

Select Committee on Risk Assessment and Risk Planning

Corrected oral evidence: Risk Assessment and Risk Planning

Wednesday 9 December 2020

10.30 am

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Members present: Lord Arbuthnot of Edrom (The Chair); Lord Browne of Ladyton; Lord Clement-Jones; Lord Mair; Baroness McGregor-Smith; Lord O'Shaughnessy; Lord Rees of Ludlow; Lord Robertson of Port Ellen; Baroness Symons of Vernham Dean; Viscount Thurso; Lord Triesman; Lord Willetts.

Evidence Session No. 3

Virtual Proceeding

Questions 28 - 41

Witnesses

I: Professor Sir John Beddington, Former Government Chief Scientific Adviser; Professor Sir Mark Walport, Former Government Chief Scientific Adviser.

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Examination of witnesses

Professor Sir John Beddington and Professor Sir Mark Walport.

Q28 **The Chair:** Welcome to this evidence-taking session of the House of Lords Select Committee on Risk Assessment and Risk Planning. We have two witnesses today, former Government Chief Scientific Advisers Professor Sir John Beddington and Professor Sir Mark Walport. You are both particularly welcome.

A transcript of the meeting will be taken and published on the Committee website. You will have the opportunity to make any corrections that turn out to be necessary in the transcript. I would like, as a matter of practice, to finish this by 11.45 am, so please will you bear that in mind? Could Committee members please ask snappy questions and could the witnesses please give snappy answers?

Let us begin with a question about the role of the Government Chief Scientific Adviser in the risk assessment process. What would you say that that role was? From your experience, can you share any general observations about the national risk assessment process and how effectively it works?

Professor Sir Mark Walport: As you know and will have heard, the national risk assessment is led in its preparation by the Civil Contingencies Secretariat. Individual government departments have the responsibility of working with one another and the relevant agencies on each of the risks, according to the appropriateness of its allocation to that.

The job of the Government Chief Scientific Adviser is to make sure that, as far as possible, it is wholly evidence-based. The job is working with the chief scientist in each government department because, as the Committee will know, all government departments have chief scientific advisers. Their job is to work with their departments to make sure that the evidence base is properly developed and then acted upon for all relevant risks.

The UK is one of the leading countries in the development of a national risk assessment, the register being the public version. The challenge is how it is used. My general observation would be that the risk assessment is used more for handling emergencies when they arise and clearing up afterwards. It could be used more in preventing adverse events happening wherever possible and mitigating them in advance.

The question is the extent to which insurance policies are paid to prevent emergencies happening, where they can be mitigated by an insurance policy being taken out. Everyone has coronavirus in mind at the moment. In that context, we can see that Governments around the world are generally much better at managing the last emergency than they are the next one. I was very involved in floods at the start of my time as Government Chief Scientific Adviser and it was quite difficult to persuade

people that it is important to invest against the development of droughts as well.

Professor Sir John Beddington: Mark was rather more recently in this role than I. When I first became the Government Chief Scientific Adviser, its role in the national risk register and risk assessment was really very minor. I started to make fusses as various emergencies occurred and, towards the end of the five years I was in the job, things had improved quite dramatically, so that we were working very closely with the Civil Contingencies Secretariat. It sounds, from what Mark has said, that that has continued and things are working pretty well.

I was concerned that the allocation to individual departments of a particular risk meant that certain other relevant departments were not involved. The way I mitigated that was by using the regular weekly meetings that I had with all the chief scientific advisers to indicate that this particular risk has been allocated, for the sake of argument, to transport; however, this is highly relevant to the Ministry of Defence or BEIS—BIS, as it was then. That was one of the issues.

In the way the risk assessment has been done over the years, there has been a real improvement, but there is a bit of a flaw in the way it is constructed. I am sure we will come on to this in more detail later, but there is a likelihood of a particular event occurring, which is on the X axis of the risk matrix. That is a logarithmic scale and perfectly sensible. If you then look at the impact scale, that has come about by averaging various possible impacts, which are scored from 0 to 5.

The average is not that meaningful, because the impact scale would show, for example, a slightly lower impact from an electricity disruption than the pandemic we are currently experiencing. That seems to me to need re-examination of the way the impact is looked at. It will not be easy, but try to think about some degree of quantification of that impact that goes way beyond what is currently done, which is on a 1 to 5 scale.

The Chair: We will go into all those questions in more detail during the questioning that follows, but if it were easy you would not be involved in it.

Q29 **Lord Browne of Ladyton:** John's last remarks are a pretty good bridge into this question, because it is about the risk assessment process and the methodology. It is our understanding from evidence that we have heard and that has been submitted to us that any risk assessment process or categorisation of risk is determined by combining the likelihood and the impact of a particular risk, as you have led us to, Sir John.

You have already told us something of your assessment of that approach and how it could be revised. Were you aware at any stage in the process whether there was an alternative approach to risk categorisation proposed and rejected or how we came to this particular approach? Could a more qualitative evaluation of the broader contextual factors have been

built into this?

Professor Sir John Beddington: The current risk matrix and the one I inherited seemed to have been established for some while before I came. There are alternative approaches. I commissioned one of the Blackett reviews to look at high impact, low-probability events, and it came up with an alternative schema. Being quite frank, it was very complicated and very hard to see that it could be adopted in a useful way. I am pretty content with the current risk matrix idea. The public document in 2017 uses it rather well and shows how the risks are ranked. It is fairly clear and understandable to the general public, which is highly important.

I know you had Roger Hargreaves giving evidence somewhat earlier in this inquiry. One question that would be reasonable to pose for the future is to do not so much with the likelihood of risk, which is reasonably well done, but with the impact. In a sense, I am starting to repeat myself, but I feel that the Covid pandemic indicates that these things should not be done in quite the same way as they hitherto have been.

Professor Sir Mark Walport: On that point, I essentially agree with Sir John Beddington. There are things that could be improved, although the danger is that you end up with a complete mess because it gets so complicated. Each of the risks contains within it a number of different scenarios. If you look at the one that is very germane at the moment, pandemic infection, in the national risk register of 2017 there are two scenarios. There is the flu one, which is undoubtedly the commonest pandemic historically over the last century, and SARS was given as the other example, which was a new and emerging infection that caused a relatively limited outbreak. It was mainly infectious when people were at their sickest, so it was somewhat easier to control.

But there is a whole range of other scenarios of emerging infections, and we are seeing one of those at the moment. Indeed, when I was the Chief Scientific Adviser, I initiated science guidance papers for helping with the management of SAGE. In that, we had an additional emerging infection scenario that was more smallpox-like, with a much higher mortality than we are currently seeing with coronavirus. The bottom line is that there is a very wide range of scenarios of emerging infections, just as with floods, for example. At the extreme end, you have a severe east coast surge that could cause enormous damage, against which a lot of planning has been done. Within each risk, more of a scenario approach might be a better way of looking at it.

Q30 **Lord Rees of Ludlow:** I would like to go back and ask a bit more about the matrix, which is the only way the public get a feel of the assessment of the relative likelihood and severity of these things. One criticism has already been made in answer to the first question, which is that the severity is not sufficiently manifested because, within grade 5, there is at least a factor of 100 spread between the really, really catastrophic and something that makes it into grade 5. It would be good to know whether there is a better way of presenting the range of really extreme phenomena.

In terms of the likelihood, it depends a bit on the extent to which you are planning ahead, because there are a number of risks that are getting more likely year by year, within a 10-year timescale, such as cyber and bio threats. That surely needs to be taken account of in the planning process, but it does not show up at all in the matrix. I wonder whether you could expand on what you said about how one could improve the presentation of the risks in the public document.

Professor Sir John Beddington: The first thing is the trend. You are quite right, Lord Rees, in indicating that such risks are not static. One of the obvious examples is that some of the weather events are subject to climate change. Therefore, some events to do with warming are moving to the right, becoming more likely, and moving up, with more impact. That expectation is definitely there. Oddly enough, the Met Office has just announced that one of the rather high risk weather events of heavy snow and cold is moving in the opposite direction, given climate change. We are not going to have any heavy snow or extended periods of cold over the next few years.

You are completely right. Of course, there are other trends. You mentioned cyber and the problem of antibiotic resistance. Both of those are very concerning, and they should be taken into consideration. Your point, which in a sense both Mark and I dealt with earlier on, is the enormous variation you see within an impact category between the very worst case, the reasonable worst case and the most probable case. That needs to be examined. Mark's suggestion of thinking about different scenarios is definitely a way forward. We can think about pinpointing these various events on to a simple matrix but then expanding a particular point to show the range of outcomes that could occur, which would be through scenario analysis.

Professor Sir Mark Walport: Building on that answer, it is important that this is used as a planning document. That is where a lot of the challenge is. The risk assessment is the starting point. It is then a decision as to how much energy you put into each of the possible scenarios.

There are some extreme existential threat scenarios, such as a very large asteroid crashing into the planet. It is unlikely that any single nation is going to tackle this problem and it becomes a broadly political question as to how much attention is paid to these very extreme events. Similarly, you can imagine that there are extreme existential threats related to nuclear. There is no doubt that nature still beats humans almost all the time. There are some very large tsunamis that do not pose planetary existential threats but may form national ones, such as Tenerife falling into the sea in relation to the east coast of the United States.

How do you make sure that, at some level, it is comprehensive but also that it is a useful document? I cannot think of a better approach than some kind of scenario-based one, because almost every event on the risk register carries something from a small threat to a very large threat. In the case of a small number of them, it may be an existential threat.

Lord Rees of Ludlow: There is also a classified version, which of course we do not know about. Does that change your perspective drastically?

Professor Sir Mark Walport: It does not, because the classified one is mainly on the threats side. There are the natural hazards and the threats. There is the NRA and the national security risk assessment, and I understand the two are being brought together. It is clearly on the security side that more is classified, for obvious reasons.

Lord Rees of Ludlow: I have a supplementary to Sir John Beddington about the Blackett review of high-impact, low-probability risks, which was an important advance. Would you like to say anything else about the recommendations that were or were not implemented and what you learned from that exercise, which produced a very worthwhile document for us to read?

Professor Sir John Beddington: The document makes 11 recommendations, some of which, looking at Roger Hargreaves' evidence, have been implemented. We did the sorts of things that various Select Committees, in both the Commons and the Lords, have been suggesting, bringing in many external experts rather than keeping it among government officials and the CSA network. It was very effective in that sense.

One thing that was recommended has been done to some extent. Recommendation 5 concerns probabilistic analysis and recommends it to government. That is very important. It can mean looking at scenarios, but it is also a real problem in thinking about how one passes on recommendations about probability to government. The current risk register operates by saying that a risk is one in 100 years, one in 200 years and so on, using a logarithmic scale. I found it quite useful when I was dealing with individual scenarios to reframe the probability analysis and ask, "What is the probability that you will go five years, or 10 years, without a phenomenon such as this occurring?" I found that really effective to use in communication. That is pretty much one of the recommendations that the Blackett group had.

I passed over the mantle of GCSA to Mark in 2013 and things may have changed. One recommendation that was implicit in the Blackett review was that one should compile a list of high-impact, low-probability events. We started to do that in an ad hoc way, but something more comprehensive on that would be very welcome. Mark has cited a few of them: Tenerife falling into the sea and flooding New York; an asteroid taking us all out. These are the sorts of things that have a low probability and a high impact. There are some less existential risks that could be documented. An exercise such as that might well be co-ordinated by the Cabinet Office and the Government Office for Science, bringing in a lot of individuals to give indications and then some degree of synthesis.

Q31 **Lord Mair:** Sir John, you spoke earlier about the question of co-ordination between government departments. What is your assessment of the way in which risks are assigned to lead government

departments? Does the system of risk ownership allow for effective co-ordination for the assessment and mitigation of risks that might impact across more than one department?

Professor Sir John Beddington: When I arrived as Government Chief Scientific Adviser, that was not working very well at all. In a sense, the Government Office for Science was not much involved even in developing the risk matrix. That changed quite quickly. After a couple of years, it was happening. The major co-ordination we had was primarily at the chief scientific adviser level. That worked reasonably well.

There are always going to be some problems in saying, "This is a transport problem" or "This is a BEIS problem". There will always be some degree of debate about that. Indeed, when you move to the COBRA activities, you can sometimes have a lead Minister or, where the activities spread beyond an individual department, COBRA can be chaired by the Prime Minister. Those things are working.

The actual allocation of which is the most important department, at least from reading what has been happening recently, seems to have been done fairly well. Mark would be able to comment in more detail on the co-ordination between different departments that have relevance to a particular issue, because I am yesterday's man. The year 2013 was the last time I looked at this carefully.

Professor Sir Mark Walport: I too am yesterday's man with respect to this, but I am slightly more current than John. The Government Office for Science, as a result of John's pushing, became much more involved in the national risk assessment process. Indeed, there was a presentation to the Cabinet that I attended in 2013 on the national risk assessment. When it came to the 2016 NRA, I co-signed the foreword to it with the Minister for the Cabinet Office at the time, so there was much more involvement.

The departments need to be involved, so it makes complete sense to have a government department leading because, at the end of the day, they are responsible for responding. Almost every risk involves a number of government departments. Transport gets caught up in everything; housing gets pretty much caught up in many things. It comes down to, as with most things, the question of money. For almost all the risks, there is an insurance policy to be paid if you are going to mitigate it, prevent it happening and, indeed, handle it. For example, how much personal protective equipment do you have in stock? That is where the challenges come in departments.

Let us take the National Health Service. One of its issues is that it is really the national disease service, in that its day-to-day activities are driven by the management of disease. If you are operating the NHS, the incentive to spend a lot of money on an insurance policy is quite challenging. When it comes to public health—we have seen the importance of public health with respect to the coronavirus pandemic—a lot of the levers for its management sit with other government departments. They sit with education, housing, transport or culture.

That is where there could be stronger cross-government co-ordination and a stronger role for the centre and the Cabinet Office. There is a question that we may come back to as to where the money for the insurance policies associated with the NRA should sit. It is difficult for a government department that has to respond to a need for scanners, diagnostic tests or whatever in the health service. How much do you put aside for things that you hope will never happen?

Lord Mair: Can I ask about the consistency across departments when there is a risk that involves more than one department? When we heard evidence from Roger Hargreaves, he talked about how CCS has to play a referee role to arbitrate differences. He implied very strongly that this is an area that requires improvement. Could you comment on that?

Professor Sir Mark Walport: I suppose I can comment generically rather than specifically. I would agree with him from my experience in, for example, table-top exercises for SAGE. There are different officials involved and so there is no generic answer, but it is an issue when someone from one department is saying, "In order to mitigate or handle risk A or B, you need to spend money on this or that, or do this or that". The response is a bit variable.

The question is who holds the stick to ensure that departments work together effectively. It is quite difficult to see any mechanism over and above them. It is the siloed structure of government. What organisation is not siloed? How do you break across those silos? Does CCS have the sticks itself? It is a creature of the Cabinet Office. Arguably, this is a role for Ministers in the Cabinet Office to deal with. It is good, in my view, that the Cabinet took an interest in the national risk assessment. I am sure there is more to do on that front.

Professor Sir John Beddington: By and large I agree with Mark, but there is a real difficulty in asking about the correlation of available resources with the level of risk that is there. If one did a retrospective on the national risk register and asked what resources were applied, they would not be well correlated.

The way of examining that is to do scenario analysis, to look within a particular risk at the worst and most likely cases, and then to think about allocating finance. Once you have allocated to an individual department, it will have competing demands. It may not be taking this forward. One solution is to think about some allocation of funding to individual departments to deal with the risks they have to deal with. Another is the stick mechanism of giving them a hard time when they get it wrong. With that said, the possibility of a degree of separate funding for the national risk register, so that resources are correlated appropriately with the position on the risk matrix, makes a lot of sense to me.

Q32 **The Chair:** Arising out of that, can I ask about the issue of cascade and risks that cascade from one area to another? Everything is connected in this interconnected world. How is the process at predicting where that cascade is going to go?

Professor Sir John Beddington: I can answer only for the time I was there. That was done in quite a detailed way within the community of chief scientific advisers. That was then. I really should pass to Mark for the more contemporary view.

Professor Sir Mark Walport: Lord Chair, you raise a really interesting and important point. It is a general resilience question. As societies have become more efficient, arguably they have become less resilient. We rely far more on just-in-time supply lines. The technology that was vital was power; now the second technology that is vital is the internet. There is a risk of cascading failures. That could have happened with the pandemic, but luckily has not. We have not had any of those cascading failures that would have got us into terrible trouble. Supply lines have held up.

This is a generic issue. It is one that came up in a number of the Blackett reviews on emerging technologies, which I developed during my time as the Chief Scientific Adviser. It came slightly into the first annual report that I wrote, *Innovation: Managing Risk, Not Avoiding It*. It comes down to one of the major areas of threat, as Lord Rees identified. There are some very major risks associated with cyber now, such as the breakdown of the internet. Space weather is an interesting one, which we might come on to. John identified this as a major risk. If we lost satellites and GNSS, our position, navigation and timing capability, it would have a devastating effect.

The Chair: We will come on to that, he says ominously.

Q33 **Baroness McGregor-Smith:** Good morning, Sir John Beddington and Sir Mark Walport. From your time as Government Chief Scientific Advisers—we have started to cover this already, so give us more detail on what you have said—do you feel there are any risks that the Government and policymakers have been poorly prepared for? Could you also take us through any risks you think we are still inadequately prepared for?

Professor Sir John Beddington: I will kick off, because it is a historical sequence. In the national risk register, when I first started as Chief Scientific Adviser, nobody had thought about any risk from volcanos in Iceland. Volcanic eruptions occur about every four years, so that was a very large error.

There are issues to do with risk in supply chains, but also the welfare of UK citizens, that cannot be handled within our risk register because they occur within another country. The obvious one that I had to deal with was the problem of the tsunami in Japan, followed by the nuclear issue, but Chernobyl had a much more major effect from a nuclear point of view. Issues may happen with an earthquake or big volcanic activity in Santorini, where there will be many hundreds or, indeed, thousands of UK citizens on holiday, if they occur in a certain period of the year.

Those things need to be reflected on. The current public document of the national risk register published in 2017 is really quite good in the sense that it points out that there are risks to UK citizens abroad, which can be

mitigated and recognised, although those risks are not incorporated in any form of national risk register. I do not see how easy it would be to do, but they are important.

The one I would single out as a clear problem when I was there was the failure to think about the potential disruption to the north-east Atlantic seaboard in aviation due to volcanic activity in Iceland. Mark has a rather more important one coming up to do with the current pandemic, so I will hand over to him.

Professor Sir Mark Walport: Are there any huge individual gaps? It is difficult to pick out one and say, "This one is awful and we are not fully prepared". More could almost certainly be done on almost all of them, and it comes down to the extent to which the different scenarios have been examined in each case.

It is this question of integration, the efficiencies of modern societies and the risk that resilience has decreased. If you look at what is going on at the moment, it is the whole question of whether the logistics of modern society function in the most effective way. If you were to look back at what has happened over this pandemic, a lot of the challenges have been with logistic delivery. A failure of national logistics, if there is such a thing, does not really appear on the risk register. It is the logistic response that is often the challenge, actually.

Q34 **Lord O'Shaughnessy:** Good morning, Sir Mark and Sir John. Sir Mark, I have a question for you, if I may. You have already mentioned the 2014 report that you published as the Chief Scientific Adviser, *Innovation: Managing Risk, Not Avoiding It*. I just wondered whether you could tell the Committee what your motivations were for choosing risk as a theme for this report. How were your conclusions and recommendations received by politicians, policymakers and others at the time?

Professor Sir Mark Walport: The reason for choosing it was that there was clearly confusion for policymakers—this was quite an issue in Brussels at the time—about the distinction between managing things according to hazard or risk. The report was very focused on innovation and how we manage the risks associated with innovation while making sure we get the benefits.

It was framed in the context of Ebola. I wrote at the start of it, "As this report is published, Ebola is raging in west Africa". I wrote, "No one would dispute the vital need for innovation to control and reduce the risks from this terrible infection. Once again, we are reminded that the forces of nature hold many of the trump cards in the evolutionary relationships between humans and other species on the planet". I could have written that yesterday.

It then went on to look at risk. This was the first recommendation: "To achieve this the UK will need further to develop the national risk register as a key part of the discussion and debate". A lot of the report was then about the whole question of how one gets the benefits of technologies

such as AI, distributed ledger technology or quantum technology. It made an important point about the vital nature of distinguishing between hazard and risk. Risk ultimately is a product of the hazard, the exposure to the hazard and the vulnerability. Not all hazards are risky, if you can avoid exposure and reduce vulnerability.

It also made an important point about regulation, which I am not sure has been taken on. Regulators are held to account if they do not stop something happening that would cause harm. On the other hand, they are not held to account if they stop something happening that would have caused good. There is an asymmetry. It is much easier for a regulator to say no, because it will get into trouble if it does not, but nothing happens if it stops something happening that would have done good. Regulators need to be made accountable for all their decisions, whether to stop something or to let something happen. That is one of the big challenges. There is an asymmetric accountability for regulators.

Lord O'Shaughnessy: I definitely recognise that from my own time in DH. I would be interested to know your thoughts on whether the UK generally tends to get that balance right.

I have a slightly provocative follow-up question. In that report's conclusions, you stated, "The United Kingdom starts in a very strong, indeed world-leading, position in the assessment and management of the risks facing our population". I wondered whether you felt that was still true.

Professor Sir Mark Walport: Well, the retrospectoscope is infinitely powerful. It turns on a rather important question. This will be picked over again and again. In terms of the impact of coronavirus, the UK has certainly not been world-leading in a good sense at all. There is no doubt about that. The question then is whether that is related to the nature of the science advice. I do not think so.

There are areas where the UK has been well prepared. Following Ebola, following the NRR, following what happened with SARS and Zika, a committee was formed called NERVTAG, the New and Emerging Respiratory Virus Threats Advisory Group. The UK Vaccine Network was set up and funded, led by Chris Whitty. As a result of that, the Oxford group had developed a vaccine for MERS, a closely related coronavirus to SARS-CoV-2, and this formed the basis for the Oxford/AstraZeneca collaboration to develop a vaccine against Covid-19.

This is a question of the relative investment in the maintenance of public health as opposed to the management of disease. It is a bit too easy to say this is a failure of science advice. The rhetoric about following the science was never an entirely accurate one, because the job of science is to provide the evidence and the job of policymakers is to make the decisions.

It goes back to the question about the extent to which the NRA has been used for mitigation and preparedness. If I had to identify one substantive

weakness, it is that the risk assessment has been used mainly for clear-up and management, and not enough for prevention. There may be a distinction—I do not think I am fully qualified to answer this, actually—between the threat side, where the security community has used the NSRA as a way of preventing those threats from arising as far as possible, and the natural hazards side, where that has not happened to nearly the same extent.

The Governments that have done well on coronavirus are generally the Governments that have been exposed to something a bit similar in the past. If you look at the Environment Agency and flooding, one of the consequences of the years and years of floods we have now had has been an increased focus on flood defences, but it then becomes a question for government about where it spends its money on insurance policies. Does it spend it on drought, floods, infectious disease or transport resilience?

There is a question, which we have not really got on to, about the resilience of our national infrastructure and built environment. There are some quite important risks there, and I know Lord Mair has worked on this over the years. There are really important questions about our national infrastructure.

The bit that has not been world-leading has been what we have spent on prevention and, if you cannot prevent completely, mitigation. That is more about how the risk assessment and register have been used. The process of developing it has been good. I wrote in a letter that a good risk register should drive thinking about how risks can be prevented, mitigated, handled if they transpire and cleared up afterwards. The NRA is used fairly effectively for the handling and clear-up but variably to derive decisions about prevention and mitigation. That was a theme of my advice throughout my time.

Professor Sir John Beddington: Some events manifestly cannot be prevented, such as space weather, an asteroid hitting us or, indeed, heavy snowfall. They can only be mitigated after the event. It would be quite possible—as Mark has said, in the security world this is actually what is done—to look at for which risks you can think about significant investment in prevention, and which ones there is no way you can prevent anyway, so you have to put your money into mitigation. That would be the only qualification from what Mark says, but I agree completely with him on his general points.

- Q35 **Baroness Symons of Vernham Dean:** Good morning to Sir Mark and Sir John. Unfortunately I lost contact for about 10 minutes of the exchange, so please forgive me if part of my question overlaps. I wanted particularly to ask Sir Mark to explore further the relationship between scientific advice and policy-making. I know we have touched on this in the exchanges, but the key issue is where policy-making interacts with government decision-taking. The demands of political life are sometimes in conflict with the scientific advice that is given. Could you comment a bit more on that?

Professor Sir Mark Walport: In a nutshell, the job of science—I am talking about STEAM, which is science, technology, engineering, the arts and mathematics, because the social sciences are an important part of advice—is to provide the evidence. Policymakers look through three lenses when they decide on making policy. Of course, policymakers are politicians.

First, what do I know about X or Y? That is the job of scientific advisers. Secondly, if I make a policy, can it be delivered? People are always coming up with great ideas for policies, but they cannot always be delivered. Thirdly, how does this fit with my political, personal and social values? Policymaking is ultimately an integral of the three of those.

In the context of a pandemic, which illustrates this, the job of the scientist is to provide the evidence. That evidence comes in different categories. It comes as biomedical evidence. In other words, what is this virus? What are its clinical effects? How might it be mitigated? How might it be treated? How might its spread be stopped? Then there are all the secondary effects of the infection on the economy, and then there are all the questions about the logistic delivery of policy.

We certainly saw that with testing at the beginning. No country initially had a test because it was a new virus, but the logistic capability of different countries to deliver tests differed quite widely. The UK very rapidly ran out of testing capacity and simply got overwhelmed. It is not the job of SAGE or, indeed, the scientific advisers to do that integration. It has been suggested that there should be economists on SAGE, but that would then be doing the job of politicians. The Government get economic advice through the Treasury and through consultation with economists. The job of SAGE is to look at the science of the infection itself, including the behavioural science. There is social science input there.

That ultimate integration has to be done by the policymakers, because in the end there is no absolute right answer. In other words, what is the balance between saving lives and saving the economy? Of course, the damage to the economy damages lives as well. That decision can be made only by politicians.

To take another area, which is climate science, this has largely passed but there was a ridiculous phase where people were trying to argue that the science was wrong because they did not like the policy implications. There ought to have been a much straighter conversation: "The science is clear as to what is happening. How much do we care about future generations? How much are we prepared to invest?" There is a policy outcome that says, "We do not want to do anything about climate change; we do not care about future generations". That is not one that I imagine anyone on this call agrees with, but it is a position. Ultimately, it is the policymakers who have to decide this.

That was the basis of the article I wrote recently following the publication of the science and technology report. It is really clear. It is the famous quote that scientists should be on tap and not on top, which actually is

attributable to George Russell, although people sometimes attribute it to Winston Churchill.

Baroness Symons of Vernham Dean: Can I take that point a little further? What you have said seems to imply that you do not think it would not be necessary, for example in relation to Covid, for SAGE to have any expertise in emergency planning. You talked at the beginning of our exchange about how some illnesses take a long time to come to their peak, but Covid has moved so quickly and so universally. There does not seem to have been that sense of emergency planning by the members of the SAGE committee.

I take your point: ultimate decisions are for government and for politicians, but should there not be a little more input from SAGE on what is and is not an emergency?

Professor Sir Mark Walport: SAGE has been very clear that almost everything about this is urgent and an emergency, but I would disagree that SAGE is the place where the logistics should be considered and handled. In other words, the logistic delivery is another set of expertise, and anyone who looks back at this will need to look at the logistics very, very carefully indeed.

During the flooding that happened in 2013 or 2014 when I started, the Army was brought in to help. Indeed, the Army is being brought in at the moment, because the Armed Forces in general are extremely good at logistics. In a sense, this is another aspect of the response. There is an enormous piece of delivery at the moment, which is the vaccine. This needs to be done using extremely expert professional logistics. This is an area where there are very few academics, although there are some, who have particular expertise. A lot of the expertise in logistics comes from industry, where just-in-time supply lines have been developed. Our retail industry has been made very efficient.

Not everything can be focused on SAGE. SAGE is expertise; it brings together a group of experts who know an enormous amount about infectious diseases. The second you try to bring in the logistics people and the economists, SAGE is doing the job of the whole of government, and that is not its job. The job of government is to integrate the different inputs.

Arguably, on the basis of the discussion we are having now, there are three sets. There is the set of inputs around the science of the infection, which tells you that you need to develop tests, deliver vaccines and work out how to help people self-isolate, for example by giving them the necessary supplies. Then you also need the economic input. You need the logistic, economic and science inputs. I suspect there is also probably a bit more. It is the job of government to bring that together; it is not the job of the Chief Scientific Adviser, the scientific advisers in departments or SAGE to do that. It is one of the key components, but ultimately it is the politicians who make the decisions.

Professor Sir John Beddington: I would agree with that. It did not happen when I was Chief Scientific Adviser, but I would have resisted very hard any attempt to bring economists or people dealing with the logistics of delivery into any form of SAGE advice. I would really endorse that.

The only area where there is a potential problem is distinguishing between scenarios. To an extent, there has been some ground-truthing. I know nothing about the detail here, but we saw that the use of the reasonable worst case, which is a classic for SAGE advice, turned out to have been overcome by events. That is exactly what you would expect, because these things will be uncertain.

- Q36 **Lord Willetts:** Good morning, Sir John and Sir Mark. It is very good to see you both. Sir John, I would like you to explore any lessons for the Committee from your experience in your time of dealing with the Icelandic volcano and Fukushima, both of which you have briefly referred to already. You could argue that, if anything, the response to the Iceland volcano was excessively disruptive because we did not have a proper plan. On Fukushima, you could argue that the British response was proportionate. It is an interesting case study in the role of SAGE. Do you have any advice for us on those two?

Professor Sir John Beddington: Thank you, David. It is nice to see you again. In terms of the Icelandic volcano, there are two sorts: there is the explosive thing we saw at the time and then there is the effusive volcano eruption that people point to, largely back in the 18th century, which was very different. We looked at what was happening and, first of all, we got it wrong. Nobody had thought about the fact that volcanoes go off in Iceland about every four years, and there was therefore a fairly hefty chance that a volcano would go off and that would occur with weather patterns that would bring ash clouds over.

There was a real controversy between the aviation industry, engineers and the Met Office. The real error, in my view, was in the actual regulation. The regulation basically said, "If there is ash in the air, you should not be able to fly". It goes to a point that was made earlier: the regulators do not want to be proved wrong, but they do not mind too much about being proved right.

The problem here is that the physics are nonsensical. The factor in whether an aeroplane might accrue damage will be how long it flies through a particular concentration or a variable concentration of ash. That is the way the regulation should be framed. They are not and they are still not; they are framed in terms of whether there is ash in the air and how dense it is. That produced a great deal of controversy between industry and the Met Office, which was really unfortunate. The fault really lay in the actual regulation.

There is very little evidence on the effect that ash had on aero engines. Experiments have not been done. One has some degree of sympathy with that, because these aero engines cost millions of pounds. Putting one into

a test and throwing ash into it is not the sort of thing that people will take on lightly. It was a problem. In retrospect, there are things that could be done in the engineering and design community to improve things.

That is Eyja. I call it "Eyja" because I found it completely unpronounceable. Whenever I was interviewed on the "Today" programme, I referred to it as "that volcano" on the grounds that I knew I would pronounce it wrongly.

On Fukushima and the aftermath, we did moderately well. We had to get information from a variety of sources. The SAGE committee I pulled together for that was able to do that. We were able to find out how much radioactive material was in the particular reactors. We were able to get good estimates of how high after a hydrogen-based explosion radioactive material would go up. We were also able to get very good almost four-hourly weather forecasts from the Met Office for that area of Japan, so that we were able to provide prompt advice.

It was not in the risk register, for obvious reasons. This is a risk overseas. I referred earlier to how that should be thought about in the current risk registers. We were able to make an assessment to answer the question that the Prime Minister and Cabinet posed to me. Should we evacuate our people and should we move our embassy from Tokyo further south to Osaka or somewhere like that? That was the basic question posed to me, which we dealt with in SAGE and provided advice.

There was pretty much no dissent among the people in SAGE. We basically said that the amount of radioactivity you would see even in a reasonable worst case was not sufficient to worry about and there was no need to evacuate our countrymen or to move the embassy. That was unequivocal advice coming out from SAGE.

There were some issues that occurred. The day we prepared advice to Cabinet, the French Government decided to evacuate all their personnel from Japan. It has to be said that I was subject to a fair bit of quizzing by both Cabinet and the Prime Minister, but the advice was right. One of the really interesting things we were able to do, which I think we also got right, was down to David Warren, the then ambassador in Tokyo. He suggested that we have a series of question and answer sessions for people phoning into the embassy. I organised four of these, in which I had people from the Department of Health, people from the Food Standards Agency and people involved in the modelling of radioactive explosions.

Essentially, we were able to answer most of the questions posed, and then the embassy translated it and put it out. In this way, the Japanese were getting independent advice coming from the UK, which went against the alarmist press that was occurring at the time about the potential damage of Fukushima. We got that right, and it worked fairly well.

David, I have gone on a bit on both issues. I hope I have answered what you wanted to hear.

Professor Sir Mark Walport: They are both perfect examples of the distinction between hazard and risk. The hazard is volcanic ash or radiation, but what is the exposure of the jet engine to volcanic ash? What is the exposure to radiation? As John said, in Fukushima the exposure was very small indeed.

Lord Willetts: Yes, that point is very well made. Thank you both. That is very interesting.

Q37 **Lord Robertson of Port Ellen:** Good morning, Sir Mark and Sir John. Can I address the first part of my question to Sir Mark? Both Des Browne and I looked after the Ministry of Defence. Indeed, there are other Ministers of Defence here. It is the one government department that is predicated only on an insurance policy. We encapsulate the fact that there is insurance. All the money is allocated to that.

As a consequence, the Ministry of Defence does a huge amount of scenario planning for events and a lot of exercises, which does not really happen in the civil area, as we already know. In 2016, there was Exercise Cygnus, which was designed, it said, to test systems to the extreme for a pandemic. As it happens, the pandemic being planned for was flu.

Sir Mark, out of that exercise came a number of recommendations. What did it say to you? How did we come so unstuck when the pandemic moved from flu to coronavirus?

Professor Sir Mark Walport: I would comment on that in two parts. First, this point about exercises is really important. There were a reasonable number of exercises, both table-top exercises and full-blown exercises, on natural hazards as well. For example, in July 2015, there was an exercise on space weather, which I chaired. In July 2017, there was an exercise on a volcanic eruption, which was chaired by my interim successor. I was involved in other exercises on threats.

When it comes to Exercise Cygnus, it was largely on the operational response of the NHS to a scenario constructed for flu that would have had very significant case numbers and mortality. It was, as much as anything, an exercise in how the response would happen. The science input was predominantly to create a model that would be used for responders. It was a response, and there were local responders involved.

My main involvement was to chair a mock SAGE exercise in 2014. In fact, as events transpired, Cygnus was done in a rather staccato fashion. The whole exercise was originally planned for October 2014, but, due to Ebola and a lot of other activities, the main exercise was postponed. SAGE did happen in 2014, but the full exercise happened in 2016. I chaired a SAGE that was a pretty good illustration of how it would operate with a broad variety of people around the table, including the Chief Medical Officer.

When it came to the exercise on logistics, GO-Science was an observer. My deputy participated in one mock COBRA meeting, but the scientific involvement was relatively small. Most of the lessons were about the

logistic requirements if the NHS became overwhelmed, should there be significant numbers of deaths.

Lord Robertson of Port Ellen: Why was it obsessed with only flu? Was there some groupthink that this was the only likely thing to happen? After all, we had SARS, H1N1 and Ebola, but this seems to be focused in terms of SAGE only on flu.

Professor Sir Mark Walport: As I said before, the scientific community was providing plenty of advice that there were lots of other infections. During that time, we were involved in the Ebola outbreak in west Africa and the Zika outbreak predominantly in South America. NERVTAG—it is worth reading the introduction—made the point about the risk of lots of emergent infections. Fortunately, SARS and MERS have not spread more widely, because MERS has a much higher mortality than Covid-19. There is a wide variety of potential pandemics.

The reason for the choice of flu is that, historically, it has been the most probable. There are regular pandemics. They come roughly every 10 years or so. It is the nature of the flu virus because of its fragmented genome and the fact that it can exchange between humans, pigs and birds. It does not seem foolish to exercise the most frequent pandemic, and there are certain common principles to all pandemics.

The rule is that, at the end of the day, you want to reduce transmission. Therefore, you have to work out how the virus transmits. It matters how much asymptomatic infection there is, and you do not know that with a new infection. A SAGE science guidance paper was prepared to help as a result of our experiences with SAGE, which covered a lot of this ground.

You have to exercise something, and the most probable thing was to do that exercise. Could there have been more exercises with more different scenarios? Absolutely, the clearest lesson of all of this—it goes back to all the questions at the beginning—is that one needs to look at the risks in terms of a whole range of scenarios and then exercise a number of them. There is always more that can be done.

The Chair: We have a number of other questions to ask, so I need some snappy answers, please.

Lord Robertson of Port Ellen: Even with flu, you would have needed PPE. How come we got that so badly wrong?

Professor Sir Mark Walport: That is a question you would have to ask DHSC. It is ultimately for the departments to respond to.

Q38 **Viscount Thurso:** Good morning, Sir Mark and Sir John. Can I come to you first, please, Sir John? An emerging theme in our inquiry so far has been the way in which risk is communicated to the public and the degree of transparency in the whole process. How informed, in your view, should the public be and how transparent should the process be?

Professor Sir John Beddington: I read only yesterday the 2017 national risk assessment, which went out to the general public. I confess that; I had other things to do. I was very impressed by it. I thought the process was well described; it went beyond the simple matrices of the national risk register and was able to explain some of the issues. It posed questions: has this happened before? On space weather, it pointed to the Carrington event and a coronal mass ejection that missed the earth very narrowly in 2012, on my watch. It covered a lot of the detail that would be appropriate to be communicated to the public at large.

I also thought that it had some very good cross-references. For example, on the issue of space weather that we discussed earlier, it referred across to a study by the Royal Academy of Engineering, which looked at ways of mitigating space weather and the bits you could not mitigate. I thought it was really a rather good and comprehensive document, so I would not have any criticisms of that.

As I indicated earlier, when I became Chief Scientific Adviser, the process of involving scientific advice in the national risk register was not ideal. It has improved. From the points Mark has been making this morning, it is pretty clear that it is now working in a fairly comprehensive manner and that the scientific evidence is being used in an appropriate way, to guide the national risk assessment and the national risk register. I am not normally so positive, but I feel quite positive about it at the moment.

Viscount Thurso: The reason for the question, among other things, is the evidence that Roger Hargreaves at the CCS gave us. He said there had been a chequered history in this area, but he picked up two points, one of which quite surprised me. He called it the moral case. Do the public have a moral right to know of the risks that might befall them? The second was about effectiveness. Does it make the public response more effective? I thought there was a third point: if you want to have accountability in the process, you must have transparency. Could you comment on those three points?

Professor Sir John Beddington: They are interesting points. I have read Roger's evidence. The first thing is the moral issue. I am here as a former Chief Scientific Adviser, but, yes, I would endorse the moral case as a UK citizen. The risks should be outlined.

The second thing is to do with how effective things can be. What has been happening during the Covid pandemic is a very good example of both good and bad. Some sets of individuals have chosen to ignore the scientific evidence and carry on because it suits them. That is very unfortunate.

The consultations seem to be working rather well. Historically, they were very poor, but my impression from Hargreaves's evidence and from Mark, both rather more contemporaneous than I am, is that this now seems to be working pretty well.

Professor Sir Mark Walport: I agree with Sir John about the national risk register. It is a good publication, but there is quite an interesting difference if you look at different countries. Fortunately, in a way, Europe does not have a lot of major natural hazards. In Italy and other parts of Europe, there are earthquakes that are quite problematic, but in New Zealand, for example, citizens are very well aware of the hazards of the natural environment and, in particular, of earthquakes. They understand that they will be on their own, potentially, for a few days after an earthquake, so there is much more resilience in the population.

Similarly, in Japan, there is almost every natural hazard you can imagine: tsunamis, earthquakes and volcanos. Again, there is a much stronger public recognition of issues of resilience and security, and the need to take responsibility. In Europe, there is much more a sense that it is a very safe world, and if something goes wrong someone must be to blame. That is one of the big challenges of all this: nature always wins at the end of the day.

The other area of transparency is SAGE and what happens in an emergency. A learning exercise from what has happened is that there was far too little transparency at the beginning and there is now better transparency. SAGE papers, by and large, are now published very quickly. I only joined SAGE after Easter, but I have seen the papers become much more immediately available, and that is a good thing.

Some in the scientific community have felt that their expertise extends to commenting on policy aspects, where they have no particular expertise, as opposed to the science, where they do. The role of the scientist is to provide the advice, not to tell government what the policy should be.

Q39 **Lord Willetts:** Very briefly, as we are running out of time, space weather has been referred to several times already. It is an unusual risk in that it is relatively predictable, on an 11-year cycle. Looking to 2024, it would be interesting for the Committee to hear from both of you as to whether we are properly prepared or whether there is more we should do. Sir Mark, I see you nodding.

Professor Sir Mark Walport: I picked this one up from John, because they did not teach me about it at medical school, so I learned very rapidly on the job. We did exercise it. To be honest, I still have concerns. The electric grid is quite well prepared, but one of the big challenges in a major space weather event would be threats to avionics and flights. It is an area where the UK has worked with the US, because this is global. In my assessment, there is more to be done on how the airline industry would, in flight, handle a solar weather event.

It is an example of something that crosses government departments. BEIS has the responsibility on the energy side, but transport does on the aviation side, for example. More preparation could be done.

Lord Willetts: It was one of our high risks for jeopardising the London Olympics, when we thought there could be space weather.

Professor Sir John Beddington: There are three things. One of them is the ability to predict how quickly something is going to happen. Solar flares can arrive here in a minute or less than a minute. Solar particles take less than an hour, but the coronal mass ejection takes one to four days. Even with that one, which is the most dangerous and could disrupt grids, satellite communication and geo-positioning satellites, we really do not have any ability to work out what is happening very quickly.

The problem with the grid will be to do with the polarity of the coronal mass ejection. If the polarity is southward, it can completely disrupt grids. If it is northward, you have no problem and there will be a minor effect. You will only know it when it passes the ACE satellite, and you have about 30 minutes to decide. The Royal Academy of Engineering has addressed this in quite a bit of detail and suggested ways to mitigate it.

This is really important. It is not quite an existential threat, but the level of disruption could be very substantial. What we have done within the UK, which I pushed a bit for, is to set up in the Met Office a space weather advisory service, which operates 24/7 and provides early warnings. There was actually a very nasty near miss of coronal mass ejection in July 2012 when I was Chief Scientific Adviser. We were able to pick that up, and we did not know it was going to miss us until about eight hours before it arrived. We had to be thinking about it, and there had been really very little preparation.

The work of Mark and others, subsequent to me passing this over as a problem, seems to have mitigated that in a very important way, but Mark could add to that in much more detail than I.

Professor Sir Mark Walport: The only other area is GNSS. Satellite navigation resilience is another critical issue. The very last Blackett review I did when I was Government Chief Scientific Adviser was on that topic. We made a series of recommendations. I cannot tell you in any detail about their implementation, because it was after my time as Chief Scientific Adviser.

The Chair: Sir John, I might write to you about whether this is existential.

Q40 **Lord Clement-Jones:** Good morning, Sir Mark and Sir John. Sir Mark, I want to come to the specific subject of artificial intelligence on which, as I expect you know, the Lords reported a couple of years ago. We have just done a follow-up report, in fact.

Directly, via funding Turing fellowships through the EPSRC, UKRI, your current incarnation, has planned and already engaged in a very significant research programme into artificial intelligence. AI clearly has immense potential application across public services and society, but are you able to outline what you see as the potential risks of these developing technologies?

I am sure the scenario approach that you discussed earlier will be very relevant, but how do you see those risks being mitigated? How does the

scientific community scan for those issues? I am sorry for the compendium, but we are running short of time.

Professor Sir Mark Walport: That is fine. It is an important question. As with any technology, you cannot look at AI and ask, "Is it a good thing or a bad thing?" Its use is always specific, and it always has to be AI for what purpose, done in what way and by whom.

What are the risks? It is all too easy to do AI badly. Where are the boundaries of what really is artificial intelligence? Machine learning has to be a key part of it. It can be done unethically; it can be done illegally. It could be used in principle for warfare. AI can cause harm in all sorts of ways. On the other hand, it can be highly beneficial in all sorts of ways.

A very good example came out this week from DeepMind. Its AlphaFold programme appears to have cracked a really important biological problem, which is how proteins fold themselves. That has taken many, many years to tackle and it has huge importance in developing our understanding of viruses and developing drugs and vaccines. As with any technology, the way to look at it is through the rather precise lens of how it is going to be used, by whom and for what purpose.

It comes back to the question of regulation. How do we manage the risks of AI rather than simply throwing our hands in the air and saying, "It's all too difficult. We must stop it"? That would be a very bad mistake indeed. Artificial intelligence offers huge opportunities. A bit like fire, it is a great discovery, but it is very, very dangerous. "You can burn yourself, so let's not have fire". That would not be a good argument for AI.

It comes down horizon scanning and scenario planning, recognising that it adds to the repertoire of modern complexity. There is a whole set of new threats associated with it that need to be managed.

Lord Clement-Jones: Do we have the right mechanisms for assessing that risk currently?

Professor Sir Mark Walport: I should declare an interest, because I am a member of the AI Council that was set up. The AI Council is providing advice to the Government at the moment. It is about to publish its roadmap if it has not already. There are institutes such as the Turing Institute. It is very important for the UK that we invest in the research and innovation that is needed. This is going to be a very important part of future economies. It is one of a whole array of really important technologies that are changing the world. We are going through an industrial revolution. It is an area that is good for you to scrutinise through Parliament as well.

The Chair: Your interest is what gives you your expertise, which is why you are giving evidence to us.

Q41 **Lord Triesman:** It is very good to see both Sir John and Sir Mark again. Thank you very much for everything you have said. This is either a great question or a beast; I am not sure. Could you suggest to the Committee

one policy recommendation that we should make to the Government?

Professor Sir John Beddington: The only one I have is one I have covered earlier on. One needs to see a significant disaggregation of impact effects. That is crying out to be done. It should be done, and the potential impact and the variation of that should be more widely publicised, alongside the basic risk register and some disaggregation of key risks.

Professor Sir Mark Walport: Good organisations use their risk registers as a constructive way of managing themselves. The Government have made great steps with the national risk register and the risk assessment, but, as I have alluded to a number of times, I am not sure it is used as a guide to how to spend taxpayers' money on insurance against the different risks in it.

It is about how the Government take an integrated approach to managing the risks that we as citizens all face. Given that one of the major cares of government is the resilience, security, health and well-being of the population, as well as the economy, the risk register is a really important tool. It has been used much too much for response and clear-up, and it needs to be used as a guide to investment. Very tough decisions need to be made as to where the insurance policy money is going to be spent, because the insurance policy against something such as a pandemic is expensive. As we have discovered, it is also very expensive if you have one.

The Chair: That was a good end. Thank you all very much indeed for that fascinating session. We knew it was going to be fascinating when we set it up. To our witnesses, thank you very much. I am afraid you will probably hear back from us when we have any number of further questions to ask. To the Committee, thank you very much.