not really thought, "Okay, how do we have the back-ups and risk mitigations to make sure that this works first time?" We were not prepared, in short.

Then there was enormous risk stemming from a lack of timely funding. Adam mentioned the pivotal meeting. A key topic in that meeting was whether we could afford to take the risk of kicking out the project that was then in Cath's facility, delaying the deliverable for the funder of that project, which happened to be Innovate UK, and whether we could backfill if we lost that funding. We were putting at risk about £50,000 per week where we switched projects. It is debatable whether we did lose weeks over that; I think possibly we did. But for want of really very small amounts of money, meaningful time could have been or was lost.

At a slightly larger scale, when we were negotiating to book the contract manufacturing facilities to make the first large-scale batches, all through March 2020 we had agreement in principle from contract manufacturers that they would back us and make a batch. However, we were having phone calls every week and saying, "Next week there'll be some money. Please don't give the capacity away to somebody else". Importantly, that included a Dutch manufacturer which we knew was being approached by other development programmes.

We needed low single-digit millions to book capacity. We did not have that until early April 2020, when the BIA's predecessor to the task force connected us with Alok Sharma. We presented one slide and there was a one-line email saying, "You can have £65 million", so we were running on that for a while, but it was very precarious.

Baroness Neville-Jones: What were the Government doing in all this?

Professor Sandy Douglas: To start with, we did not have connections. Who are the Government? Who do we speak to? There were connections between the clinical development side—my colleague Andy Pollard and Chris Whitty, for example. There were established personal relationships there. There was no established relationship with anybody who might make a rapid decision to invest some money in making a vaccine quickly. Who even has that responsibility in government?

The very first contact we had with government about manufacturing was when I sent some emails to Patrick Vallance and Jonathan Van-Tam in late February or early March 2020, but the actual discussion that made things happen was brokered by Ian McCubbin and the BioIndustry Association's vaccine manufacturing task force, which predated the Kate Bingham VTF. It had the connections into government and the OLS to make things start to happen.

Baroness Neville-Jones: So that was perhaps when the framework for action began to develop.

Professor Sandy Douglas: Yes. I did not know who to speak to. Ian phoned me on the last weekend of March 2020. He obviously knew how to find the right people. Eight days later we were having a call with Alok Sharma.

Dr James Miskin: You asked about risk. I completely agree with everything that has been said about the personal risk and the institutional risk associated with those early decisions, which were taken at their own volition by individuals at the University of Oxford. That is absolutely vital. That step to get things moving bought time.

Oxford BioMedica was and still is a listed company with a primary duty to shareholders. The conversations that I was having with my colleagues in the exec team and with the board were more about what the risk was to the organisation.

To give a bit of background, OXB had made a decision, which I had driven back in 2017-18, to expand our manufacturing and development capabilities. By sheer chance, unrelated to the Covid pandemic, we had taken control of a commissioned, newly built facility in Oxford in the final quarter of 2019. We were in the process of planning steadily, gently, slowly—if that is the right word—to bring that capacity online through the course of 2020 and 2021 That was the plan.

We just happened to have a facility that was principally designed to manufacture viral vectors, our core business being viral vector manufacturing. We had no organisational experience of working with adenovirus-based vectors, but we knew a lot about how to make viral vectors safely in a clean-room environment and do the development work around that.

Going back to the risk, my challenge was needing some money to offset some of the work that had already been committed to with clients. As a company, we made a commitment to all our existing clients, who were working in the very meaningful development of cancer therapies and things like that that we would not delay any of their work unless we had to.

Our plan was to keep all that work on track but, in addition, to start building up our capabilities to support what was initially the consortium's plan to manufacture. That plan went from an initial 200-litre scale to, very quickly, within a few weeks: "We're going to have to do it at a larger scale".

As you can probably imagine, my challenge was that my team needed to be able to operate and to do the development work that was required by that group, and we needed to start putting the machinery in place—the physical equipment, and so on—to be in a position to manufacture later that year. The concept was that I was given a monetary figure—I will not tell you today what it was, but it was a reasonably substantial amount—the company said, "Go away, spend that, don't go over that amount" and, in the meantime, we had to hope for funding.

Like Sandy, I was talking to people like Ian McCubbin to try to encourage some tangible threads of funding. We had our own links as a company through IUK. We had several conversations there. Another fortuitous thing was that, again in Q4 2019, I had begun conversations with what was beginning to be the Vaccine Manufacturing and Innovation Centre—VMIC. I knew Matthew Duchars, the CEO there. We were trying to build a collaborative partnership with VMIC because it is a local organisation in an adjacent field, which made sense. That discussion changed through early 2020 into, "What can we use this relationship for?"

One of the things the Government did was to find a way of using the VMIC organisation for initial funding of some of the work that we needed to do. Also, VMIC purchased some equipment that we needed, for example. The equipment was paid for by VMIC. I signed an agreement in June 2020 saying that we would use that equipment with an option to buy it. We later bought that

equipment, so it was essentially a loan. It gave us that credible track record and momentum that we needed to build up.

We planned, at that stage, three 1,000-litre scale production facilities. As you probably all know, we ended up making over a hundred million doses in Oxford, in that facility. There is an alternative universe where that facility did not exist. Organisations like OXB have those core capabilities. There are not that many of them in the UK; I think ours is still the biggest facility of that type in the UK. It is worth this committee thinking about how we make sure that there is an ongoing mechanism to help that kind of thing to be there when it is needed.

Dr Adam Ritchie: Thinking about the bits that were lucky, what James has just talked about was the single most lucky bit: that the capacity was available. The odds of something like that being there next time are very low. Without it, I do not know that we would have delivered anywhere near what we were able to deliver.

Dr James Miskin: The facility is still there and busier now than it was at the beginning of 2020, obviously, which is exactly what the business needs. You do not need an empty facility; that is not good. Conceptually, it is about encouraging organisations to maintain that warm capacity, capability, competencies. The Covid vaccine manufacturing world was littered with examples of organisations trying to do something they had never done before. Quite a few organisations trying to make a viral vector had not done so before, and mistakes and errors were made. You need organisations that are in the right technical competency space to do that. Obviously, there are multiple technologies. We are talking here primarily about viral vector technologies, but there are others out there.

Q4 **Lord Drayson:** As a listed company, so without the academic freedoms that your colleagues had, how on earth did you manage to do it?

Dr James Miskin: I ill-advisedly went skiing in February 2020. I remember a very distinct conversation with my then boss that week. He had already started to show signs of support. I may have given you the impression that it took me a long time to get that support from my colleagues. It did not; it took two to three weeks. Within that period, I was given the budget that I mentioned earlier to get that early-stage stuff done and start putting in place the building blocks that we knew would be needed later that year if this vaccine candidate was remotely useful. At that stage, obviously it might have failed. We had no idea.

One of the conversations the board had, which somebody has already mentioned, was on vaccines being a notoriously challenging area for for-profit organisations, simply because a lot of vaccine projects are negotiated with Governments rather than commercial organisations, and Governments can and sometimes do change their mind quite quickly, which is not helpful for a commercial organisation.

So there was all that discussion, but at the same time—I speak here as a former leader of Oxford BioMedica—the general consensus among my colleagues at the BIA manufacturing advisory committee, for instance, was that everyone wanted to do something helpful, and suddenly you had a real common need and enough people thinking, "We need to do something that will make a meaningful difference".

Lord Drayson: Did you have support from your institutional shareholders to take that risk?

Dr James Miskin: We did not ask for support at that stage from our shareholders, primarily because there was not the forum to do that—there was not an AGM or anything like that. Also, we were committing to a sum of money that was within my personal budgetary remit in the organisation. Obviously, had it gone badly wrong we would not have had any future funding. By the way, our hope was that some commercial organisation would sign some kind of contract with us. In Oxford BioMedica's world, the fact that AstraZeneca joined in, novated over a lot of the agreements and accepted the responsibility for driving the plan was quite positive news for a company like Oxford BioMedica, primarily because we knew who we were dealing with. It is public that quite quickly we signed a contract with AZ very shortly after the University of Oxford did.

Professor Sandy Douglas: A further enormous risk was that we could have ended up with the wrong large pharma partner. I explained that we did manage to get a certain way without having a large pharma partner. Personally, I think that the fact that we were working with small entrepreneurial organisations was quite important for our ability to move quickly.

However, ultimately to do a global rollout, you need a big pharma partner. We spoke to a number of them at the same time as we spoke to AZ. I do not need to name names, but at least one, in my view, would have been a disaster, because they just did not share our vision, which was that the impact of this vaccine was going to come through making a very large amount of it quickly. That work needed to start a long time before we knew whether the vaccine

was going to work, and, given the technical details of how it was made, it was not going to be possible to do this just on one site for global scale.

James's site was able to fulfil UK needs, but to have impact in the world ultimately about 3 billion doses were made. Over half were made by the Serum Institute of India. We were working with it before we were working with AZ. It was enormously important for the global impact of the product that we were able to find a partner that was willing not only to keep going with this broad strategy of multiple sites but to work with this particular Indian company. It is the biggest vaccine manufacturing company in the world by number of doses, but it is an unusual organisation, and I do not think that every large pharma would have done that.

There was a lack of thought-through routes for making sure that a big pharma would deliver what we needed.

Q5 **Baroness Young of Old Scone:** I want to focus on whether some of the initiatives that were set up during the pandemic were the right ones and what has happened to them since. You mentioned VMIC. The aim was not only to get through the pandemic and produce the vaccines but to set ourselves up as a vaccine provider of the future.

Who wants to tell us the inside story of what happened to VMIC? Was it a good idea? Why was it scrapped, and who made the decision?

Baroness Neuberger: Look at the body language.

Professor Sandy Douglas: Yes, it was a good idea. The idea in 2017 that the Government should invest about £60 million in a facility to make vaccines in a hurry, in an emergency, was a good one and somewhat ahead of its time. In the pandemic, the facility was not ready yet. Some of the employees played important roles, but the facility itself did not. As you know, it got repurposed to become a commercial-scale, a much larger-scale, facility with further investment from the Vaccine Taskforce. That facility in the end proved not to make any doses and is now mothballed.

In my view, that investment in the facility did make sense as part of the Vaccine Taskforce's portfolio of projects. It was placing multiple bets and needed a couple of them to come off, and it was sensible to invest in that in early 2020.

From the pandemic, we have learned that it is very important for government to invest in innovative and rapid-response vaccine manufacturing capability. VMIC was a way of doing that. However I

have since had conversations with colleagues from Innovate UK, the UK BioIndustry Association and former members of the Vaccine Taskforce about how we could achieve the objectives that VMIC had but possibly do better.

I think we know now how we could do better, and it is not by building new bricks and mortar facilities; as I said earlier, the facilities exist. It is instead by having something like a peacetime vaccine task force that invests, puts in place the contracts for emergency response and decides over time to invest in this platform, that platform and that platform—a similar portfolio approach—and pulls in the capability that is used to make other sorts of medicines to serve the UK public for emergency vaccine response.

Looking around the world, other countries have learned the lessons. In early 2020, we were not as far forward as we could have been, but we were somewhat ahead of the rest of the world. From where we are sitting, it appears that government and the public have concluded that the UK can do this and that we do not need to improve our systems, whereas other countries around the world, notably the EU, have looked and thought, "Well, maybe things did not go so well. What preparations can we put in place?"

The EU has a scheme called FAB. It has placed contracts with budgets of €160 million a year with four contract manufacturing organisations to provide capability not just for mRNA, which is obviously important, but for other types of vaccine—viral-vector based and protein. They have a portfolio approach. Those contracts ensure that those facilities are ready, warm-lit, stocked, staffed and have the processes to produce up to 325 million doses of vaccine in a year when the EU says so.

Germany has done exactly the same, or a very similar thing, but within Germany, so it has domestic capability. If you speak to the contract manufacturers, they have done a detailed piece of work. They could press "go" tomorrow and make a batch of our vaccine probably more quickly than we could in the UK. The UK has absolutely nothing comparable.

Baroness Young of Old Scone: Is there a governing mind? Who is in charge at the moment, and who was in charge then? Who actually made the decision about VMIC going?

Professor Sandy Douglas: About VMIC being sold? The gossipy version I have heard is that basically Treasury got its hands on the remnants of the Vaccine Taskforce's investments. I was part of an informal working group with the representatives of the other

organisations I have mentioned. We made a pitch through Innovate UK for not even the whole proceeds of selling the facility but just the amount of money that had been invested pre-pandemic—about £70 million—to be retained for use in the field in order to do something like I described: a peacetime VTF, reserve capacity and so on. That proposal sank without trace.

Q6 **Baroness Young of Old Scone:** The comparative other side of this is the 10-year strategic partnership with Moderna. Do you think that government thinks that is a substitute?

Dr Adam Ritchie: I am worried that it does.

Professor Sandy Douglas: Do you know what that contract gives us? We were a bit concerned when speaking in advance of this session that we are a bit narrow: we basically have representation of Oxford here. We have tried to speak to colleagues with a broader understanding of the bigger picture of what is going on.

I do not know, and I have not been able to establish, whether the contract with Moderna extends beyond batches of basically a Covid vaccine and a flu vaccine—respiratory viruses. Think of the scenario where, for example, there is some obscure Ebola-like virus on the other side of the world and it is not yet clear whether it is an emergency. If there is somebody in the UK Government to decide that we should make a vaccine against it—I do not know whether there is—does that contract require Moderna to make a batch quickly when the UK Government say so? I have no idea. There may be a problem with what is in the contract. There is certainly a problem with transparency about what is in the contract.

Baroness Young of Old Scone: Does anyone else want to finger decision-makers in this, either in the past or—

Professor Sandy Douglas: Now you are saying it that way—

Dr James Miskin: As Sandy said, VMIC the concept was thought about and pushed for by the Medicines Manufacturing Industry Partnership and secured £66 million. The clue is in the name: it was supposed to be about vaccines manufacturing innovation and building a bridge between the academic world and the industrial world to try to accelerate new technologies, new capabilities and so on.

During the pandemic, the design of the facility and the remit of the organisation changed substantially from that innovation focus—early-stage, small-scale manufacturing; it was definitely not going to be commercial-scale manufacturing—to the number one priority being fill-finish capability, which, as a GMP expert, I have to say is

the single most difficult thing to achieve from the standing start of a field at the start of the pandemic.

In my opinion, there was no way that any competent organisation, even a very heavily staffed one, which VMIC was not, could have achieved that build in that timeframe and delivered. It is important to say that I do not believe that VMIC as an organisation did anything wrong. It was encouraged to change its remit. That decision may have been okay as long as it did not delete the original remit—that innovation and bridge-building and capability-building concept—which would have been a useful legacy.

Inadvertently, I have heard words to the effect that the industry stepped up and showed that we do not have a market failure in the UK for this problem, so we do not need to invest in government support for such capabilities. That is too big a jump to make. Oxford BioMedica is one of a few organisations that have relevant competencies, and another organisation, like a peacetime vaccine taskforce, that has the duty to co-ordinate and create that joined-up thinking is missing. I think that closing that concept off was a mistake.

Dr Adam Ritchie: In 2020, as a country we were at the front of the queue in many ways. Now I am not sure that we are not right near the back of it. The US is obviously very strong in this area. We have talked about what the EU, Germany and other high-income countries are rolling out. Organisations like CEPI—I should mention that Sandy, Cath and I get funding through CEPI—do a lot of work on improving capacity, but it is not there to improve capacity for the UK; it is there for low and middle-income countries.

There are big programmes to improve manufacturing capacity in almost every other part of the world at the moment, but there is very little here that would allow us to pivot quickly. The capacity is there, but there is not quite the pathway at the moment.

Professor Sandy Douglas: Where you are in the queue matters. We were early in our development, so we got first dibs on the finite global supply of all the tedious things like bioreactor bags, filters and so on that you need to make very large quantities of vaccine. Now, nowhere in the UK is holding stocks of them, to my knowledge. Germany has contracts with the suppliers already and would get them in an emergency.

The Chair: This is very interesting, but lots of people want to come in with questions.

Q7 **Lord Drayson:** During this period, am I right that the Office for

Life Sciences was the main vehicle for the connection between the Vaccine Taskforce and the machinery of government?

Professor Sandy Douglas: I believe so.

Lord Drayson: Who is responsible for the Office for Life Sciences and the machinery of government?

Dr James Miskin: As in, who is the director?

Lord Drayson: No. Who is the Minister?

Dr James Miskin: It is cross-department. It is between the Department of Health and what is now DSIT.

Lord Drayson: So who would have made the argument against the Treasury decision? If your rumour is correct, it was, "There is no market failure. We can cut this". Who was the Minister who should have made the argument, "This is a mistake"?

Professor Sandy Douglas: I believe it would have sat with George Freeman at that time. If you were to speak to Robin Shattock, for example, who was the chair of VMIC, I think you might find that he had let his feelings be known.

Q8 **Baroness Northover:** This question follows on from what you have just been saying. The UK's 2023 biological security strategy set out various initiatives that were intended to secure the UK against future pandemics, including targets to improve vaccine and therapeutics manufacturing. How well is this policy progressing—I think we have some of the answers there—and do you feel that the UK is on course to be ready for the next pandemic? What would happen if a novel pandemic threat emerged tomorrow?

Dr James Miskin: Personal disclosure: I knew of the strategy, but I did not know very much about it. I still do not, unfortunately.

Baroness Northover: Oh really?

Dr James Miskin: There are some high-level concepts and strategic aspects to the plan. How much of that has turned into action, budget and progress I cannot say, I am afraid. As Sandy said, we consciously know that we are a relatively narrow group of people here, with things that are specific to Oxford, so we have reached out and asked the opinion of the BIA and other organisations.

I think the general consensus is that conceptually it is a great idea as a strategy. The committee has been convened and has met on at least one occasion that we know about, but the remit seems to

be quite narrowly focused on, for instance, sequence security. That is an interesting concept, but what we are talking about here is readiness for a potential pandemic, whether the cause of that pandemic is a virus that escaped from a lab or has been generated artificially, or, more likely, is a pandemic of an already naturally occurring virus.

I have seen no tangible action that is helping to build the UK's capability around that yet.

Professor Catherine Green: We see pandemic threats emerging all the time. There is an ongoing Marburg outbreak in Rwanda currently, and Oxford has responded to that. We had a vaccine in early phase, and we will be getting manufacturing done through a different route, but not in the UK.

If we had a capacity to keep things warm, there would be vaccines that we could make for emergency scenarios. The money would not be wasted if we had a peacetime vaccine taskforce. It would keep them warm by making useful things that would go out into the world and have useful events. So we know what we should do, but we do not do that currently in the UK.

Dr Adam Ritchie: We discussed this beforehand as a group, and what James said about the strategy applies for all of us. No one has reached out to us or our peers on what we should do with vaccines under this strategy.

Professor Sandy Douglas: Not even consulted.

Dr Adam Ritchie: Nothing at all, not even an email or a phone call.

Professor Sandy Douglas: We looked at the strategy and the front-page highlights. There is something called the biothreats radar—fine—and a Minister for Biosecurity. I do not think that exists; you may know. As James said, we did a bit of homework on a leadership council. Our understanding is that its remit, or what it is actually doing, is very narrow and does not cover emergency vaccine manufacturing.

Regular exercises are also mentioned. That sounds like a great idea. If you are serious about the UK being able to make a new vaccine in a hurry, rather like the Army or a fire brigade you are trying to prepare for something that you hope will not happen but you definitely have a drill each year to ensure that you could do it—

Dr Adam Ritchie: That is what the EU is doing.

Professor Sandy Douglas: —and if you wanted to have capability that was any broader than mRNA and Moderna—as I said, I do not know whether Moderna is required to do that sort of drill—and have eggs in any baskets other than the Moderna one, I think we in Oxford would be involved, and we have not heard anything about it.

There is mention of the 100-day mission to make vaccines in response to a new pathogen within 100 days. CEPI, the Coalition for Epidemic Preparedness Innovations, is open to proposals and is funding people, including us, to develop that capability for global level. However, its remit is not the UK. I am not aware of any joined-up plan from government, either in advance to prepare and to make sure that we had the capability to respond within 100 days—that is certainly technically possible; it just requires some preparation and a modest investment ahead of time—or to know what will happen on day one. What is the process that we would follow in that emergency.

Dr Adam Ritchie: If Marburg gets out of hand tomorrow, we are not in a great position to respond to it.

The Chair: We have Patrick Vallance in two weeks' time, so will pass on your questions and comments to him.

Q9 **Baroness Neville-Jones:** I have a very narrow question in relation to what you just said. The biosecurity strategy has a very strong background in national security. Would I be right in thinking that the emphasis is on preventing bad things happening rather than on good things flourishing?

Professor Sandy Douglas: Seemingly.

Baroness Neville-Jones: I think it is to do with preventing pathogens and biological warfare.

Professor Sandy Douglas: The analogy with defence is quite important.

Baroness Neville-Jones: The bureaucratic energy has gone.

Professor Sandy Douglas: How do we prepare for an emergency that might never happen? Markets and pharma companies left to their own devices are not very good at doing that.

Baroness Neville-Jones: These are worries about things like China.

The Chair: I think it is one that we will take up with Patrick Vallance and explore it a bit further with him. You have given us

some really interesting input.

Q10 **Lord Borwick:** There was a lot of talk about the work being done in Wuhan before Covid appeared—the gain-of-function research that it was doing. Is that research being done now in Wuhan and by other countries, as far as we know?

Dr Adam Ritchie: We do not know what happens in Wuhan. We do not have oversight of that. Gain-of-function research definitely happens and there is good scientific justification for it. There was a reasonable controversy about this in 2014-15 around bird flu and swine flu, and studies into which mutations would make those flu viruses spread better or be more dangerous to people. There was a lot of umming and aahing about whether that should be published.

So research like that definitely happens, but with the purpose of informing us to allow us to prepare better, such as knowing what sort of flu vaccines we would need to combat a more dangerous flu virus. There is a very good justification for that, but what is happening in other countries that we do not have good contact with is hard for us to judge and hard for almost anyone to judge.

Professor Sandy Douglas: Should we be worried about someone bad making something bad? Absolutely, yes. It is entirely technically possible. It is probably not possible at a global level to get assurance that no one will do it.

Dr Adam Ritchie: You can get some mitigation. There can be regulation in national agreements that will decrease the risk somewhat. During your engineering biology sessions there has been some discussions of that in other areas. That is all very good, but you will never get it to zero. So what is the plan if something goes wrong? As James said, whether it is natural or a bad actor state or non-state, vaccines and other things like therapeutics are part of the response to that and doing that as quickly as possible. We do not want to be in a situation where it takes us six months to decide that we need to do something. Last time, we decided in less than six weeks. I do not want us going backwards.

Dr James Miskin: On the ability to respond, you cannot build that capability from nothing. You need established organisations that all already operating in a regulatory environment and making relevant stuff. It does not have to be vaccines all the time, but that for me is the thing that is easily the distraction: "Let's build a government-funded organisation". But then what do you get it to do? You will start looking at whether it makes sense from a financial perspective, you realise a few years later, change your plan and nothing happens.

Building on the existing infrastructure across academia and industry, from my perspective, is by far the strongest response, because then you have lots of eggs in lots of baskets.

Professor Sandy Douglas: When Robin Shattock and I were considering this pitch to retain the VMIC funding, we were conscious of the need to explain to government why having all the eggs in the mRNA basket was not a very safe idea. If I had to pick one basket, I would probably go for mRNA too, but there are some really important things that mRNA cannot do. In a scenario of a multi-resistant bacterium, you cannot make bacterial polysaccharides with mRNA, so we could well not be able to respond to that sort of situation.

Q11 **Baroness Neuberger:** You have answered a lot of what I was going to ask you. Let us give you a clean slate and you can design what we need in the UK. You are looking forward to this. We do have much power, but anyway. Clearly, we are going to have a peacetime vaccine task force. You seem to be agreed on that. That would take an overview of what we need for future pandemics. What else do we need to maintain strategically in the UK underneath that task force?

Professor Catherine Green: I will start at the front end, because that is my end. We need to be supporting creative, innovative academic manufacturing and idea generation. You need to know which kind of vaccines you are doing to make, so we need to be supporting the scientists, and not only in our universities; it can be small biotech. At the front end, we must know what these new types of vaccines will be that might be able to combat a potentially multi drug-resistant bacteria. We need innovation at the front end.

We then need the ability to demonstrate that they work in people, so we need an effective phase on clinical trials—all happening in peacetime, because that is the foundation on which you then pick the one that you will go up to. Then we need kept-warm manufacturing capability for sufficient doses for the population to draw on.

Baroness Neuberger: Okay, but in order to keep that academic skills base, how do you ensure that enough people are coming in who want to do that work? How do you support them? You are designing this system.

Professor Catherine Green: This is a huge ongoing question.

Dr James Miskin: There are things already. VaxHub is a good example.

Professor Catherine Green: We have some funding from EPSRC, from the UKRI foundations, to support academic funding for vaccine development. There are not very many of them; it is low-digit tens of millions over a seven-year period. It is not large amounts of funding. Maintaining this creative, innovative university infrastructure is hugely important, so keeping that funding coming through UKRI for grants for academics to do innovative work is really important.

Dr Adam Ritchie: Cath may not quite say it, so I will. It is very odd that the CBF—

Professor Catherine Green: That is my facility.

Dr Adam Ritchie: —Cath's facility, where so many of these vaccines are manufactured—has not had great funding. It is a small facility with one clean-room suite. We have been talking for a decade about trying to expand it, future-proof it and allow it to have greater capacity. It is pivotal. Without the CBF, there would have been no Oxford AstraZeneca vaccine at all.

Professor Sandy Douglas: I will have a go at something at a completely different end of this debate, if I may. Everyone thought in 2020-21, "Never again. Surely memories can't be so short that we won't figure out how to do this again". However, it seems that memories are quite short. Clearly, there is an enormous problem of long-termism here. We all know that democratic Governments are not terribly good at investing for the long-term in things that might never happen.

There needs to be some serious thought about how to impose cost on a Government who neglect this and about how to put in place the mechanisms to give this issue greater prominence in public and governmental discussion, and to make really clear who is accountable. Who is responsible for this?

I asked earlier whether there is a Biosecurity Minister. It seems like a good idea. I do not know whether it needs to be a dedicated individual, but this is a cross-departmental issue. The responsibility for this 100-day response clearly needs to sit with a named Minister. We were lucky that we had Patrick Vallance as the CSA. We might have a nuclear physicist in future. There needs to be a named, identifiable individual who is—I do not know what you would call them—the chief 100-day officer, the chief biosecurity officer, or the chief pharma officer. There needs to be a specialist non-Minister responsible for this.

There perhaps needs to be something that is at arm's length from government and is a reporting mechanism—something like an annual report on the state of the UK's preparedness and whether we are in a good place.

Baroness Neuberger: Could that sit under the Chief Scientific Officer and the Chief Medical Officer together, or something like that?

Professor Sandy Douglas: I do not know whether you think they are significantly independent to be able to say unpleasant things. It could sit with this peacetime vaccine task force. There are wider issues about scientific advice from the Covid inquiry.

Q12 **Baroness Neuberger:** You have talked about the pitch that you have made, Professor Douglas, so I will leave that to one side. You have also talked about not depending entirely on mRNA. That is really important; what other technologies should we be supporting? Obviously, we are not in the EU, but should we be part of something like the effort that the EU is making? Should we model ourselves on Germany? Should there be something like that, or should we do it entirely ourselves?

Professor Sandy Douglas: The EU scheme that I mentioned secures capacity to make three different types of vaccine. One is mRNA. Another is viral vectors, like the Oxford vaccine; there is a particular problem with them in that the world has concluded, rightly or wrongly, that they are not the way forward, so there are no companies doing them at the moment and it falls to us. Then there are protein vaccines, like the Novavax vaccine.

So the EU scheme has a reasonable portfolio of three different approaches, in my view. Between those, I would be quite confident that if a vaccine could be made against a viral threat, they would be able to make it.

Baroness Neuberger: And your bacterium?

Professor Sandy Douglas: I would add the development of a bacterial platform capability if I was able to. Could we buy into the EU system? That would seem to me to solve the problem if we could, but if not, we need to replicate something quite like it.

Baroness Neuberger: So do something like what Germany is doing.

Professor Sandy Douglas: Yes.

The Chair: We move on to Lord Lucas to talk about funding.

Q13 **Lord Lucas:** We have covered a fair bit of this already in one way or another, but is there anything else you would like to say about how what you would like to do ought to be funded? It is a perennial problem in government.

Dr Adam Ritchie: Yes, money is good. Throw money at it. One thing I would encourage is that, if there was a committee like this that was talked about, it would be best if it was set up so that it could make relatively low budgetary cost go/no-go decisions early on, accepting that most of those will be overreactions. If you are not responding quickly and find out that you did not need to respond nine times out of 10, you are responding too slowly.

So that is the one thing I would say: I would like the funding through that and the way it uses its funding to be able to go, "Let's start to make a batch against Marburg, Ebola, Mpox", or whatever it is emerging at the moment, and accept that a lot of the time we will not end up needing or using it. It becomes an exercise anyway in making sure that the capability is there. That is what I would add to what has already been discussed.

Professor Catherine Green: Often those would go into stockpiles or have uses elsewhere. Just because it does not become a pandemic does not mean that it is not a local problem. You do not lose that materially; you gain it in expertise and capabilities, and in soft power if you are delivering vaccines to where there is an outbreak in Rwanda.

Dr James Miskin: We need organisations that are ready to go and that have the ability to make at scale quickly. Some of the stuff like having the contracts and the agreements in place takes a long time. It is easy to do in peacetime. It is difficult to do when you are on your back foot.

Dr Adam Ritchie: One of the central tenets of how the Oxford programme started and what AstraZeneca took over was the distributed manufacturing approach of: "It's not a zero-sum game. We can manufacture some here in the UK, but we can transfer the process to India, South Korea or wherever, and they can make some". It is not a zero-sum game most of the time, with the exception of supply chains, in that if your supply chain is not secure and there is competition for the bioreactor bags, or whatever, and there are not enough of them, that becomes an area of difficulty.

Dr James Miskin: Going back to the experience during the pandemic of the supply chain, Oxford BioMedica manufactured many batches. It is not publicly disclosed how many, but it was a lot. That required a Herculean challenge in material supply to be

met: buffers, media, bioreactor bags, and having the agreement in place with suppliers, which are often global. We had the defence procurement Act to deal with during the pandemic, meaning that it was illegal in the US for multinationals to sell material to us in the UK or anywhere else other than the US, if there was a demand in the US.

Thankfully, most of the larger suppliers managed to find a way of delivering both to the US and to outside the US but be mindful of nationalism during that, and making sure that the UK was sufficiently well prepared. Having relevant suppliers, which are domestic, of capabilities that can be pivoted is, again, probably worth thinking about.

Dr Adam Ritchie: It is listed in the German and EU approaches that part of what they scope through their committees and their systems is looking at those supply chains. So funding to strengthen those chains is one area where the funding could be well used.

Lord Lucas: Can you send us links to the German and the EU schemes?

Dr Adam Ritchie: Yes, it would be quite easy to send Thomas the information, the links, on those.

Lord Lucas: You made a point earlier about fire drills. That combined with transparency might give the rest of us visibility of the vulnerabilities, which would make us want to fund them.

Professor Sandy Douglas: Absolutely. I mentioned the budget for that EU scheme. It is big-scale: 325 million doses per year capability across three different platforms. It would be lovely to have that here, but you could do a lot that would be helpful with a lot less than that.

For the capacity to exist to make commercial-scale, million-dose scale, batches of vaccines based on our technology platform, with an annual drill to show that it works and to make sure that the staff are trained, competent and so on, you are talking single-digit millions of pounds a year. You are not getting nothing for it; you would get millions of doses per year of a vaccine against the new pathogen, and there are plenty of things out there that the world could do with vaccines against.

As Adam mentioned, as well as that ongoing sustaining fund, there needs to be an emergency pot, a rainy-day fund that is there—the trigger gets pulled and, okay, there is £1 million tomorrow to do this for real. Where does the money come from? I do not know

where the proceeds of the VMIC sale have gone. Someone might be able to find them.

As for other possibilities, we in Oxford have had a lot of research funding over the years that has come through overseas development aid funding to develop vaccines for things like malaria and some of the outbreak pathogens—Ebola and so on. They are entirely reasonable ODA investments. So that is one budget.

If anyone is at all serious about thinking about this as a true national security priority, there is no real connection at the moment that I know of between this world and the defence world. If the Government are thinking of increasing spending on defence to some larger percentage, there is a significant amount of money available there, and a very small amount of it could make a very big difference.

Lord Lucas: Allowing the ministry to have a rainy-day fund would be a real Treasury innovation, and it would have made our response to BSE much quicker if we had had it.

Q14 **Baroness Neville-Jones:** You have said quite a lot about the partnership that is essential between government, academia and industry. We are going to see that pattern in the development of lots of science and technology in forthcoming years. In all that you have said, do you see anything being a key element or essential part of long-term working between government and health sciences, particularly vaccines, given that vaccines are not a great money-making area for industry? How does one maintain the necessary capabilities when there is no pandemic going on?

Professor Sandy Douglas: Obviously I am biased, but it is extremely important to think about the role that academics can play in this. What we do in Oxford is a bit like what small biotech companies do, in that we do the early phase of vaccine development—the first clinical trials for a new product, and so on. In industry, that is often done by small biotech companies that are quite short-lived. They are making a single product and then they get taken over into a bigger company if they are successful.

We in Oxford had the unusual experience that we were trying to make vaccines for very difficult diseases, and we had the capability and experience that usually sits in small short-lived organisations in an organisation with a very long institutional memory. That meant that we had individuals with quite broad experience, and as an organisation we collaborate. That is what we do; there is not a lot of barrier to me picking up the phone to Cath and doing a new project with her.

Contrast that with big pharma. As I said, AZ did a fantastic job. It has not had enough credit. It has not had the credit it deserves for what it did, and big pharma clearly has a central role in global scale.

Baroness Neville-Jones: But there has to be a transition at some point.

Professor Sandy Douglas: There has to be a transition, but look at how big-pharma vaccine companies around the world did in the pandemic. GSK, Sanofi, Merck all make a lot of vaccines, but none of them made a Covid vaccine. Pfizer did but with a small partner.

It is important to understand that big pharma is institutionally not very good at moving fast, so government needs to foster co-operation between different sorts of organisations.

Q15 **Baroness Neville-Jones:** And on that scale-up bit they need to be conscious of where the money needs to go in, presumably.

In light of the experience, this was a success story, but a rather nasty aftertaste has been left by what has happened subsequently. Are you concerned that the companies may have regarded themselves as having been a bit burned and thought that co-operation would not be forthcoming next time round? Has it left a negative legacy which government needs to do something about?

Dr James Miskin: To a degree, it has, yes. That said, the UK is blessed to have a close-knit BioIndustry Association network of organisations, behind which are individuals who care about this sort of thing. That is still there, so I would like to think that people would make those at-personal-risk decisions again.

Again, I am not speaking for OXB, but I can talk about the experience when I was at OXB when the decision was made by central government to stop ordering AZ vaccine. That was a very sudden decision. My personal view was that it was driven, to an extent at least, by public sentiment and some of the other geopolitical stuff that was going on in the background. That is unfortunate. For a scientist, you should make scientifically based decisions, and would it not be better to invest in understanding some of the challenges faced by particular platforms—all of them had some challenges—and try to solve them by funding that work?

OXB told shareholders relatively early on in the pandemic that we were going to do this work. OXB did not make the decision that AZ made, which was, "We're doing this not for profit", because, as a small company, OXB could not make that decision; that would not have been acceptable to the shareholders.

Some money was made—probably a bit more than was anticipated, because we ended up being one of the largest European manufacturers, if not the largest manufacturers, in Europe—so the sudden stopping of revenues was a big problem, which the leadership then had to deal with, and we had to make adjustments. You are probably aware that the company has resized relatively recently. We could probably have made that choice earlier if we had worried more about that sort of thing. My philosophy was, "We're a company. We're trying to build this competency, this capability, and we can build on that". You feel a little bit burned afterwards. It is public about Valneva and other companies having had similar challenges. Wockhardt had to make some people redundant; it made choices very early on post pandemic.

Baroness Neville-Jones: Would it be valuable for a new Government to have a proper wash-up with you?

Dr James Miskin: Very much so. You can learn a lot from what was done, and it could have been mitigated. Demand goes up and down, absolutely. I am sure that the current leadership would agree that this is something that the company has a duty to deal with, but ultimately there are ways of making it a softer landing for a company that essentially took on an enormous amount of risk early on.

Professor Sandy Douglas: I would just like to highlight the importance of good will in making things happen fast. It is not really possible to contractually enforce people working flat out 24/7, so for a future emergency response to happen as quickly as it could we need organisations, companies, to want to do it and to know that the significant risks that they are taking on, not just financial risks but reputational risks, will be covered.

Q16 **Baroness Young of Old Scone:** Going back to the resourcing, it sounds like there is not a lot of research collaboration, or indeed funding collaboration, between your networks and Porton Down's networks. Is that the case?

Professor Sandy Douglas: That is fair to say. I have never done a collaborative project with Porton Down, either the Dstl bit of it or the UKHSA bit of it.

Dr Adam Ritchie: Other people at Oxford do collaborate with Porton Down.

Professor Catherine Green: Particularly those who work on animal health. Teresa Lambe does.

Professor Sandy Douglas: There is very limited manufacturing capability and experience there. I cannot think of anybody in UKHSA or Dstl who has the experience, industry links and so on to act as a co-ordinator of any sort of emergency response.

Dr James Miskin: They could be a credible addition.

Baroness Young of Old Scone: One would hope, though, that if they are spotting fresh threats, that gets fed into the wider vaccine development community.

Professor Catherine Green: It will, but only to the extent that that would require somebody to write a grant to propose getting some funding to do the initial research. It is slow.

Professor Sandy Douglas: The fresh threats are spotted at a global level. There are email lists of people who are in emergency response and who get an update saying that there is a new virus somewhere or other.

Q17 **Viscount Stansgate:** You have mentioned already in your comments the Coalition for Epidemic Preparedness Innovations—CEPI—and I would like to ask you about the way in which the UK participates with CEPI on the potential next pandemic that may hit us. Do you have views on how the co-operation is going? What do you think CEPI's role is now, and how does it relate to the UK's role? Can we explore this area for a moment? That is really what this question is about.

Professor Catherine Green: The other guys are probably working most closely with the CEPI-Oxford partnership. There is a specific Oxford-CEPI relationship.

Dr Adam Ritchie: There is a CEPI-Oxford strategic partnership, which we do some work under, including significant work towards the 100-day mission. However, as we have touched on, that is very much a global 100-day mission. It is not about the UK responding quickly; it is about how we develop technologies to make a large amount of vaccine quickly and tech-transfer that to manufacturers in different parts of the world.

I do not know much about how the UK Government interact with CEPI or what funding comes from the UK into CEPI, but CEPI's mission really is global, and it is focused especially on low and middle-income countries rather than on what happens in high-income countries.

Viscount Stansgate: You made that clear earlier, too. Do you have any other thoughts on the relationship between the UK

Government and CEPI, as far as you can tell?

Professor Sandy Douglas: It is an enormously important initiative. It is very positive that the UK Government are a significant funder of CEPI and we (the UK) probably get very good value from that funding.

I have two words of caution. One comes back to the eggs in one basket versus portfolio approach. Relying on any one organisation to make the critical decisions in a real emergency is perhaps not the safest approach, so we should not rely wholly on CEPI's decision-making.

Secondly, as has been said, CEPI's remit is not the UK. Adam declared our conflict of interest: we have, and are seeking further, funding from CEPI to improve our technology, but when that discussion turns to whether it might be a good idea to set up something like the drills that we discussed so that we know that we could make a million doses in a hurry, and probably the logical and easiest place to do that for our type of vaccine might be at Oxford BioMedica, that is beyond what it sees as its core remit. It is turning its eyes to the UK Government. We would like to, but we do not know who that is.

Q18 **Viscount Stansgate:** What can we learn about what other countries are doing on emergency preparedness as a result of all your connections or interactions with CEPI? You mentioned earlier that it turned out in the end that a great deal of the manufacturing of one particular vaccine was done in India. Clearly, we benefitted from that ourselves, did we not? What have you learned about what other countries are doing, were we to face the same terrible situation again?

Professor Sandy Douglas: On the relatively narrow question of procuring and making available the emergency response manufacturing capability, we have already mentioned the EU and German initiatives. They are a very good template.

On the somewhat bigger picture, the really big players—the US, Japan—are investing orders of magnitude more money in vaccine technology than we are. That is relevant to us. We are competing to recruit the best scientists in a global market, and frankly we are not able to attract the best people from elsewhere to Oxford at the moment. We are largely dependent on home-grown talent.

In the US and Japan, there are serious strategic efforts to address the weaknesses in the current technology armamentarium. The obvious one I am thinking of is mucosally delivered vaccines, such as intranasal or oral vaccines, which might be easier to distribute

but also might induce stronger immunity where the viral infection is happening in mild infection, and hence not just stop people getting sick but actually stop a virus being transmitted by mildly infected people. That is what you need if you want the schools to stay open. I do not know of any UK strategy on that other than to rely on CEPI.

Dr James Miskin: Or a PhD student.[1]

Professor Sandy Douglas: Oh yes.

Professor Catherine Green: CEPI is also supporting significant global efforts to provide manufacturing capacity on the continent of Africa, in conjunction with the WHO. It was clearly a global response that was missing during Covid, so one of its key arms is trying to enable technologies that would provide better global equity by supporting manufacturing, such as we have in Europe, and getting that into Africa.

Q19 **Viscount Stansgate:** If we were to face another pandemic, would there be an element of competitiveness about where vaccines are manufactured and produced?

Professor Sandy Douglas: I think so, yes.

Viscount Stansgate: For the *Hansard* record, all four witnesses are nodding.

Dr Adam Ritchie: Vaccine nationalism is very predictable. We saw it happening. I remember Sandy and I sitting in my office early on trying to come up with our big concerns. We discussed things that thankfully never happened, such as military intervention to take vaccines from one place to another. That was our worst nightmare, and I am glad to say that it did not come about.

But lots of the things that we talked about did come to the fore, such as export blocks from India during the pandemic when it was in a particular wave. Our biggest manufacturing was in India, so that was a challenge. Thankfully, because of the distributive manufacturing, the big Korean manufacturer was able to step up and continue to supply countries that did not have their own manufacturing.

[1] There are small amounts of funding that might contribute, but it is not enough in terms of technology or platform innovation. One example is the OXB-UOXF-UCL-BBSRC-funded collaborative training partnership (ABViP - Advanced Bioscience of Viral products) - there is a PhD student with Sandy investigating "Properties of adenovirus vector mediating mucosal immunogenicity". This could perhaps be used to illustrate there is a need to scientifically address some complex challenges, and the community will try to find a way to explore it within the confines of available funding sources.

That sort of approach helped somewhat, but it is never going to be entirely equitable. CEPI and other organisations would love it to be. Morally, I would love it to be, but I also live here first.

Dr James Miskin: It is publicly known that OXB made the majority of the UK doses of the AZ vaccine, but it was also used to supply other territories. So it was not just the UK.

Q20 **Lord Drayson:** On the point you just made about how in Oxford you are struggling to attract the best people now, I think the UK was lucky that Oxford was a centre of excellence that has been built over more than 30 years; it started with Professor Moxon and the Oxford Vaccine Group. So what is going wrong with the funding? Could you address from the academic and the company standpoints the availability of funding to maintain the academic excellence and the view of institutional shareholders in the light of the experience that OXB and other companies went through?

Dr Adam Ritchie: This is broader than vaccines, from the university perspective. Before I was at the Jenner Institute I was in the School of Government, which was having trouble competing with Harvard, Chicago and so on to attract the best and brightest academics on public policy internationally—another topic that is fairly relevant here.

In short, salaries are relatively low and the cost of living is relatively high, and if you are the best and brightest sitting somewhere else and you can go to the US, where your salary will be twice as much and the cost of living is lower, the self-interest decision is to go to the US, or maybe Germany, or lots of other places. That is the first big thing.

Lord Drayson: There is the access to grant funding that has sustained your facility.

Professor Catherine Green: That is also true: that academics, more and more, see a struggle to attract research funding in the UK. If you had a great grant, you could fund a great big lab and you might be prepared to take a personal salary cut. But we do not support very well funding for PhD students and PhD projects in this country. It is quite hard as academics to get the next generation into our labs, because many of those funding streams have been cut. It is very difficult to fund those via UKRI, for example.

Dr Adam Ritchie: The VaxHub funding we mentioned is good, because it is longer.

Professor Catherine Green: It is not just the academic salary. The whole ecosystem for supporting academic research is struggling at the moment.

Lord Drayson: On the company side, you have made the point that the BIA and the industry came together in the national interest. However, the biotech industry depends on the support of investors to exist. What is the current attitude of those investors, in the light of the experience of OXB, should this happen again?

Dr James Miskin: Again, not speaking as a representative of OXB, lots of positives came from the relationship that OXB ended up nurturing with AstraZeneca. We built lots of communication with teams at AZ. We did not have a partnership with AstraZeneca prior to that. That has been helpful and positive.

The shareholders are not against doing the kinds of work that we were talking about, the keep-warm type of activities, on the proviso that it is put into the pot of projects alongside all the other academics' mid-size / small-scale biotechs and big pharma companies. There is capacity in OXB and other organisations to do that kind of work and the shareholders support doing it, providing that it is not made at a loss. Companies, I think, will look favourably at doing things at relatively marginal cost to be involved conceptually. There is still a level of commitment from the leadership in UK biotech companies and CDMOs to do that sort of thing. I do not think that bridge has been fully burned.

Q21 **Lord Drayson:** Looking forward, you have already given us some really helpful advice about what you think the new Government should be doing in the light of this experience. We are nearly 100 days into this new Government. Have you seen any difference so far?

Professor Sandy Douglas: There has been an expressed willingness, I believe, to fund Innovate UK on a 10-year cycle rather than from spending review to spending review. That is really important.

Lord Drayson: Are the Office for Life Sciences and the new Science Minister actively working to build this vaccine capability that you point out the UK really needs?

Professor Sandy Douglas: It is possibly too soon to say. I am glad that Patrick Vallance is in the post he is in and I have a degree of confidence that if anyone will, he will.

Q22 **Lord Drayson:** Are there any other points in addition to those you have already made that you would like to share with us regarding

learning the lessons and a new Government taking actions for the future?

Dr James Miskin: Speaking from my experience sitting on the leadership team for the Medicines Manufacturing Industry Partnership for many years—I stepped down earlier this year, for obvious reasons—one of our frustrations as a group was that cycle of funding and not knowing when the funding would be allocated. We think it is coming up and then the spending review gets delayed. Typically, the view from the industry perspective is that often things take a lot longer than we feel they should, and the window of funding is, bizarrely, frequently narrowly crammed into a particular tax year—to deal with Treasury issues, I assume.

If you could circumvent that in some way by having that longer window horizon, that would be good. For industry, you need pots of money that are relevant for competency building that do not crop up once every six years without any warning but are there every six months. They are something on which you can say, "I'm not ready now, but I'm there for the future". That applies to collaborative R&D funding, but also to things like capital support.

I push for getting a significant amount of capital support for things in an adjacent space—building capabilities for cell and gene therapies. One of my personal bugbears is that I keep coming across the same problem: you have to be able to say to a Treasury forensic accountant, "You wouldn't do this project unless you had that 10% or 15% of additional support from the UK Government", which as a company is very hard to say categorically.

Taking away some of the requirements for that sort of thing in order to encourage growth of organisations to build capabilities, and then be able to see that there is a window of potential funding for a project where you can build that relationship with your academic colleagues and go together to put a grant application in, would be helpful.

Q23 **Lord Drayson:** Are there any lessons that we must not forget from this experience?

Dr Adam Ritchie: There are two big ones that we have come back to multiple times. Do not pick a winner. If the lesson is: "mRNA will save the day", that is the wrong lesson to take away. We need a diversity of approaches. Also, the UK, having once been at the front, is now falling behind, because other countries are either building capacity or building a way to pivot existing capacity to deal with an emergency in a way that is supported, funded and actionable. We are not seeing that from the UK at the moment, and it is a concern.

Dr Sandy Douglas: I mentioned earlier the idea of a peacetime vaccines task force and maybe retaining some of the VMIC sale proceeds in the field. When we were discussing that idea, we were very much thinking about lessons from what had been done before and how to overcome this long-termism problem.

We talked about whether that funding could go into an endowment or some structure like that, which is quite foreign to how UK research is funded at the moment but could be worth looking at.

Also, the Vaccine Taskforce was essentially a venture capital outfit and it was very flexible. One of the things it did very successfully was fund responsively in the way that was appropriate to an individual project, with very expert people making those decisions. It was not your typical Innovate UK call for proposals and then a year's review or whatever.

There is a role, if government is seriously trying to achieve missions, which this is, for that VC-type approach to make really rigorous investment decisions efficiently.

The Chair: Thank you all very much. It has been a really interesting session. As I say, we have upcoming sessions with our current Chief Scientific Adviser and Patrick Vallance, the Science Minister. We are about to have a private session to look at what questions we want to ask them. I am sure we will put to them some of your points. I very much appreciate that. At this point, I thank all our witnesses.