HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: UK science, research and technology capability and influence in global disease outbreaks, HC 136

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Chris Clarkson; Katherine Fletcher; Darren Jones; Mark Logan; Zarah Sultana.

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Witnesses

I: Professor Neil Ferguson, Director, MRC Centre for Global Infectious Disease Analysis, Imperial College London (via video).

II: Dr Richard Horton, Editor-in-Chief, *The Lancet* (via video).

III: Dr Melanie Saville, Director of Vaccine Research and Development, Coalition for Epidemic Preparedness Innovations (via video); and Professor Andrew Pollard, Professor of Paediatric Infection and Immunity at the University of Oxford (in person).

IV: Sir Patrick Vallance, Government Chief Scientific Adviser (via video).

V: Professor Sharon Peacock, Director of the National Infection Service, Public Health England (via video).

Examination of witness

Witness: Professor Ferguson (via video).

Q1 **Chair:** I start by saying to all our witnesses today and those watching that we put on record our gratitude to the wider science and research community for all the extraordinary work that is being done under incredible pressure and at pace across the country and indeed around the world. We are very grateful. Alongside them are health and care workers, people in the public and private sectors and volunteers, and the work that is being done is deeply appreciated by everyone. We are particularly grateful to the witnesses who have taken time to appear before the Committee today.

Let me start by saying something about the work that the Committee is conducting. As I am sure everyone would expect, we will be conducting an inquiry into the lessons, in particular, as the Science and Technology Committee, for UK science and its role in government to be drawn from the crisis. Manifestly, most of the analysis and conclusions will have to be appropriately done after the crisis has subsided, but it is important to take evidence during the crisis from time to time for two particular reasons.

The first is to capture contemporary evidence of what is in people's minds during the crisis, to be able to review afterwards and not just to rely on the benefit of hindsight. Secondly, if there are lessons to be learned already from what has happened and that can be applied in real time, it is obviously very important that we should discover them and be able to reflect on them if that is the case. That is the reason for today's session.

Our first witness is Professor Neil Ferguson. Welcome, Professor Ferguson.

Professor Ferguson: Good morning.

Q2 **Chair:** Thank you in particular for appearing, given that you have suffered from the virus. I hope you are feeling better.

Professor Ferguson: Yes—improving day by day.

Q3 **Chair:** That is good. Earlier, we caught sight of your mug, "Keep Calm and Carry On," and I think you personify that approach. Was the experience as you expected?

Professor Ferguson: I don't think I knew what to expect. It was like rather bad flu. For a couple of days it was quite unpleasant, but I think I am basically on the mend now. Actually, severe symptoms tend to happen in the second week, so I am crossing my fingers, but I think it is basically over for me.

Q4 **Chair:** We hope it is, and we hope the second week will not be as bad as the first.

Professor Ferguson, are you a member of SAGE—the Scientific Advisory

Group for Emergencies?

Professor Ferguson: Yes, I am.

Q5 **Chair:** Who are the other members? Could you give us a kind of feel for what the group comprises?

Professor Ferguson: SAGE consists of other chief scientific advisers from Government Departments and a set of external members. There are the heads of subgroups of SAGE, so there is a subgroup that is modelling, chaired by Graham Medley from the London School of Hygiene and Tropical Medicine, and a subgroup for behaviour, and specific individuals representing expertise in virology, immunology, behavioural science and the like. I will not list them all. I don't think I can remember all the members off the top of my head; there are probably 10 to 12 external members and a lot of people who attend meetings as observers.

Q6 **Chair:** I see, and all the chief scientific advisers from every Government Department?

Professor Ferguson: Yes. The meeting is co-chaired by the chief medical officer and the Government chief scientific adviser Patrick Vallance; and there is representation from every Department, from the Cabinet Office and No. 10.

Q7 **Chair:** How often does it meet as a full group?

Professor Ferguson: It has been meeting twice a week since—I cannot remember the precise date—sometime in January.

Q8 **Chair:** Has SAGE presented unified advice to the Government? Has it formed a consensus or has it offered different opinions?

Professor Ferguson: It varies depending on the topic under consideration. The aim of SAGE is to give the co-chairs sight of the best scientific evidence and the uncertainty around specific topics. We are not trying to reduce uncertainty; we are trying to convey to Patrick and Chris what is known about the science and what the uncertainties are, so that they can make a judgment about how they communicate that to Ministers.

Q9 **Chair:** In your view, having seen the decisions that have been taken by Ministers, and having been on SAGE, would you consider that the Government have followed the advice of SAGE?

Professor Ferguson: To be clear, SAGE does not recommend policy. SAGE makes judgments about science, looking at scientific evidence, including about how rapidly the epidemic is moving and what the likely lethality is, and not recommendations about interventions but insights into what interventions might have what effect. I am not sure that the relevant question is asking whether Government have followed the advice of SAGE. The Government have, I believe, been informed by the scientific evidence and have balanced that against other considerations—economic, health and all the things one might expect them to do.

Q10 **Chair:** Are there any areas where there has not been a united view among the scientists on SAGE and where it has been necessary to report a significant difference of opinion?

Professor Ferguson: I think on key conclusions, no, but on lots of the details, yes; people do not so much take a different view as emphasise different aspects of the science or the uncertainty in particular topics.

Q11 **Chair:** Could you give a representative example of that type of detail?

Professor Ferguson: For instance, in the media today you will see reports of a paper claiming that a large proportion of people may have no risk of severe disease or there may be an asymptomatic pool that we are underestimating. SAGE has considered that issue in a lot of detail. We have ruled out the sort of assumptions actually in that paper, but there is still uncertainty about the extent of asymptomatic infection. I would class that as not a critical issue because it does not really make any difference to what the Government response should be at the current time.

Conversely, in the last two or three weeks, the increasing evidence about the growth rate of the epidemic, the severity and the likely healthcare demands have led to a fair degree of unanimity on SAGE about the impacts of the epidemic.

Q12 **Chair:** That is very helpful. We will come back to the particular study that you mentioned.

In the paper by you and your colleagues at Imperial of 16 March when you concluded that mitigation is unlikely to be feasible, you said that in the UK that conclusion had only been reached in the last few days with the refinement of likely ICU—intensive care unit—demand due to COVID-19. Could you explain why modelling of the intensive care capacity was not available until that point in March?

Professor Ferguson: Maybe I will go back. We, the London School Hygiene and Tropical Medicine group, and NHS England senior analysts got together on Sunday 1 March to review with clinicians and scientists the evidence around the severity of COVID-19. We had at that point come up with probably what is still the most definitive estimate of case fatality. The meeting was to put that into a UK context, to try to make an assessment of likely bed demand. We did that and, actually, that day and in the immediate days following came up with estimates with NHS and SAGE of the likely profile of the epidemic and its effect on bed demand and mortality.

NHS England then looked at the potential for surge capacity over the following week or two, and that is quite an intensive exercise. I was not involved in it, so you will have to ask them. The one thing that came into play then—I cannot remember the precise time but probably about 10 days after that—was that it became clear from data from Italy and the UK experience that prior assumptions about intensive care usage we had made on 1 March were probably optimistic and care demand might be

twice what we had anticipated. The reason for that is that we had assumed that roughly half the patients with severe COVID-19 requiring ventilation would be able to be ventilated *[inaudible]* in general. The emerging data shows that that was based on poor clinical outcomes.

Q13 **Chair:** We are struggling a bit with the feed, Professor Ferguson, but we can still see you. Could you repeat that last bit again if you wouldn't mind?

Professor Ferguson: Apologies.

Chair: It is not your fault.

Professor Ferguson: The revision was that basically estimates of the proportion of patients requiring invasive ventilation, mechanical ventilation, which is only done in a critical care unit, roughly doubled. The combination of that and NHS England assessing how much they could surge led us to conclude that, even with what we are now talking about, surging at least to double normal capacity, if not triple, would be still insufficient to cope with an epidemic if we had just mitigated, and where we were not going for full-scale lockdown and containment.

Q14 **Chair:** I understand that. Indeed the peak, according to your paper, would be 30 times the maximum capacity of the ICUs across the country, I think I am right in saying.

Professor Ferguson: That would be unmitigated. I do not have the paper in front of me, but I think we concluded it was about eight times in the sort of mitigated single-peak epidemic—the best we could do. I should say that, with what the NHS are now planning to put into place, that gap reduces from eightfold to, I think, about threefold, but it is still a threefold gap.

Q15 **Chair:** On the basis of the announcements that the Prime Minister made this week, you think that gap at the peak is about threefold.

Professor Ferguson: No. Let me go back, to be clear. Since we did that initial analysis, which came out on 16 March, the NHS has refined its ICU surge capacity estimates. Those have gone up again, more than doubled, and that means that the gap, had we followed the mitigation strategy, would have been less, but it would have still overwhelmed ICUs.

Chair: I understand.

Professor Ferguson: With the current strategy being adopted now, we think that in some areas of the country ICUs will get very close to capacity but that it will not be breached at national level.

Q16 **Chair:** That is a very important point. That is a combination of the surge in the NHS provision plus the measures that the Government announced this week. At a national level, on your modelling, that will be containable within the capacity of the health system.

Professor Ferguson: Yes. There will be some areas of the country that are extremely stressed. We are reasonably confident, which is all we can be at the current time, that at national level we will be within capacity.

Q17 **Chair:** That will be tremendously reassuring to many people, although we understand your caveats that this is based on predicting something that has not happened yet.

I have a couple more points and then I will turn to some of my colleagues. There is a perception that the approach that has been taken in the UK, and reflected in the papers that have been helpfully published by SAGE, is rather different from the approach that has been taken in other countries in the world, notably in Asia, but sometimes in the continent of Europe as well. Indeed, in the paper that was published in the bundle of evidence dated 9 March, on the potential impact of behaviour and social interventions on the epidemic of COVID-19 in the United Kingdom, the summary view was that, "implementing a subset of measures"—of these interventions—"would be ideal"—that is, not the whole set. "Whilst this would have a moderate impact it would be much less likely to result in a second wave. In comparison, combining stringent...measures...as a long-term policy, may have a similar impact to that seen in Hong Kong or Singapore, but this could result in a large second epidemic wave once the measures were lifted."

Could you talk us through why you think, among eminent scientists in this country and around the world, that quite a different view was taken on the way to manage this, and why you in SAGE are concerned about the second peak?

Professor Ferguson: Yes. The background to that is that we were being asked to look at interventions that would not have this country locked down for a year or more—the optimal goal—and to balance mitigating the health impacts of the epidemic against the economic impact and the impact on the NHS. So, had it been possible to deploy extreme cocooning of the elderly to shield them from severe disease and manage the epidemic such that it did not exceed healthcare capacity, there would be clear advantages economically to having it over by the end of the summer. That is the context where we were looking at a range of interventions that might achieve that.

When it became apparent that actually there would be no way of managing the epidemic to the extent that healthcare demand in that first wave would not overwhelm the NHS, we moved—in some ways slightly reluctantly—to looking at much more intensive strategies. I say reluctantly because, as I commented before, we would be paying for this year for many decades to come in terms of the economic impact.

Q18 **Chair:** Is it your view that the majority of the population will expect to contract COVID-19, or do you think that can be avoided?

Professor Ferguson: With the current strategy, no, we do not think that would be the case. The aim of the strategy is to suppress transmission

indefinitely until we have some other countermeasures to put in place, particularly vaccine. The challenge is that, if in some sense we allow a significant fraction of the population to become infected, we are back into the scenario of an epidemic, which the health system cannot cope with.

Q19 **Chair:** The difference between the UK view, or the SAGE view, and other countries is in the capacity of the local healthcare systems to manage and to absorb the pressures during the peak.

Professor Ferguson: The strategies are fairly aligned at this point. I think the UK, more than many countries but not all countries, did intensive assessment of whether alternative strategies were possible in terms of avoiding the country needing to be in lockdown, or equally effective measures, for a very long period. We concluded that that was not possible and therefore the strategy we are in now is rather similar to many but not all other countries.

Q20 **Chair:** There is a final question from me before I hand over to colleagues. What was notable in the bundle of evidence that was published is that a lot of the work of the advisory group, in so far as the evidence published reflects that, is around the social interventions of distancing, closure of schools, and so on, with comparatively little on the testing and contact tracing that has been foundational in some of the other approaches, as you are aware. In fact, the evidence includes as background papers a couple of quite striking papers that point to the importance of that, but they do not appear in the report of the deliberations. Is what has been published a fair reflection of what has been discussed, or did that have a more prominent place in the discussions?

Professor Ferguson: Testing has always been discussed significantly. The reason it was not included in initial modelling was about the projections by PHE of how quickly this country could ramp up testing capacity. If we have to transit from the suppression strategy and the lockdown strategy to something this country can maintain long term, undoubtedly much more widespread testing, contact tracing and other methods will have to be deployed. If we are talking about back in January/February/early March, it was very clear from messages from Public Health England that we would have nowhere near enough testing capacity to adopt that strategy.

Q21 **Chair:** That informed the discussions that took place in SAGE.

Professor Ferguson: Yes.

Q22 **Chair:** When do you expect the peak of the epidemic to be? Have you made a projection of that in your model?

Professor Ferguson: Yes. It is something we are working on intensively this week. If—it is an if; we are moderately confident, as I said, but we cannot be completely sure—the current measures work as we expect them to, we will see intensive care unit demand peak in approximately

two and a half to three weeks' time and decline thereafter. The reason for that lag is that it takes people something like two to three weeks of being infected to actually being in an intensive care unit. We think the measures put in place last week and intensified this week will have had a significant effect on transmission, but it takes that time for it to propagate through to healthcare demand.

Q23 **Chair:** How many people, either as numbers or as a percentage of the population, do you expect to be affected by COVID-19 during the next six months, or whatever interval is the most appropriate to consider?

Professor Ferguson: It is a very difficult thing to assess precisely at the moment, based on current data; it will vary a lot by geographic area. It is possible that up to 5%, and at the outside 10%, of the London population will have some form of infection in that time, but then basically, once we achieve suppression and case numbers go down to a low level, the number is unlikely to increase much beyond that.

Q24 **Chair:** Obviously a very serious point is the number of fatalities. Have you made a projection of that? That was one of the concerns you had in the development of the strategy.

Professor Ferguson: Yes. It is not a detailed projection based on the most current data, but we assessed in the report on 16 March that fatalities would probably be unlikely to exceed about 20,000, with effectively a lockdown and an intense social distancing strategy, and it could be substantially lower than that. That is where real-time analysis modelling, of the type we are doing now, will be needed to refine those precise estimates.

Chair: Aaron Bell has some questions on some of the recent publications of studies.

Q25 **Aaron Bell:** To go on with public health interventions more generally, you concluded that epidemic suppression was the only viable strategy at the current time. Do you think that is a feasible strategy for the UK and, if so, for how long?

Professor Ferguson: We clearly cannot lock down the country for a year. The challenge that many countries in the world are dealing with is how to move from an initial intense lockdown, which is what China deployed and has now lifted, to something that will probably have societal effects but will allow the economy to restart. As the Chair pointed out, that is likely to rely on very large-scale testing and contact tracing.

It should be stated that the entire world is at an early stage in developing such strategies. China has only been coming out of lockdown in the most affected areas in the last week. We have yet to see quite what the results will be and the extent to which transmission will resurge. I suppose the most encouraging data is coming out of South Korea. People talk about South Korea as if they only did lots of testing; they actually had quite a lot of social distancing on top of that, and school closure, so even in

South Korea it remains to be seen what will happen when they completely restart their economy. They have relied on very rapid intensive testing and case isolation, perhaps more than most other countries, with some degree of success, so we are looking at that as a model. The UK does not have the testing capability to replicate South Korea right now, but it is likely in the next few weeks that we will.

Q26 **Aaron Bell:** Bearing all that in mind, to what extent would you say reaching a degree of herd immunity, either through a vaccine or through, in the end, everybody having had this, is the only complete exit strategy for COVID-19, or are what you have just described in South Korea and the report on China—the paper that Imperial published yesterday—actual exit strategies or just management strategies?

Professor Ferguson: I think those are management strategies. The very intensive testing, with contact tracing and isolation, is still going to have significant costs, both economic and societal, associated with it. As yet, I have to say that we do not know how sustainable it is long term. The long-term exit from this is the hopes around a vaccine.

Q27 **Aaron Bell:** Perhaps I could ask you about a couple of other papers. You mentioned earlier the one that was reported yesterday, from the University of Oxford by Gupta et al, suggesting that potentially half the population may have already had it. Could I ask you for your general comments on that and whether it can be squared with some of the observed data, for example, the Diamond Princess case?

Professor Ferguson: Yes. We do not think it is consistent with the observed data. I am not sure that the Diamond Princess is a good example because it was a very closed community. Even if you can take that, the proportion of symptomatic cases was much higher than assumed by Gupta et al.

Over the last few weeks, we have been analysing data from a number of Italian villages at the epicentre where they did a viral swab of absolutely everybody in the village at different stages of the outbreak, and we can compare that with official case numbers being reported—symptomatic cases. Again, those data all point to the fact that we are nowhere near the Gupta scenario in terms of the extent of infection.

Q28 **Aaron Bell:** In *The Times* yesterday, there is a paper reported, before peer review, from Professor Thomas of Bristol University, who questions the damage to the economy and whether that has been taken into account, suggesting, I think, in his paper that a fall of more than 6.5% of GDP would in the long run be worse for health outcomes because of the obvious correlations between GDP and life expectancy. Is that any part of your models or are you focusing on essentially flattening the curve in the shorter term?

Professor Ferguson: That is a very important consideration. It sounds very utilitarian in a philosophical sense, but when you are weighing up potentially the mitigation scenario of over 200,000 deaths versus the

economic impact, given the scale of economic cost, of the unintended consequences for health in other sectors, it is a perfectly valid consideration, and one the Government and scientists have been grappling with. We do not know what the level of excess deaths will be in this epidemic, and by "excess deaths" I mean by the end of the year what proportion of people who died from COVID-19 would have died anyhow? It might be as much as half to two thirds of the deaths we are seeing from COVID-19 because it affects particularly people who are either at the end of their life or with prior health conditions. I think those considerations are very valid.

Nevertheless, policy was determined in some sense less by that, which is a valid scientific and ethical debate, and more by the evidence that the NHS could not cope at all with the level of demand that was going to be seen, which would have unintended consequences on the health of the entire nation in terms of people being treated for other conditions.

Q29 **Zarah Sultana:** Dr Ferguson, you have spoken about more intensive and socially disruptive interventions being required to suppress and to transition to low levels, and that it is likely social distancing will be needed in place for many months, perhaps until a vaccine is available. With the measures the Government have already taken, how likely are we to see another peak in the winter and could it, if at all, be stopped?

Professor Ferguson: We think the Government's measures now, with a reasonable but not certain degree of confidence, will tip the curve over and will turn the epidemic from a growing epidemic into a declining epidemic. Whether we get resurgence of transmission depends on the policy decisions made probably in three or four weeks' time and the effectiveness of the measures that we put in place to replace the current regime. It comes back to the issue of whether we can move from a complete lockdown, which almost certainly is not sustainable for the rest of the year, to something that perhaps makes more and better use of intensive testing and contact tracing.

To be honest, I cannot give you an answer to your question, "Is resurgence likely?" There will be some resurgence of transmission. The hope is that, by deploying more focused policies to suppress local outbreaks, we can maintain infection levels at low levels in the country as a whole indefinitely. It remains to be seen how we actually achieve that and how practical it proves to be.

Q30 **Zarah Sultana:** I want to ask about modelling for different age groups. There has been a lot of focus on the elderly—rightly so—and we have a policy of shielding for the next 12 weeks. At UHCW in Coventry, we have had the youngest victim, an 18-year-old person with underlying health conditions, so what do your models suggest about the impact on younger people, particularly in light of how much time young doctors, nurses and hospital staff are spending around infected patients and the availability of PPE for them?

Professor Ferguson: It is a good point. I do not have the numbers to hand that I can share. Without doubt, most of the mortality is going to be in the elderly and frail, but mortality from the virus among younger age groups is not insignificant; it is substantially higher than, for instance, seasonal influenza. While the absolute proportion of deaths will be low, we will unfortunately see more such instances of mortality in younger age groups. That is clearly important in decision making as well.

Q31 **Mark Logan:** Going back to a point that was just raised, at the moment, seemingly, in the southern hemisphere, which is opposite us in terms of winter to summer, they already have cases. To what extent in your modelling or your thinking do you see higher temperatures, come this summer, having a positive effect on managing the decline of the virus?

Professor Ferguson: There has been a lot of debate around that, but there is very little in the way of firm evidence. It is plausible that the virus will show similar patterns to other respiratory viruses, and that suggests that transmissibility of the virus would be somewhat reduced in summer, but perhaps by not more than 10% or 20%. That will aid control, but it is not as if the virus could not transmit in the summer. Our best guess is that you could easily get a very large epidemic in the summer, although it would spread slightly more slowly than in the winter months. There is evidence for other viruses, such as influenza, about that. Back in 2009 when we had the very mild H1N1 pandemic, we were seeing very effective and efficient transmission of that virus all the way through to July.

Q32 **Mark Logan:** In terms of regionality within the UK, your current study looks at Great Britain on its own, excluding Northern Ireland, so can your model extend to the whole of the UK? Secondly, some of the research that I have read on this, and looking at maps, seems to suggest that, yes, in Westminster, where we are located, in London, we have a current higher rate, but in the rest of the UK there appear to be hubs of infection that may be slightly different from other countries. Could you comment on that?

Professor Ferguson: What we are seeing now is community transmission across the UK and, indeed, across the island of Ireland. The reason we are seeing hotspots is, we think, down to different levels of seeding of infection into the country in different areas, in terms of cases that have come from outside the country—how the infection got into the country.

We always would expect London to be ahead of the rest of the country; it is the principal destination of most foreign visitors to the country and people returning. What we are seeing is a result of that difference in seeding and a bit of random chance. For instance, there is a hotspot around Nottingham and Derby at the moment. We might not have predicted that based on people returning from overseas. It is probably likely, just as in Lombardy in northern Italy, that one or two people who came back somewhat earlier, maybe in late January, started seeding

transmission there. It was unrecognised and therefore that bit of the country is a little bit ahead of other bits that got less seeding.

There is transmission everywhere. At the weekend, I talked to my parents in mid-Wales—remotest, rural mid-Wales—and they have seen a case in their local community hospital. It is very widely distributed.

Mark Logan: Thank you.

Professor Ferguson: On the question of modelling across the whole country, yes, we are intending to roll out models across the whole of Europe and allow policymakers to use our model in different settings, and indeed we will be releasing the open source code in the next week or so.

Q33 **Chair:** On that point, Professor Ferguson, you said in an earlier answer to the Committee that the capacity of the national health system would be adequate, but perhaps not in particular places. Is that a bottom-up analysis or a top-down prediction? Do you know already that particular places will need to be helped out by others?

Professor Ferguson: Yes. We are producing daily estimates, short-term broadcasts of healthcare demand at NHS trust level and then aggregating those up to English regions, for instance. We can see in the data, and you will have read the reports, that there are individual hotspots where ICUs in particular hospitals are already being overwhelmed. It is informed by that sort of analysis.

Q34 **Katherine Fletcher:** Professor Ferguson, the British public are extremely grateful for the work of the scientific advisers, exemplified by yourself spending time while you are still not feeling brilliant answering these questions, so I want to say a big thank you for taking the time to come in and do a cracking job as well. I am sure I speak for lots of people across the country when I say that.

On the modelling, people are desperate to understand and make sure they do the right thing, and I have certainly had a lot of questions from South Ribble residents about different rates of transmission—five people working in a mechanic garage who are very familiar with each other, versus 50 strangers in a pub. It would be helpful if you could explain how you model those different types of social interactions.

Professor Ferguson: First, I should be clear that no or very few models, and certainly the models we look at, model society at that level of granularity, to distinguish five people in a garage versus a group in a pub. What we do is try to abstract those things. We model, for instance, workplaces. At workplaces, we represent people who meet every day, or most days, for instance—small networks of people who have consistent contacts—and we compare that with typical social mixing outside households, outside schools and outside workplaces, which is much more random between people. We capture some of the essential details without capturing absolutely every detail, which would be impractical. I am not sure if that helps. I can expand.

Q35 **Katherine Fletcher:** On the difference between the big groups, there are lots of people wanting to understand how risky it is to go to Old Trafford versus watching football on the sofa with your granddad.

Professor Ferguson: Yes, and I completely agree with how the chief scientific adviser and chief medical officer explained that. All the evidence we have is that the thing that poses the most risk of transmission is being in close proximity to people for extended periods of time. Whether you do that sitting next to somebody you do not know at a football match or sitting next to somebody in a pub makes very little difference. There is nothing intrinsically riskier about a mass gathering compared with normal social activity.

Q36 **Chair:** I have a question from one of our colleagues who cannot be here today, Graham Stringer MP, who asks, Professor Ferguson, what is the sensitivity of your model to variations in the incubation period, the basic reproduction number and the onset and length of time of infectiousness?

Professor Ferguson: There are two very important quantities: one is the reproduction number—the number of secondary cases per case. The other is what is called variously serial interval distribution and generation time distribution, which is basically how long it takes from when I get infected to when I have infected all the people I might infect. Those quantities govern a lot of things about how difficult the epidemic is to control and how fast it grows in time.

We have always done sensitivity analysis in the modelling to a variety of levels of value to those quantities. What we have been seeing, though, in Europe in the last week or two is a rate of growth of the epidemic that was faster than we expected from early data in China. We are revising upwards our central best estimate of the reproduction number to something more of the order of 3 or a little bit above, rather than about the 2.5 level. That adds more evidence to support the more intensive social distancing measures applied this week, because the higher the reproduction number, the more intensive the controls need to be to achieve suppression of the epidemic. But the current values are still within the wide range of values that modelling groups informing SAGE had been looking at previously.

Q37 **Chair:** Given that SAGE has recommended an escalation of the response in order to keep cases within NHS capacity, are those numbers, those parameters, now stable, or would you expect to have to revise them again? If so, is the reassuring reflection you were able to give the Committee about the capacity of the health system contingent on there being no further change to any of those variables?

Professor Ferguson: Maybe I will put it this way. We are getting a better picture all the time from surveillance data, which I have to say are not perfect, but, as they accumulate, we understand better the patterns of transmission not just in China, which we were relying on before, but in this country and in other European countries. Undoubtedly, parameter

estimates will be refined, but future changes will be less than we have seen in the past. We and a number of other groups are constantly updating models and predictions of both immediate bed demand in the next few weeks and the likely impact of interventions, but I do not think they will change to the extent that they undermine the conclusions I have given you today.

Chair: Professor Ferguson, we are very grateful to you for appearing before the Committee today. You have been extremely helpful and informative, and, as Katherine said, to have done that when you have recovered from the nasty experience of having gone through the virus is a real testament to your professionalism and your resilience. We are very grateful. Thank you very much.

Professor Ferguson: It is a pleasure. Thank you.

Chair: Thank you.

Examination of witness

Witness: Dr Richard Horton (via video).

Q38 **Chair:** Dr Horton, thank you very much indeed for joining the Committee this morning. You may have heard me say at the beginning of the previous session that the Committee will want to look at the lessons to be learned from this epidemic for policymakers in the UK, but it is important to gather evidence during the crisis and to inform future decisions that may need to be taken in the light of the evidence during the crisis.

You have been a notable critic in some ways of the response that has been taken. Is it your assessment that the Government have reliably taken scientific advice and acted on it, or are you concerned that in some way they may not have done?

Dr Horton: Maybe I can answer that question by taking us back to the last week of January when the true extent of what was taking place in Wuhan was beginning to be understood. We published three papers in the final week of January that set out the severity of COVID-19.

Q39 **Chair:** Those are papers in *The Lancet*, I should clarify for people who may not know, of which you are the editor-in-chief.

Dr Horton: Yes, indeed. Those papers were truly alarming and showed that the disease caused a serious fatal pneumonia. A third of patients who had been reported in those papers required admission to the intensive care unit. The number of deaths that were being described was rising quickly. The authors of the papers were advocating the immediate provision of personal protective equipment and were urging the importance of testing and isolation. They were describing the fact that there was no effective treatment and also emphasising the pandemic potential.

Those were the people from the frontlines of the epidemic at the end of January. Many of us at *The Lancet* felt that that was a red flag. We have had seven to eight weeks since that time, and February was the opportunity for the UK to really prepare, based on testing, isolation, quarantine, physical distancing, ICU capacity and so on.

I think you described it as being critical and, yes, it was, in the sense that we missed that opportunity. We could have used the month of February, based on what we knew in January. When I look at the evidence that SAGE posted on the website—there is a lot of evidence and it is great that they have been so transparent—what strikes me is the mismatch between the urgent warning that was coming from the frontline in China in January and the, honestly, somewhat pedestrian evaluation of the likely severity of the outbreak in that evidence. That suggests to me that we did not fully understand what was taking place on the frontline. What I also did not understand is why those three papers were not part of the evidence. Those papers were fully available, openly accessible and published on 24 January, 29 January and 31 January. Why they were not part of the published papers that SAGE considered is somewhat mystifying.

Q40 **Chair:** Dr Horton, reflecting on the structure of the advice that is given from science on this, we heard from Professor Ferguson that there is quite a broad spread of genuine experts of great standing, many of whom will be known to you as editor-in-chief of *The Lancet*. How do you explain what you have just said is the absence of reflection on papers that you consider very important?

Dr Horton: First, when I look at the evidence that SAGE considered, it is from an extremely respected group, largely within the United Kingdom, but what I have not seen is outreach to the scientists in China. The big difference in China now compared with 2003, when there was the SARS outbreak, is that China has top-class scientists who are doing absolutely cutting-edge work. They have responded in the most unbelievably rapid way to gather evidence and submit it to the world to send a warning signal.

If I had been chair of SAGE, I would have wanted to go to those scientists on the frontline saying, "Please come and tell us your experience. What is coming for us in the UK? Why are you sending this warning signal?", because it is not there in the SAGE evidence. That is the first thing.

The second part is that I do not see the clinical input and the public health input. I see the modelling input. There is evidence on modelling. There is evidence on behavioural science and on mass gatherings, but I do not see evidence from the public health community or from the clinical community. Especially if the clinical community had been giving evidence, they would have said, "If the burden is on intensive care unit usage, with the presentation of patients with severe viral pneumonia, with respiratory conditions and ARDS, this is something that we need to be taking exceptionally seriously now in January."

Q41 **Chair:** I will come on to the composition of SAGE to follow up the point that you made. People of great eminence and international distinction are members of SAGE. My experience, as is yours I am sure, is that science is resolutely international, and much collaboration and research crosses borders and continents. How do you explain or account for the relative scarceness of references to research that had been done in Asia at this time? Do you have a hypothesis as to why that may be the case?

Dr Horton: I do not, because the people who are leading the effort in China—Chen Wang, President of the Chinese Academy of Chinese Medical Sciences; Chen Zhu, a former Minister of Health; Ma Xiawei, the current Minister of Health; and Gabriel Leung, a professor in Hong Kong who was one of the first to model the outbreak and send a warning signal, and whose 31 January paper was about the risk of a global pandemic—are all very well known in the scientific community. They would be very well known, I am sure, to the chief scientific adviser and to the chief medical officer. An email to Gabriel Leung, Chen Wang or Chen Zhu to say, "We would like to bring you into our discussions to understand what is taking place in China," would have been easy. It does not look from the evidence that I have seen that that took place. That seems to me a matter of regret.

Q42 **Chair:** On the point that you made or implied about the structure of SAGE, you said you were surprised that there were not clinicians or that there was not that representation. Are there amendments to the composition of that advisory group that you would therefore recommend?

Dr Horton: We do not know who is a member of the advisory group, do we, so it is a little difficult to be sure what to recommend, but for a condition where you have viral pneumonia that rapidly leads to a critical care situation, I hope we have some of our best respiratory and critical care leaders on that committee.

Given the public health dimensions, I hope we have some of our best public health scientists and not just modellers. Important as mathematical modellers are, it is very important to have the public health dimension. You brought it up in your questioning of Professor Ferguson around testing, isolation and quarantine. Those are basic public health interventions, although I think some of the advice expressed by the public health community is that that dimension of the response has not been more forthrightly presented by SAGE. That might reflect the fact that there isn't a strong public health presence on SAGE. Again, I say that in the absence of knowing who is on the Committee.

Q43 **Chair:** There is a paper in the evidence that SAGE has published, from your journal of 28 February, by Hellewell, Abbott, et al, which is appended and says: "In most scenarios, highly effective contact tracing and case isolation is enough to control a new outbreak of COVID-19 within three months." It is notable that that is appended rather than featuring in the reflections or the deliberations.

Dr Horton: That is a paper, I think, from *The Lancet Global Health*.

Chair: That is right.

Dr Horton: The three papers I am talking about are different from that. I urge the Committee to read them very carefully because, when you read those three papers, I think you will see the signal that was being sent and you will wonder why it took so long to be heard.

Q44 **Zarah Sultana:** Dr Horton, I want to ask you about the Government's measures and the place the NHS is currently at. If the Government relax social distancing and we end up seeing a second peak of cases in the winter, as some modelling suggests, how well equipped is the NHS to deal with a resurgence of cases?

Dr Horton: There is actually a paper being published by one of our journals today that looks at the situation in Wuhan and suggests that the lockdown from around 23 January needs to be in place until early April in order to be sure that the pandemic has been suppressed. Very little is known, but we might be looking at a similar time period in order to suppress the outbreak in the United Kingdom. You are absolutely right that that will delay the peak, but it means that the risk comes back later. By that time, we should have bought ourselves enough time to build up the intensive care capacity we will need for susceptible people. The more that we suppress now, the better position the NHS will be in later, if and when the second peak comes.

Q45 **Zarah Sultana:** I have some follow-up questions about what you have been made aware of from NHS frontline staff. What evidence is there that the PPE we currently have is at the WHO-recommended levels that are needed? What evidence is there that best practice is being followed in mitigating the risks of infection for frontline staff?

Dr Horton: I am getting messages every single day, literally, from doctors and nurses, porters and security staff, up and down the country in the NHS, in primary care, hospitals, walk-in clinics and every part of the national health service, telling me that WHO-approved and European CDC-approved PPE is not available to them. They are being given surgical masks, big plastic aprons, plastic gloves, and rubber gloves that just come up to the wrists, exposing parts of their body to aerosol infection and contamination. Certain drugs are not available. Some NHS staff have even been forced to go to B&Q and other hardware stores to buy their own face masks and goggles.

To be fully fair, there has been in the last few days significant change in the provision of PPE—what is defined as PPE. Large amounts are arriving, but it is not WHO-approved so it is not of the highest standard. That is putting our health workers at risk. In addition, some of that PPE—I have posted pictures on Twitter—is in boxes where the expiry date is 2016, and, on others, stickers have been put over the 2016 expiry dates, putting a date into the future. It is PPE that is not of the highest standard

and has expired. That seems to be not what we should be doing for our health workers.

Q46 **Katherine Fletcher:** Dr Horton, thank you very much for your time; it is a busy time. As I understood the early thrust of your evidence, there was concern about delays in the UK response, with February lost. I attended my first briefing here in the House of Commons on the coronavirus with Ministers from the Foreign Office, a Minister from Health, Jo Churchill, and Professor Chris Whitty. I will confirm the exact date, but it would have been on the 20-something of January. At that briefing, there was a lot of seriousness and understanding of the threat. The very high-level architecture of the UK response to that was set out by Professor Chris Whitty under question and has broadly, although appropriately, been moved forward. I wondered if you were aware that those plans were in place, including Chinese data, and does it change your earlier remarks now that you are?

Dr Horton: I have not seen any evidence of those three papers in the SAGE advice. They are not posted on the SAGE website, so I do not actually have proof that that work was taken into consideration in the advice of SAGE. There may well have been a briefing at the end of January, but, if you look at what SAGE has posted, nowhere has it been clearly set out that you have an outbreak of a new virus that has the potential to put thousands of people into intensive care and cause thousands of deaths. That was apparent at the end of January.

Our planning was not apparent, even at your briefing, with respect, because during February and early March what were we doing to expand intensive care capacity? What we actually did was have a plan in which we hoped to push the curve to the right and delay the epidemic by building up herd immunity. Graham Medley said on "Newsnight", and Patrick Vallance confirmed it with his own figures, that we thought that we could have a controlled epidemic; we could manage that controlled epidemic over the course of March and April, pushing the curve to the right and building up herd immunity, and that way we would protect people. The reason why that strategy was wrong was that it did not understand that 20% of people who became affected would end up with severe critical illness. That was the evidence that was coming out of China in January. That is where the fundamental mistake took place.

Chair: Dr Horton, we are out of time. We are seeing several witnesses today. We are very grateful to you for your evidence. I hope you will come back and give evidence to the Committee during its inquiry. You made some important points about the coverage of the advice that SAGE is taking, especially the international dimension, that might have implications for the course of the management of the crisis, as well as lessons to be learned afterwards. I am sure the points you made about equipment have been received and understood very forcibly. Thank you very much indeed for joining us.

Examination of witnesses

Witnesses: Dr Saville (via video) and Professor Pollard (in person).

Q47 **Chair:** Welcome to our next two witnesses. We have Professor Andrew Pollard from the University of Oxford and Dr Melanie Saville, who joins us by video link. She is the Director of Vaccine Research and Development at the Coalition for Epidemic Preparedness Innovations. Thank you both for joining us.

Dr Saville, and then Professor Pollard, what is known so far about the body's immune response to the coronavirus?

Dr Saville: I am experiencing an echo that makes it difficult to talk.

Chair: I will go to Professor Pollard and then we will come back to you. Our technicians may be able to adjust that.

Professor Pollard: We know relatively little about this coronavirus so far, but because coronaviruses have been around for a long time—we had two major problems with outbreak coronaviruses about 18 years ago with SARS 1 and then the MERS coronavirus more recently—we do know quite a bit about the immune responses to those viruses. There is particularly an association with antibodies that are made against some of the proteins that the virus expresses, which are very important for controlling the virus and preventing infections. That has been really one of the major strategies for thinking about vaccine development, because of our understanding from those previous coronavirus outbreaks.

Dr Saville: Indeed, we have learned a lot from other coronaviruses where it does appear that antibodies are going to be important in the immune response and should be a focus for vaccine development, for example.

Q48 **Chair:** On the potential for vaccine development, obviously a question on everyone's lips is when we might get a vaccine and when it will be available to be deployed. Based on your familiarity with the work that is going on at an intense pace around the world, perhaps you might give the Committee a feel for the timeframe you think we are looking at.

Professor Pollard: The first thing to say is that, as you can imagine, there are intense and urgent efforts all around the world. About 30 different candidates are being worked on in different countries. Those candidates are mostly still in that development phase and testing before you get into testing in humans. The next step after that is manufacturing; we have to go through a very careful manufacturing process to make sure that when we have something in a syringe we know exactly what it is, and that the regulators have looked at it very carefully so that we have the best possible information about safety before it goes into the first person's arm.

There are some vaccines already in clinical testing. You will have heard in the news about one that is already being tested in Seattle. There is also

some vaccine testing in China at the moment. We are getting close with a number of the candidates to actually getting them into people, which is when we will start to know a bit about the safety and whether we get a good immune response with the vaccines.

The next step after that is to see whether the vaccines work and whether they can prevent disease. That will only be possible in settings where there is ongoing transmission. At some point beyond that, we will have larger numbers of individuals involved as we go through the phases of clinical trials that will provide the data needed for regulators to make recommendations for the use of the vaccine. It is likely in that setting that, if we have sufficient data from some of these products, regulators will be able to look at emergency use regulations and think about early deployment, rather than going through the very prolonged one year to 18 months of regulatory review, even when the trials have finished.

To come back to the question of how long, it depends on getting through those phases. If everything goes well with manufacturing, and the trials are able to report early with no problems, it can be done relatively quickly, but without any shortcuts; you have to continue to have due care as you progress through this.

On the estimates of one year to 18 months, it would certainly be very likely in that period of time that we will have different candidates that have been through all the testing. It is certainly possible with some candidates much sooner—maybe even this year—to have a lot of data on whether they work and whether they could be useful for populations.

Q49 **Chair:** The first phase is safety testing and the second is the efficacy of the vaccine. Of the candidates that are being developed at the moment, with the fairest wind, what is the very earliest that you think those stages could be gone through, perhaps with some changes to procedures in a safe way that accommodated it? When is the earliest that might be available?

Professor Pollard: I do not think changes in procedures are necessarily needed. What is happening globally with the regulators is that regulatory reviews that may take months are being done in days just because they are putting more people on it. It is not that there are any shortcuts. Manufacturing approaches are fairly standard, but everyone is trying to see where there is more capacity to get there quicker, rather than cutting corners. It is around urgency and providing the capacity to make sure that some of the normal hold-ups in the process are not there.

There will be unanswered questions, because what we are talking about in a development programme normally takes somewhere around five years. We are talking from a standing start of trying to do something in months or a year, so it is a huge difference from normal practice. I think it is possible with a sailing wind to do that very rapidly.

Q50 **Chair:** Thank you. Dr Saville?

Dr Saville: I certainly agree that we need to go through the normal stages of development on vaccines, from *gene* the vaccines through to pre-clinical testing, to ensure that there is both safety and efficacy testing of the vaccine in clinical trials.

Another important point is the manufacturing. In that regard, to reach a 12 to 18-month timeframe many activities need to be done in parallel and at risk. With manufacturing, you do not usually scale up your process until you have clinical data. One of the approaches that CEPI is taking in terms of funding is to accelerate the scale-up of manufacturing so that it is done even at pre-clinical phases, and you can move very rapidly to testing in humans in very large numbers and ensuring that we could get to hundreds of millions of doses being available globally in a timeframe of 12 to 18 months.

The other point, which has already been raised, is the importance of the regulators. The regulators are working very fast. There is also regulatory convergence between different regulators around the world and that can really help to advance things.

From a CEPI perspective, we are funding a number of projects. We are funding eight projects currently through phase one. With additional funding, we hope to be able to fund those through advanced development and to scale up the manufacturing, to allow hundreds of millions of doses in a 12 to 18-month timeframe.

Q51 **Chair:** On the funding side, in which you play a part, is the quantum of funds available in the UK, and are the processes for making that available to particular researchers agile enough for the purpose, or are there any changes that need to be made in flight, as it were? I don't know whether you heard that, Dr Saville.

Dr Saville: Can you hear me?

Chair: Yes.

Dr Saville: I am terribly sorry; there is an echo, so it makes it quite difficult for me to speak and hear my own voice. I can maybe address the funding from CEPI's perspective and give you a little bit of introduction of CEPI and how CEPI funds vaccine development. CEPI—*[Audio breaks]*

Chair: We have lost you altogether.

Dr Saville: Can you hear me now?

Chair: Yes; we can.

Dr Saville: CEPI was formed in the wake of the 2014-2015 Ebola outbreak in west Africa, where it was recognised after decades of research that no vaccine was available. It was recognised that an organisation like CEPI was needed to accelerate and better co-ordinate vaccine development for such outbreaks as the coronavirus.

We are funded by Governments and philanthropic organisations. Specifically for the coronavirus we have been raising funds, in which the UK Government have supported us with £20 million, together with other funders. That has allowed us to advance vaccine development with a view to global access to vaccines for the populations who need them most.

Q52 **Chair:** Is that enough for the purpose?

Dr Saville: I'm sorry?

Q53 **Chair:** Is that £20 million enough funding for the task in hand?

Dr Saville: With the funds that we have, we are taking a global approach. We do not think that one Government alone can solve the crisis. We anticipate that we need $2 billion to ensure vaccine development over the 12 to 18-month timeframe and get to widescale use with hundreds of millions of doses. We obviously need more funding, but we expect that to be an international effort. The G7 meeting last week encouraged co-ordination across Governments on funding such an effort.

Professor Pollard: The UK Government have already started to make some investments in vaccine development projects in the UK. As Dr Saville was saying, one of the real challenges that makes this very different from normal vaccine development is that you would not normally invest at risk in upscaling manufacturing at this very early stage, before we even have any data in humans. If you wait for all the trials to complete before you do that, we are years and years away.

Perhaps one of the real messages is about the investment needed now at risk in upscaling some of the potential products. I think that is one thing that CEPI is already looking at from a global perspective, but perhaps we need also to be looking at it specifically from a UK perspective.

Q54 **Chair:** Am I right in taking from the evidence of both of you that 12 months is the earliest possible time that a vaccine, with everything going right, could be available for mass deployment against the coronavirus?

Professor Pollard: I believe that six months is possible, but it needs a lot of things to fall in place in order for that to happen, including the upscaling to go well and for trials to be conducted in a way that allows us to demonstrate that there is efficacy. It may be difficult with many countries in lockdown over that period to see enough cases to know that the vaccine is preventing them as we move forwards. There are lots of reasons why it may be more difficult to get there in that time period.

Q55 **Chair:** We would be grateful, after this hearing, if you will let us know if there are any blockages that you feel should not be there and that we can draw attention to. I think everyone shares the collective view that we should maximise the speed of deployment.

Dr Saville, do you agree with Professor Pollard?

Dr Saville: Absolutely. It is fair to say that CEPI, CEPI's partners and everyone involved in vaccine development are doing what they can to move forward as rapidly as possible. It really is a multilateral effort. When we talk about 12 to 18 months, we are talking about the timeframe when we would anticipate having an emergency use authorisation of some description that would allow the vaccine to be used outside clinical trial protocols with large volume. If that could be done faster, obviously we would do everything we could, but, bearing in mind the complexity, it is probably best to say that if you are looking at very widescale use you are looking at about 12 months.

Q56 **Aaron Bell:** Thank you both for your evidence so far on timeframes. It seems that you are both quite confident that there will be a vaccine at some point. Given that we, as I understand it, have never had a vaccine for a coronavirus so far, could you explain why you are so confident that this will be successful on whatever timeframe it is?

Professor Pollard: From my perspective, we have many candidates being tested around the world. We know enough about the biology of these viruses to be fairly confident that one of the directions being taken will be successful. Although you say that we do not have a vaccine now, which is absolutely true, we already have evidence from the MERS coronavirus that some vaccines can induce strong immune responses in people. That gives us some confidence that there should not be any reason why this virus is different and that we could not get there.

The advances in our understanding of the immune response and being able from January to have the sequence of the genome of the virus, which allowed very rapid pre-clinical development of vaccines around the world to happen, is an astonishing change from the last big outbreak 102 years ago in 1918 with Spanish flu. That was the last time we had something on this scale. We would not have been able to do anything then. We are at a remarkable place in science that allows us to get to this point so quickly and even to have these discussions.

Q57 **Aaron Bell:** Can I put the same question to you, Dr Saville?

Dr Saville: Certainly. We hope that at least one of the candidates will be successful. We certainly do not anticipate that they all will. There are problems that will come along. In terms of the way that CEPI has worked, many of the organisations we are funding, including Oxford University, have experience of coronaviruses, including some clinical data. I have to say, though, that there is no efficacy data of a coronavirus in humans, but the clinical data, and certainly the data of small studies in humans, suggest an immune response that may be protective.

Q58 **Aaron Bell:** Coming on to immune response, the British Society for Immunology said that viruses related to coronaviruses do not typically induce long-term immunity. Are you able to say how long an induced immunity, whether through exposure or through a vaccine, would be expected to last?

Professor Pollard: That is a great question. One of the critical questions that usually gets addressed in clinical trials of new vaccines is how long an immune response lasts and how long protection is likely to be. The way we manage that with most other diseases that we prevent through vaccination is to do the trials and look at the duration of the response. Often, even after deployment of vaccines, we may need to look at booster doses in the future to manage that. You will be aware that there are many vaccines—for example, through childhood—where we give boosters, and we need to vaccinate against influenza every year.

Although it is an unknown, it is not an unknown that could not be addressed in the future if we need to. As an exit strategy for many countries from lockdown, particularly given the comments we heard earlier about the difficulty in sustaining something that completely avoids transmission, vaccines seem to me the most likely exit strategy globally.

Q59 **Aaron Bell:** Dr Saville, do you have any comments on that?

Dr Saville: I agree that that is exactly what is evaluated as part of vaccine development, and it obviously needs time. It is also important to follow up survivors and make sure that research is being done with survivors to see what happens to the immune response after natural infection.

Q60 **Aaron Bell:** On that point, would it currently be safe for people who have recovered from the virus to stop the social distancing measures that the Government have advised people to take, based on your understanding?

Dr Saville: It is difficult to say. What we know from the outbreak so far is that it does not appear that a lot of individuals have been documented as shedding virus. There are a couple of occasions. I think there are a couple of reports in China and Japan. From what we know of coronavirus, it is probably a reasonable assumption.

Professor Pollard: We already know that for most viruses, after you have had an infection, you have some degree of immunity, often completely sterilising immunity, so that you cannot get re-infected, at least for a period of time. Even when we get re-infections, generally they are not as severe as the initial infection. I do not think that we should be changing any advice from Government at the moment on social distancing, because we do not know for certain, but the likelihood from the biology is that we will have some protection of individuals once they have been infected.

Q61 **Chair:** You have given a provisional answer on the immunity that individuals might acquire once they have gone through COVID-19. Is there research seeking to be more precise about that?

Professor Pollard: In following up people who have had disease, there is incredibly intense science going on that I am aware of in the UK to try to understand the nature of the immune response and the nature of the inflammatory response that is causing the severe cases. Samples are

being collected in our hospitals from those patients. I have no doubt that we will have a huge amount of knowledge about that during the course of this year.

As far as the immune response is concerned, exactly the same types of approaches to dissecting the vaccine response will be occurring as soon as vaccines get into trials in this country. I am aware that it is happening in the US at the moment, with the work they are doing there on their RNA vaccine.

Q62 **Chair:** Dr Saville?

Dr Saville: I really have nothing to add. There is a lot of research. The WHO are co-ordinating a lot of the research questions to make sure that data can be gathered and well-co-ordinated.

Q63 **Chair:** Some countries may be in a position of being able to lift lockdowns over the months ahead. From what you have said to this Committee, on the basis of a vaccine, that is unlikely to be possible for a year, or possibly six months if everything busts all precedents. If the same timetable is in place for analysis of the re-infectability of people who have gone through the virus, on what basis do you think people can make decisions to lift lockdowns?

Professor Pollard: That is a very good question. To some extent, as Neil Ferguson said earlier, until we have some experience of what happens when lockdowns are lifted, we are not going to fully understand that. With most respiratory infections that transmit like this, it is absolutely the case that, if you still have susceptible people in a population, you will be able to reintroduce the infection and transmit again. As he said, there will be some mitigation, perhaps around seasons, but it is likely that you would have more transmission at some point in the future once the lockdown is lifted.

Q64 **Katherine Fletcher:** Thank you both for your time. I guess it is busy, so it is appreciated.

I want to return to manufacturing and having manufacturing facilities available while a range of candidate vaccines are going through pre-clinical and clinical. To what extent can there be commonality in the manufacturing, or does it depend on the type of virus? Do we need eight completely different sheds, or can we have two different sheds?

Professor Pollard: Probably Melanie should be first because she has good oversight of that.

Dr Saville: As I said, CEPI is funding eight projects. They come under different categories, such as the nucleic acid vaccines or recombinant proteins for vectored approaches. There are a number of commonalities between different vaccines. We are probably looking for three different types of manufacturing, and something that CEPI is looking at in detail for developers is to find a mass manufacturing capacity. To give an

example, we had a meeting with the BioIndustry Association in the UK to look at their manufacturing capacity and see whether some of that capacity can be linked to development.

Q65 **Katherine Fletcher:** Can you see a scenario where, if we get positive data, to achieve the six months, we are looking again to reach out to businesses and industry, in a way similar to what we have done with the ventilators, for the manufacturing of a candidate vaccine, or are we too far away from that yet?

Dr Saville: No, we need to do that now. We probably should have done it yesterday, and actually we have been doing it right from the beginning. We should be starting to look for manufacturing capacity and be prepared to invest at risk. If you wait until you have results, you will delay the whole process by six months to a year for large-scale manufacturing.

Chair: That is a very clear recommendation that these things need to be done in parallel.

Professor Pollard: A domestic issue for us is that we have certainly recognised that in the UK. The UK Government have invested substantially in starting to build a new manufacturing facility called VMIC. That was a decision after the Ebola outbreak, to try to improve capacity for exactly this situation. Unfortunately, that building is only just starting, so in a couple of years' time we would have been absolutely ready for this. One of the difficulties for a domestic question is that we need to partner with other manufacturing facilities here and elsewhere in the world in order to upscale any locally produced vaccines.

Q66 **Chair:** And that cannot be built in record speed; it cannot be completed.

Professor Pollard: No. CEPI has been instrumental in looking at different facilities around the world that are possible, as well as the work that is going on by developers here. Having different types of manufacturing is important. For some types of vaccine—for example, the one being developed in Oxford—you have to have a cell line in which to grow the virus that we are using to make the vaccine. For other types of vaccine you need a completely different process. You need manufacturing facilities that have all those processes in place to make the vaccine, test it and make sure it is exactly what it says on the tin at the end. Those processes can take a while to put in place. All of that has to be happening today. One of the things that is needed is investment now to make that happen.

Q67 **Zarah Sultana:** Professor Pollard, do you know if the virus mutates as it passes through the world population? If so, how will that impact on vaccine development?

Professor Pollard: The answer is that at this moment there is no good evidence that that is the case. That is a real risk and is something that needs to be monitored because the type of virus is an RNA virus and they are quite liable to mutation. It has not happened so far. Perhaps part of

the features of this virus is that its success in transmitting in human populations is because the genome it has is effective for that. It is likely that it has been making some mutations as it has gone along, but none of them has been very effective so far so they have not persisted. That is perhaps worrying, but also reassuring. To my knowledge, there is no evidence of big changes so far.

Q68 **Zarah Sultana:** Dr Saville?

Dr Saville: I agree. So far it is being well monitored and we have not seen any mutations like those we might see with influenza from season to season, but it needs to continue to be monitored.

Q69 **Zarah Sultana:** Should a vaccine be developed, hopefully soon, who should be prioritised? Should it be a mass programme or should it be targeted?

Dr Saville: The approach at CEPI is that it is a multilateral decision to make. We need to look at WHO and their mechanism for advising on vaccine use. Obviously, we must take into account any local situation, but work needs to be done to define those who are the most at risk. It is important for vaccine development that we do clinical trials testing in those most at risk to provide data on safety and protection.

Professor Pollard: I completely agree with those comments. From a UK perspective, we need to have a look at exactly where we are in the pandemic at the time when we have vaccine availability. Today, you would vaccinate a large proportion of the population if you had a vaccine, but that may look very different in the months ahead. One of the challenges we are going to have is that some of the populations who are most at risk, particularly older adults, tend to make poorer immune responses to vaccines. We have to get testing in vulnerable age groups as early as possible so that we understand that. We can then make some plans about how best to deploy vaccines when we have them available.

Q70 **Chair:** Zarah's question about the mutations of the virus was the same as a question that our colleague Carol Monaghan MP submitted. I think she will regard that as having been answered by your response, so thank you for that.

Finally, both of you talked about the global effort to develop vaccines. Would you say that the international co-ordination mechanisms are working as well and as effectively as they need to be to maximise the opportunity of arriving at a suitable vaccine?

Professor Pollard: At the moment, I am aware of three major international efforts to co-ordinate. Dr Saville has already mentioned the regulatory alignment. Regulators around the world—the FDA in the United States, our regulator the MHRA, the European Medicines Agency and all the European and Chinese regulators—have been making a global effort and have been getting together to discuss all the issues about vaccine development and aligning how that should move forward. They published

a document yesterday that provides some general advice on how we can move forward rapidly.

The second effort is from the World Health Organisation. They have oversight. They got all the vaccine developers together from around the world and have been discussing with them what their plans are, to try to get a good road map for how we move forward. Aligned with that is understanding what pre-clinical testing needs to be done before you start vaccinating humans. There are also questions around how the tests should be done and what measurements of immune response should be done. There are separate working groups that the World Health Organisation is driving on all of those.

Lastly, I pay tribute to CEPI who have also been co-ordinating a lot of global efforts, not just on the vaccines they are funding, but on aligning many of the issues and bringing academic experts together to give advice as we move forward.

Q71 **Chair:** Dr Saville, you are being praised for your role internationally. Have you any advice as to whether there is more that can be done internationally and whether this Government in particular can be doing something that they are not, or are you satisfied with their international engagement?

Dr Saville: Prime Minister Johnson, in his discussions with the G7 and with the Chinese President, has encouraged international co-ordination and collaboration. That is critical, and the UK Government are certainly very supportive of international collaboration.

Q72 **Chair:** Thank you; that is good to hear. Finally, to follow up one of the questions that Aaron asked, there are people in this country who have been tested positive for COVID-19 and have come out of it. In fact, we took evidence from Professor Ferguson right at the beginning of this session.

Can I take it from you that I would be accurately reflecting from your evidence that the best advice you could give is that someone like Professor Ferguson, or indeed other people emerging from a confirmed experience of COVID-19, can reinsert themselves into society without causing a risk for others that would be inadvisable?

Professor Pollard: We know from some of the studies following up people to see when they are no longer shedding virus that the advice we have is reasonably robust at the moment about people reinserting themselves into society after they have completely recovered from infection. The unknowns are the contribution of the people with no symptoms to transmission, and of course we do not know who they are.

Q73 **Chair:** Dr Saville?

Dr Saville: From my perspective, obviously our priority is vaccine development. We are not experts in the area, but obviously making sure

that vaccine development programmes are well designed to address questions such as durability of protection and the need for good will is going to help in that regard.

Chair: Thank you very much. We are very grateful. A lot of the hopes of the world rest on the development of a vaccine, and the work that you and your colleagues are doing in your institutions around the world is absolutely pivotal. We are very grateful for it. Thank you for your evidence today.

Examination of witness

Witness: Sir Patrick Vallance (via video).

Q74 **Chair:** I am very pleased to welcome Sir Patrick Vallance, the Government chief scientific adviser. Sir Patrick, we are very grateful to you for giving evidence to the Committee today. Can I start by thanking you for the extraordinary hard work and resilience that you as leader of the scientific profession in government are mounting in this crisis? It is deeply appreciated by everyone, and I would be grateful if you could convey that to all of your colleagues as well.

Sir Patrick Vallance: I will; thank you. A lot of people have worked very hard on this and will be grateful to hear that.

Q75 **Chair:** You would not have heard me say at the beginning of the session overall that the Science and Technology Committee, as you would expect, will inquire into the handling of the crisis and lessons to be learned. Most of that evidence will be following its, hopefully, satisfactory resolution, but it is important that we should take evidence on the way to capture, in real time, current views so that not everything is filtered through the benefit of hindsight, and if there are learnings and actions relevant to the ongoing conduct of the management of the crisis this gives us an opportunity to raise them in a way that I hope you and your colleagues will be able to find advantageous.

Can I start with some questions on the structure of Government scientific advice? One of the things that we do not know is the membership of SAGE—the Scientific Advisory Group for Emergencies. Is there a reason why the particular configuration of the membership of that group, which I understand changes from emergency to emergency, should not be in the public domain?

Sir Patrick Vallance: Let me thank you for conducting this inquiry. Learning lessons as we go along is an important part in all of this, in particular learning about a new virus. We need to look at this very carefully. The membership of SAGE is different for different meetings. We have a number of people around the table. They come from a range of backgrounds in particular emergencies: clinical, virology, epidemiology, modelling and behavioural science. There is a range of backgrounds.

Underneath SAGE is a series of ad hoc working groups that have different members as well. For example, we have a *modelling* subgroup, a clinical subgroup and a behavioural science subgroup, and others as needed. We form ad hoc groups to deal with certain requirements. It is a rather fluid membership without standing members in the way you have in other groups, as you do with committees, so publishing them becomes a bit meaningless in a sense because it depends on who is at any one given meeting rather than having a standard membership.

Q76 **Chair:** It might be meaningful in the sense that many people think it is important that the Government should be informed by the advice of scientists during this crisis. Obviously, you and Professor Whitty are visible representatives of science, but for the reasons that you have set out you draw on the wealth of UK scientific expertise. In order for people to understand that that breadth is appropriately broad and representative, there would be an interest in knowing which disciplines, institutions and individuals are represented and have the ear of you and Professor Whitty, and thereby of Government.

Sir Patrick Vallance: As you know, we have now made many of the documents from SAGE public, and the various people who took part in the mathematical modelling are making the models and the codes for that modelling available. I am very much in favour of making as much of this as open as we possibly can. That is an important part of scientific discourse and an important part of how science normally works. The challenge is how we get to some sort of understanding of all the individuals who are involved in this. It is not just a question of saying, "Here is a list of the members of SAGE," or what the membership of SAGE is at any one time.

The other thing is about making sure that all our information comes out quickly, which we will. Inevitably, we are asking for a very quick turnaround on these questions, and that very quick turnaround demands them to do things that they don't normally do. They may need to revise that afterwards. It is important that we put measures in place that mean scientists do not put out information about things *[inaudible]*. We need to make sure that we get that bit right, but I am very much in favour of the information that comes to SAGE being made public and open for others to challenge.

Q77 **Chair:** To refer to the approach the Committee is taking, there may be lessons on the way rather than just ex post, and some visibility as to what disciplines are part of the advice would be important. Can I ask whether the advice that SAGE brings together and gives to you and Professor Whitty as co-chairs has always or usually been unified advice—in other words, a kind of consensus view of the group—or have there been occasions on which you have had dissenting views that you have had to put to Government?

Sir Patrick Vallance: I think that in your previous role you will have come across enough scientists to know that, if you put a number of

experts and scientists around a table, you are not going to have a discussion in which everyone agrees with everyone else. It is important that we challenge it, that we challenge it at every stage of the process and that we discuss what the alternatives and outcomes will be. *[Inaudible.]*

Q78 **Chair:** Looking at the evidence that has been published in recent days, quite a few of the papers are headlined or referred to as consensus statements. You will recognise that. That leads me to wonder whether there is an effort to try to bring together a single scientific view, not in the sense that there are not different views but to establish where the main body of scientific opinion is. Is that what SAGE tries to do, or does it set out a range of options for Government?

Sir Patrick Vallance: I think what SAGE has to do is to try to take complex science and bring it to a position where we say, "This is the consensus view of where we are now, but we are clear about the function and purposes of argument." What I think is not helpful is to say, "Here are several different views," and ask somebody who is less knowledgeable to bring these together and come to a single view. In SAGE, we try to come up with a consensus view, but we are always clear and open about how we arrive at that.

Q79 **Chair:** In your experience, when such advice has been given, following that process and principle, in your assessment have the Government followed that advice or gone against it?

Sir Patrick Vallance: The Government listen very carefully to the advice that comes from SAGE, and I think they are following that advice closely. The experience has been that they want to hear and understand the advice and always, as is appropriate, challenge things that need to be challenged. On occasion, we have gone back and looked at that again in SAGE and asked ourselves whether or not it needs to be relooked at, but it has been a process of the scientists being listened to and understood very clearly.

Q80 **Chair:** Is there any significant aspect in which the Government have chosen to take a different view from the advice SAGE has been giving?

Sir Patrick Vallance: I think the Government have listened to the advice of SAGE very carefully and followed it. Clearly, there are decisions that need to be made by politicians on how they want to implement that advice, and those areas are, rightly, political decisions and not scientific ones.

Q81 **Chair:** But you would say that there is no significant disagreement between the Government and their scientific advisers on anything material.

Sir Patrick Vallance: No.

Q82 **Chair:** That is helpful. Perhaps you could help us in understanding what

you will have picked up and understood to be one of the criticisms—or, let us say, just questions—which is that the consensus of UK science, as reflected in the advice to Government and through the published papers, has been at variance with what might be described as overseas scientific opinion, principally in Asia, but sometimes on the continent of Europe. How is it possible in a global set of disciplines that there can be a markedly different approach recommended in one part of the world from another?

Sir Patrick Vallance: The strategy that was laid out initially was to contain. That was very much the aim—to identify cases, isolate, contact trace and contain—and Public Health England put a lot of effort into trying to do that. This became a pandemic, which, by definition, means that it was no longer possible to do this everywhere in the world. That containment stage was very successful in some places early on, and, initially, we tried to contain here as far as we could. I think it XXXXXXX these discussions.

After that, our approach was exactly the same as the rest of the world, and the timeframe depended on the circumstances we were finding. First and foremost, it was by containment—trying to reduce the number of people who got the infection. That means reducing the overall peak of the infection and trying to get that down as far as we could, and it was critically important to keep that below the NHS ICU capacity. Secondly, it was to shift it to the right and try to delay it a little bit. Thirdly, it was to make sure that the most vulnerable people were adequately protected during the time, importantly, when the infection was most prevalent. Those were the things that we built the recommendations around and they are basically three principles that everybody can follow.

The question then comes in to things and events XXXX stage of the outbreak, and we were clear, taking the example of protecting the vulnerable, that the measures in place were obviously pretty extreme, and we needed to ensure that vulnerable people were protected when the infection and death rates were particularly strong. There was a planning issue there. Clearly, there are planning issues around whether to introduce numerous different interventions that are important to delay the spread of an epidemic. We laid those out. SAGE first met in January and we have discussed this in many meetings. We laid out quite early on what the various interventions were that would be needed to try to break the peak, and to reach a consensus view on the modelling of what would be the likely impact of those measures on the size and length of the peak and the number of deaths.

The roll-out in implementing that was about trying to make sure that the most impactful measures, the ones with the biggest effect, were done first and properly, and the others were added later on. That is the approach we have taken. I do not think that, in essence, it is very different from what any other country has done. It is different from countries that had very robust containment strategies early on, like

Singapore in the first wave, although of course it is in a different position now.

Q83 **Chair:** One of the differences that one observes from the evidence that has been published—a lot of the papers SAGE has published are about particular interventions, such as closing schools and social isolation of the vulnerable—is that there is comparatively little reference in the papers to testing and contact tracing, despite the fact that there were some papers appended to the evidence published, including from *The Lancet*, that suggest that in countries like South Korea, Hong Kong and Singapore, testing and contact tracing has been the most important early intervention. That does not have the same degree of prominence in the evidence that is before the public as to what SAGE has considered.

Sir Patrick Vallance: The first few meetings of SAGE were almost totally dominated by questions about contact tracing, containment, isolation and testing. Those were the early discussions we had. Testing was largely able to be done through Public Health England. You will be aware that for a long time the UK had a *[inaudible]*. Now we are up to over 90,000 tests. If not on the agenda, I should think it has been on the vast bulk of the agendas for SAGE. At the beginning, it was in the context of testing, contacts and isolation. In more recent times, it has been very much about the scaling up of testing and making sure that we get testing at the right levels to do much wider testing, which is a crucial thing to do.

There are two types of testing that we are focused on, and there is a lot of discussion around this. One is to ramp up the testing of the viral infection itself in bigger numbers. Public Health England and the Department of Health and Social Care have worked very hard to do that. That is very important.

The second type of testing, which took a lot of time to sort out, is serology testing. This is the testing for antibodies to indicate that people have had the infection, and very early on we pushed for that to be done as soon as possible. Public Health England developed the serology tests, and others have them now. The results from that are coming through now, and that needs to be ramped up. So, I think if it is not reflected in the papers, it has certainly been a very large part of discussions that we are elading.

Q84 **Chair:** We have changed the policy towards testing, in that until a couple of weeks ago, it was available in public settings through drive-in test centres. It is now reserved for hospital in-patients and is to be broadened to NHS workers. We understand that. Why was it not possible to continue the expansion so that we would be able to cover in-patients and NHS staff and care staff, but to maintain and expand the testing in the public setting of people with symptoms, at the very least?

Sir Patrick Vallance: At the moment, there is not enough testing to do all the things we need to get on with, so the emphasis on ramping up testing is key. That is why there are proposals to get from under 10,000

tests per day, which is what we are talking about at the moment, in terms of detecting active infections. There are major XXX looking into big testing facilities around the UK, in addition to the Public Health England testing team. I think that absolutely needs to happen in order to be able to do what we need to do. Until we can get up to those numbers, the decision, which I think is the right one, has been made to test patients in hospital and primary care workers . That is the pragmatic reality—the sooner we pick up the testing the better we will be XXXX.

Q85 **Chair:** Is there anything that you think could have been done at an earlier stage to have expanded the number of tests available or the capacity for testing?

Sir Patrick Vallance: I wish we had more tests available today. It would be great to have got ahead of this more than we have been able to do, but it is not easy to ramp up testing was a technically difficult thing to do. I reiterate the point that the UK was the fourth largest tester in the world, so we were not slow in getting off the ground, but it is absolutely the case that we need to test many more now. There is an industrial-sized effort to get up to the vast numbers of tests needed. We do not only need to do it now; it is an important thing to look at as we go through this and at some point we want to relax the measures that are in place. Testing is going to be a critical part of that. I cannot over-emphasise the importance of getting the testing right.

My final comment is that it is important to improve the scale of testing, but it is also important that we improve the quality. There is a very real problem if things are rushed and tests give you false negatives and false positives. It is important that we do this at the right quality. I will give you one example. If you were to test somebody and get a false negative, you have done a disservice, because they then think they are okay to go back to work or whatever, and that will cause more problems. We need to get the quality and the quantity right, and that is technically difficult to do at scale, but I know many people are working very hard to achieve that.

Q86 **Chair:** You mentioned the serology test and how important it is to see who might have had the virus without knowing about it. When will that be deployed? You say it is already being tested now. Can you give us an idea when we might expect to see the widespread roll-out of that and at what kind of pace?

Sir Patrick Vallance: Public Health England is working on a proposal to do a community-based study of that looking at different age groups, which is important. The thinking underneath an epidemic is, what proportion is asymptomatic to infection? There are papers, for example from Japan, to suggest that a range of people are undetected there, and there is a paper from Italy saying that over 70% of those tested were asymptomatic, but we don't really know. The first priority with the serology is to try to get a handle on that number.

We then need to ramp up serological testing. That is where the sort of tests that people have mentioned, which are self-administered—the finger-prick tests that you can do—are potentially the answer to that. It is very important that the tests are properly validated to guard against false positives and false negatives. The lab-based test is up and running, and about 4,000 tests can be done per week at the moment; that will ramp up. We should be seeing results from the first community-based study in the next few weeks.

Q87 **Chair:** When do you expect that type of testing to be available at scale across the country?

Sir Patrick Vallance: The finger-prick-type tests are being ordered and looked at now, and if those are effective—they need to be tested to make sure that we are clear about the effectiveness, sensitivity and specificity of the tests—they could be rolled out relatively quickly. We need to make sure that we have the right parameters around those tests before we roll them out generally, and that is something DHSC and others are looking at now.

Q88 **Chair:** Are we talking about before the summer or later in the year?

Sir Patrick Vallance: I think it will be sooner than that, if the tests work. To be clear, that is the desired aim. If we can put this out quickly, it would make a huge difference for testing.

Q89 **Chair:** In terms of taking the best scientific advice to Government and taking policy decisions on that, can you give some clarification from your scientific vantage point on whether people should go to work, if they cannot work from home, and can stay 2 metres apart from each other? If they are not in a designated critical occupation, providing they can meet that distancing requirement and cannot work from home, is it okay for them to work?

Sir Patrick Vallance: First, I think I can commend you on being 2 metres apart, although I can't quite judge from the video.

The aim of social distancing and the other measures in place is to break transmission between households. Essentially, that is what we are trying to do. If we break transmission between households, it allows the whole thing to come down. We are trying to get the R value below 1. The R value is the average number of people infected by one person. If you have more than 1, it means the epidemic is now XXX.

The aim is to break transmission between households. All the measures we have in play are about doing that. The best way to do that, of course, is for people to stay in their own houses and not go anywhere. The work situation makes that impossible for certain types of work, and for certain types of essential work, including key workers, but many others as well.

The advice is clear: people should stay at home. Home working is absolutely what should be done wherever it is possible to do so. There

are some situations where it is not possible, and in those situations, staying 2 metres apart is essential.

Q90 **Chair:** In your view, will it be necessary for people, where they can distance themselves from each other, to work in settings that may not be listed as critical occupations in order perhaps to provide components for something that is critical?

Sir Patrick Vallance: Yes, I think those things need to happen. We need to keep things going, not least for the health service *[inaudible]*. This is obvious, but I will give you an example. It is important that we continue to discover new drugs and XXXX and vaccines.

Q91 **Aaron Bell:** Sir Patrick, on the public health interventions, essentially it seems there is a succession of interventions that you have or levers that you want to pull, and it is just a question of timing. Is that a fair characterisation?

Sir Patrick Vallance: Yes; I think that is a fair characterisation, and that is what we are trying to do.

Q92 **Aaron Bell:** Are there further levers in reserve, or are we now at maximum leverage in what we are going to ask the public to do?

Sir Patrick Vallance: I think you heard from Neil Ferguson earlier on, who is one of the modellers who has been inputting to SAGE. By the way, we have lots of modellers, but Neil is certainly world-leading on this. The measures that have been put in place to be compliant now look as though they should be enough to bring things down to well below 1. Those measures at the right time in the right way should get this below 1. That is the aim. You know, as well as I do, that we are in an extraordinary place in terms of the effects on society and the way we live, and those measures really should be enough to get us below 1, although we can never say that we may not need more. I reiterate that it is now clear that it is not below 1 and we should expect, with a time delay of two or three weeks, to start seeing that go down.

Q93 **Aaron Bell:** Perhaps I could turn briefly to communications, which are part of the strategy in how we communicate to the public. First, thank you for your efforts and those of Professor Whitty and Dr Harries. I know it is not a role you sought, but I think you have been very reassuring to the public in your appearances. Could I ask what scientific advice has gone into the overall communication of what we are asking the public to do?

Sir Patrick Vallance: In the table that we published through SAGE on what interventions could be looked at and the effects they might have, we also had a table describing what the behavioural implications were and how we could simply communicate the behavioural science point of view. Quite a lot of work has been done on that and very clear advice has come from behavioural scientists in a number of different groups that have given input to the Government communications process.

Q94 **Aaron Bell:** Obviously, we have a free press, but I would like to ask you what you think their role needs to be in this epidemic. Is there a case for some sort of agreed voluntary code on how they report on this, given the public health concerns? For example, should they be emphasising compliance rather than the exceptions and things like that? I am asking for a scientific judgment, not a journalistic one, because I appreciate there is a balance.

Sir Patrick Vallance: That is getting quite close to not being science, and I am not sure that I can comment on what the papers should or should not do. What I would ask is that papers try to follow the responsible line that is being laid by the Government. It is important to encourage people to be compliant. The message that I would like everybody to hear is that, while many people will get a disease that is mild or moderate, the aim of intervention is to protect everybody. If we do not do it, and if we allow household transmission to take place, we put other people at considerable risk. We must make sure that the measures are really understood. If people do not understand the impact of behaviours that do not allow them to adhere to the social distancing rules, this is going to cause a problem. I would like, as always, that communication to come out clearly and to be reported in the papers, but I cannot go beyond that.

Aaron Bell: That is understood.

Q95 **Chris Clarkson:** I would like to reiterate the comment about the work you are doing in very trying times, Sir Patrick; you are being very effective. I want to come back to the social distancing piece. The documents published by SAGE on 20 March recommended an alternating period of looser and stricter social distancing controls. Is there a scientific reason for that? Is that better than a single period?

Sir Patrick Vallance: That was one group of modelling that came through to the SPI-M process. Where we are now, we are very confident of applying these fully to get the R below 1. We absolutely need to do that. The question that everyone is asking across the world is, once you get to R below 1, what is the right strategy of releasing the measures? We have a number of risks there. One is to release and monitor and then perhaps go back again with some. The other is to release altogether and see what happens, or to release partly. The question of whether you can start to take off these measures and monitor the effects carefully is one that is important to do *[inaudible]*, but I do not have an answer; I do not believe anyone has the answer about exactly the right way to do that. That modelling on one way to do it but you have aXXX.

Q96 **Chris Clarkson:** We are also now following a strategy of shielding the most at risk, which will involve things like deliveries of food and medicine. Is there any risk of the disease being transmitted to those people via food or medicine deliveries?

Sir Patrick Vallance: There is an obvious risk if the people doing it go into the house and have close contact. That is why what should happen is that deliveries should be left in a place where somebody can get them without coming into direct contact, if it is possible to do that. It is clearly important that nobody delivers to people if they have any symptoms, but I think the initial advice that has been given by Public Health England about how to do that should protect the individual as far as possible and trying not to go in. In some cases, such as care homes, people may need to have contact, and appropriate measures should be taken.

Q97 **Chris Clarkson:** To expand on that, there is no chance of transmitting it via the actual food itself.

Sir Patrick Vallance: The survival of the virus on hard surfaces may be for 48 hours or so. It falls off quite quickly after 24 hours. On soft surfaces it is much less. There is no probability of transmitting it through food in the way you describe, but it is important to wash things like fruit before you eat it.

Q98 **Zarah Sultana:** The Imperial College report dated 16 March on non-pharmaceutical interventions states that mitigation is no longer a feasible strategy after refining the estimates of likely ICU demand in Italy and the UK. It goes on to say that previous planning estimates assumed half the ICU demand now estimated.

Given that the Government have updated their strategy, the most effective mitigation strategy would involve exceeding ICU demand eightfold. Professor Ferguson in a previous session said that now this would be potentially threefold with the new measures that have been introduced by the Government. Does that imply that the previous mitigation strategy still involved exceeding ICU bed capacity by some amount?

Sir Patrick Vallance: There is absolutely no intention ever of exceeding ICU capacity. That is not our strategy and never has been our strategy. The mitigation report had two parts to it, which were supply and demand, as it were. What we need to do, and what is being done at the moment, is to track the demand side, and track the numbers as far as we can, and at the same time to scale up the NHS ICU capacity so that it has spare capacity. That is being done at the moment.

I cannot guarantee, and nobody can guarantee, that there will not be occasions when in individual places ICU capacity gets breached—that always remains a possibility and of course happens in winter, or for any reason when pressures come. There is no guarantee that you can stay within that, but the various measures in place now and the increase in NHS ICU capacity that is being forecast by the NHS look like being on track to stay within that capacity limit. That is clearly what we need to do.

Q99 **Zarah Sultana:** In the previous optimum mitigation strategy that the Government pursued, there were figures for how many people were

expected to pass away from the virus. Was there a mortality figure that appeared tolerable, in your opinion?

Sir Patrick Vallance: As I said at the beginning, it is difficult to define any premature death as tolerable, so our aim from the outset was to make sure that we minimised death and suffering and that the most vulnerable were protected. That has always been the aim in what we have been trying to do.

There is of course the situation that we need to know over what time period this occurs. There is a balance between this going on for a very long time or for a short time, and different options need to be looked at. We have would never *[inaudible]*. One of the reasons we are not *[inaudible]* what is the number of deaths and the number of infections you end up with. That is the reasonable worst-case scenario we have spoken about in the past.

Q100 **Zarah Sultana:** Dr Horton mentioned warnings coming out of China before the World Health Organisation officially declared a pandemic on 11 March. There were also warnings that if the virus spread beyond China, it could become a global pandemic. That was around January. Given that, what was the reason for the Government's delay in seeking the resources they needed to deal with the pandemic? For example, leaks to journalists only this weekend show that a senior Downing Street aide wrote to research institutions asking to make use of their testing equipment.

Sir Patrick Vallance: I am not sure I understood the second part of the question.

Q101 **Zarah Sultana:** Only this weekend, there were leaks coming out that Downing Street is requesting access to use testing equipment.

Sir Patrick Vallance: This is about testing scale-up. Clearly, there are bits of equipment all over the place in the UK, and the question is whether they can be utilised in some way that then helps to upscale the testing so that is what that is about. That is an entirely appropriate thing to try to do.

In terms of indications that there would be a pandemic, very early on there were two things that could happen in China, and I think the CMO put it well. Either China could contain this completely and it would go away—that was one possibility—or they would not contain it and it would spread and become a pandemic.

Early in January, it was not clear which of those would be the case. As it has gone on, it became clear in January that the infection was spreading faster *[inaudible]*. The official declaration of a pandemic by the WHO is in their hands, and it is for them to make the decision, but by then we were planning that it would go across the world and we had already seen it spread to a number of places. Chris Whitty and I spent time making sure that we spoke to our colleagues in other countries to learn what was happening there as well, but I think the growth of a pandemic became

inevitable at some point during that time, probably before the WHO declared it to be a pandemic.

Q102 **Chair:** Zarah mentioned Dr Horton. In his evidence before us this morning, he wondered whether there was sufficient clinical representation on SAGE. Can you clarify that for us?

Sir Patrick Vallance: Rather unusually, both the Government chief scientific adviser—me—and of course the CMO are medics. We also have the NHS medical director on SAGE itself. We have a number of clinicians around the table, including some from Public Health England, so quite a proportion of SAGE is clinical, but—it is an important "but"—there is a clinical subgroup within SAGE and they are all clinicians. They do a lot of the work on modelling the clinical aspects. They are involved in the processes of SAGE and play an important part in its direction. That is crucial. Modelling is one form of evidence. The real understanding of what this means in hospitals for clinicians who have patients in front of them at the different layers is why the make-up of SAGE is so important, in terms of the different disciplines we have round the table.

Q103 **Mark Logan:** Sir Patrick, I have some questions around the science advice to Government. I want to understand a little bit more about why it took until 20 March for SAGE to publish the evidence informing its advice to Government.

Sir Patrick Vallance: SAGE historically has never published any of its recommendations until afterwards, so this is a departure, and it is one that I personally welcome. It is important that we get the evidence out there. It took us a while to get it into the right shape to get it out there and get permission from people, because we were reliant on the papers you mentioned that had come from them and were attributed to them. *[Inaudible.]* That change to the way SAGE works is one that I personally welcome.

Q104 **Mark Logan:** Who took the decision to publish the evidence from SAGE?

Sir Patrick Vallance: It was taken by me as a proposal to SAGE and SAGE agreed it.

Q105 **Chair:** Reflecting on the evolution of the approach that we have taken in this country, and from reading all the evidence that has been published, it seems to divide into two phases. The first phase was a belief or an assumption that most people in the UK would contract the coronavirus, one way or another, and a certain scepticism about what might be called the Asian approaches.

The SAGE paper of 26 February, for example, on the potential effect of non-pharmaceutical interventions, says: "Implementing all the measures"—the suppression measures—"would result in a second epidemic once they were lifted."

The paper of 9 March, on the potential impact of behavioural and social interventions, says that, "implementing a subset of the measures would

be ideal. Whilst this would have a moderate impact, it would be much less likely to result in a second wave. In comparison, combining stringent measures as a long-term policy may have a similar impact to Hong Kong or Singapore, but this would result in a large second epidemic once the measures were lifted." I discern that, but then there was a shift to suppression.

We had evidence in person from Professor Ferguson, and in his colleagues' famous study, showing the capacity of the healthcare system. That is obviously one very important reason for the shift. Is it the reason for the shift? Was it not possible, earlier than March, to have accurately modelled the balance between the demands on the NHS and its capacity to supply intensive care unit beds?

Sir Patrick Vallance: The figure for most of the population becoming infected was a reasonable worst-case scenario, which was derived from what an unconstrained epidemic would do. The figure of 80% is the upper figure you get to if you have an unconstrained epidemic; it warns people of what would happen. Of course, however you look at this, it does not look like anything close to 80% of the population becoming infected, but that was the reasonable worst-case scenario.

We were concerned, and remain concerned, about a second wave. Of course, that was quite a feature of the 1918 flu pandemic; the second wave caused even more deaths than the first one. The second wave is the main concern. The more you suppress it down to zero early on, the more likely you are to get a recurrence at some point. It is a very difficult thing to try to balance. What we are trying to do is to get the numbers below the ICU capacity and keep them there, and allow for the release of those measures. Of course, treatments are being looked at, and vaccines, hopefully, will come along one day, but we need to make sure that we do not allow the ICU numbers to increase. The modelling that Neil Ferguson and many others did right from the beginning has *[inaudible]* a range of possible outcomes.

Q106 **Chair:** We have taken evidence today that a vaccine is unlikely to be available before 12 months, and I think you have said much the same. There was the outside possibility that it might be six months, but that was an outlier rather than something we could rely on. If we are to suppress in the way that we are, without a vaccine, are you anticipating a second wave later in the year?

Sir Patrick Vallance: I think that goes back to the answer I gave earlier on. This is true across the world. When it has been suppressed, we start relaxing measures, which is what is happening in many countries. We are now in the process of trying to keep the R value below 1. As we release those measures, we have to monitor very carefully what happens in terms of an increase in infection. You can see that happening in places already, where an increased number of infections is now occurring, having very successfully contained it early on. That is going to be something that we have to measure as we go along. I do not know for

sure if it can be contained for longer than that. All we can say is that it is one thing we have to be very concerned about and keep an eye on. We cannot do anything now other than suppress and then release, and see where that goes.

Q107 **Chair:** Shot through the early papers that have been published is great concern about a second wave in the winter. Obviously, the capacity of the NHS currently to absorb critically ill patients has been very influential in determining the change of approach, but I have not detected any revision of that concern in anticipation of a second wave.

I was struck by one paper published in evidence, the SPI-B insights on public gatherings, which was given to the Committee on 12 March. That advice to SAGE said: "Acting in a way that does not meet expectations poses a risk that a section of the public will view Government actions as incompetent or not in the public's best interests…SPI-B has pointed out repeatedly that trust will be lost in sections of the public if measures witnessed in other countries are not adopted in the UK."

To what extent is the adoption of measures that have been adopted by other countries driven by compliance with the advice of SPI-B that we need to be seen to do that for public confidence, or to what extent does it reflect a change in the very solidly argued early assessment that we must act to prevent a second epidemic?

Sir Patrick Vallance: There are several questions wrapped up in that one. We laid out the measures that we were taking early on. Those measures needed to be implemented at the right time, and that is the path we have taken. Mass gathering was one of the very early ones that caused quite a lot of interest because it XXX. We could see several people going early to stop mass gatherings. The point that we found, which I think is laid out in the papers, is that banning mass gatherings alone is a very ineffective way to try to stop the problem, which is why we did not do it early. We did the things that mattered early and concentrated on getting those things done first.

We were also clear that stopping mass gathering was part of a broader social distancing programme, but also talking about stopping smaller, more intimate gatherings that do cause spread more rapidly would be a sensible thing to do. Measures on mass gathering actually only came in at the time when we were also dealing with other types of gatherings and greater social distancing. That was why they came in at that point.

I am sorry—I have forgotten the second part of your question.

Q108 **Chair:** Mass gathering was an instance, but the point of the advice in the paper for SAGE was that we should take measures that other countries are doing because, if we did not, there would be a fall in public confidence. What I was getting at was whether we are taking these measures because others are doing it, with some private scepticism continuing, as you evidenced before—an, "If you can't beat 'em, join 'em," kind of approach— or is there a reappraisal of the actions that are

needed?

Sir Patrick Vallance: It is none of those. We laid out all the measures and said that, as we monitor the epidemic, you may need to work through those and pull all those levers, and all those levers have been pulled. Well, not all of them—there are other things you could do—but the levers have been pulled get us there. So it was a tighten thing. The reason why it became necessary to have measures to enforce more compliance is that, without good compliance, it did not look like we were on track for getting the numbers down below the ICU capacity. Therefore, we had to have compliance to do that.

It was not in response to what others were doing or things like them. It was about following the trajectory that we had set out, implementing those measures properly, making sure that people knew what compliance was, and, when we saw that compliance was not enough, there was the question of what needed to happen to make compliance greater, and that is all.

Q109 **Chair:** To go back to testing and the roll-out of new tests and making them more widely available, is that now an operational matter for the Government and the NHS, or is it something where you and your colleagues in SAGE continue to have an important role in setting policy?

Sir Patrick Vallance: It is largely an operational matter. It is certainly a matter that we continue to look at, because it is so important in the approach to be able to monitor this going forward and release measures. It is operational.

Q110 **Chair:** In Professor Ferguson's evidence, he gave some comfort that the capacity of the NHS, with the measures that have now been taken, is likely, in aggregate, to be sufficient, which is obviously important news.

Finally, as a wrap-up, can you give the Committee and those watching this a feeling for the length of time you would expect the current measures to be in place and to have a significant effect?

Sir Patrick Vallance: If you look at what has happened in other countries, and you take the measures that we have taken, you start to see a change in the R value within two weeks or so. If you measure ICU patients, maybe two to three weeks. As I said, if you get R down below 1 then, that gives you indication timewise, although not of scale because the scale is measured very differently in different countries, but timewise the moment at which you start to see this coming down.

As for getting it under control, if R is at 1, the epidemic goes down. I think we could follow that sort of timeline. The important question that comes next is what we do politically to allow things to go back to normal. Can you alter that? You may want to leave some measures in place longer than others to achieve what needs to be achieved. This is starting now in China, where measures are being relaxed, apparently, and we will see what happens in terms of the disease and the outbreak. I cannot give

you an answer as to what will happen there, but we can observe and be clear what we need to do here to respond.

Q111 **Chair:** Sir Patrick, thank you very much indeed. As you said much earlier in our discussion, my experience of working with scientists, and indeed yourself, in government, is that science often involves disagreements and arguments. In fact, the way it proceeds is by testing hypotheses. That is inevitable. I feel sure, having observed the structures that we have, that it is a good thing that we have people of your calibre, supported by others, advising Government. This is a time of great work and pressure on you, and we are very grateful to you for your public service during this time.

Sir Patrick Vallance: Thank you, and I take this opportunity to thank the many scientists who have given input into this work, and who have worked day and night to try to make information available. I am extremely grateful to them.

Chair: Thank you, Sir Patrick. At the beginning of the session, we conveyed similar thanks, and I reiterate it now through you.

Examination of witness

Witness: Professor Peacock (via video).

Q112 **Chair:** We are very pleased to have Professor Sharon Peacock, who is the director of the national infection service at Public Health England. Thank you very much indeed for joining us at a very important time. Could you describe briefly the main diagnostic tests available for COVID-19?

Professor Peacock: Yes. I would divide them into two types. The first is what we call an antigen test, which detects the presence of the virus in people who have COVID-19 and who are sick with it. There are a variety of ways of detecting it, but fundamentally you just have a virus test. The second type of test is an antibody test, which is looking at evidence of the immune response after somebody has had the illness and recovered. The difference is that you do the antigen test at the time of the illness, whereas the antibody test you need to do later in the illness, at least seven days after the start of symptoms.

Q113 **Chair:** Tell us about the stage of development and deployment where we are in this country on both, if you will.

Professor Peacock: We were one of the first people to develop an antigen test, and that was done in Colindale. Within a very short space of weeks, we had a test that was operational to detect the antigen. We subsequently devolved that to eight laboratories in the first instance, which were either PHE laboratories or linked with PHE, so that we could develop capacity. We then rolled it out to further NHS laboratories, so now we are in the position where we are ramping it up to the NHS network.

On the actual numbers for where we are going with it, by 30 March we will have capacity for 11,900 antigen tests a day for patient care. I am just focusing on new patients coming into hospital, in the first instance. By 6 April we will have 15,000, and by 25 April we aim to have 25,000 tests. This is being ramped up throughout the NHS network; there are 29 NHS laboratory networks, but we need a new paradigm to increase our numbers. We have full NHS capacity, pretty much, as they function at the moment, and we are putting in very high-throughput machines in some laboratories, including in London and Manchester, from 30 March, which will give us a much higher throughput per machine.

Q114 **Chair:** How long does it take for the results to come from each of the tests?

Professor Peacock: Doing the test actually takes around four hours. The actual time that it takes will depend on the duration of travel of the sample from the patient to the laboratory; it then takes in total about 10 hours to process the specimen. We have to do some pre-processing, and then we do the test. We get the laboratory to have a result within a day, and then the result goes out to the clinician. There is some variability in the time that it takes to get the test to the lab, which will depend on the proximity of the patient to the laboratory. Then it is about getting the result out through the NHS system to clinicians, going by the usual route for patient care.

Q115 **Chair:** On the development of the testing capability, obviously the virus is a global one, so the same tests apply to every country in the world. Why has it required a national programme of development to source our own test?

Professor Peacock: When COVID-19 first arose, nobody had a test for it; it was completely novel. We were approached by the WHO to be one of three reference laboratories. It is important that there is diversity in people developing tests, because you need to do it at pace and, because they are in-house tests, you need to be able to compare your results with other people's. There was a major effort from numerous countries to develop a test, but now that we look back and compare them, they are all very similar. Our test was based on one done in collaboration with Germany, but tests elsewhere are quite similar, certainly in format. It was a case of everybody acting as rapidly as possible and trying to act within country as well as interacting with the WHO and other countries.

Q116 **Zarah Sultana:** I have a question regarding the 2016 exercise, when the UK Government ran Exercise Cygnus looking at a national pandemic flu, which highlighted the necessity for ventilators. What was learned from that, and do you know why there is currently such a shortage of ventilators in the UK?

Professor Peacock: This an unprecedented pandemic, which it would have been difficult to plan for. However, we have enough ventilators for patients at the moment, and I think that the rapid scale-up of ventilator

availability in the coming weeks aims to match demand with supply. This outbreak has been of unprecedented size; it is reasonable to use what we have, which is the existing capacity at the moment, and then increase our availability rapidly. That is the Government's plan.

Q117 **Zarah Sultana:** I have a follow-up question about the high levels of mortality we are expecting to see. How is Public Health England preparing to deal with the high numbers of bodies, essentially? What do the most effective disposal procedures look like?

Professor Peacock: This is obviously a very sensitive issue, and one that the NHS will be dealing with in particular, rather than PHE. We would expect the case fatality rate to be around 1% and, if it is any higher than that, it is because we detect the most severe cases that are in hospital, rather than in the community. At the moment, the case fatality rate is somewhat higher than that, but, over time, as we get more data, we expect that it will be around 1%.

In terms of deaths, when they sadly occur, Public Health England has developed guidelines on how to deal with deceased individuals, which are available on the gov.uk website. We have guidelines on how to deal with deceased people. Mortuary capacity would be an NHS issue, and I know that they are planning around that through their worst-case scenario planning.

Q118 **Zarah Sultana:** Given the likely human and economic costs of the epidemic, how much money globally should be allocated to research, protection and prevention measures against the next one?

Professor Peacock: That is a really important question. I have to say that I have not been involved in the economics, and if you wish to have an answer to that I will have to take it away and confer with people who can give you an accurate answer. I apologise that I cannot answer it right now.

Zarah Sultana: That's okay. Thank you.

Q119 **Chair:** Can I put a couple of similar questions from two colleagues who cannot be here, Graham Stringer MP and Carol Monaghan MP? Graham asks why the UK does not have the same capacity to test as Germany, and Carol asks why the Republic of Ireland is testing three times as many people as the UK per head of population.

Professor Peacock: On capacity to test, we have obviously looked at the numbers of the tests being done elsewhere, and in the early phases of disease we were testing a large number of people compared with others. You will start to see those numbers rise very rapidly now, because the Government have a four-point plan for increasing testing, so we anticipate increasing our testing of sick patients to 25,000 per day by the end of April. There are also plans by the Government to develop mass testing of key workers for the antigen up to 100,000 or more tests per day, and those plans are rapidly rolling out. In the current situation we

are meeting the most critical demand, which is for sick patients in hospital, and over the coming days you will see an increase in the number being tested.

Q120 **Chair:** When will the capacity for 100,000 key workers be reached?

Professor Peacock: There is early work going on in a centre in Milton Keynes, so they are standing up their capability now. I anticipate that in the near future that will be going to key workers. The tests being developed through the NHS, once there is sufficient capacity, will also be made available to key workers, if there is capacity after we have tested patients.

Q121 **Chair:** Given my colleagues' questions, are you benchmarking what is being done in other countries such as Germany, the Republic of Ireland and, more famously, South Korea? They have installed a capacity greater than ours in terms of coverage of the population, and I assume that they are continuing to increase that capacity. Are you studying what they are doing and looking to replicate it?

Professor Peacock: We are studying what they are doing but not necessarily to replicate it. In South Korea, they managed to increase their testing by having testing running in 79 laboratories. We do not intend to run the tests in 79 laboratories; we are taking a different model. We believe that we need centralised, high-throughput sequencing for key workers, together with a distributed network of tests in the NHS, so that we can actually test our sick patients. Yes, we are looking at how other people are operating, but our model is to have a distributed NHS network for testing, together with very high-throughput capability.

Q122 **Chair:** Given that you described the South Korean model as being distributed over 79 testing centres, and that Public Health England has chosen a different model, can you explain why we rejected the South Korean model in favour of that approach?

Professor Peacock: That is a good question. I am thinking about how I would respond to it. We need to build on the strengths of the NHS, and the NHS actually has 29 laboratory networks around the country, so building on our existing capability is key for us. Once we have exhausted that capability, we have two options. First, we can open up new specific laboratories in universities or other hospital settings. Laboratories in this country have largely been merged, so we have a smaller number of larger laboratories. The alternative is to have a single large testing site. From my perspective, it is more efficient to have a bigger testing site than dissipating our efforts into a lot of laboratories around the country.

Q123 **Chair:** Given that the handling of the epidemic has been informed by the science continually—we have taken evidence from many scientists today, and from the Government chief scientific adviser just before you—and given the decision to follow a different model of testing from South Korea, is the evidence base and the rationale for that published in such a way that it can be scientifically interrogated?

Professor Peacock: It is not published at the moment, but we will be looking at the model. It will be used in an exercise. The straight answer is that it is not published at the moment, so we could make it available and do that piece of analysis, and we will be doing the analysis of how we have operated compared with other people.

Q124 **Chair:** Can you say when it might be published so that people can comment on it and perhaps come up with some different perspectives on it?

Professor Peacock: Yes. We need to take that away and do it in the next few days so that you are able to see it.

Q125 **Chair:** But it is an example of a very important intervention that has been foundational for the handling of the virus by many countries, and, in a regime where we are basing it on the science, it seems a little surprising that the evidence base and rationale for that is not subject to scrutiny by other scientists.

Professor Peacock: The programme of testing has been discussed extensively by our scientists. The plan for the roll-out of testing was developed as a four-point plan, and that got widespread agreement in terms of the models, so it has had support from our scientists and others.

Q126 **Chair:** Is there any reason why, rather than the sequential approach you described of using public laboratories, NHS laboratories and then others in the universities, it is not possible to do everything at once?

Professor Peacock: The test we used required particular reagents, so we needed to scale up use of those reagents. For example, the tests that we were using required the virus and other reagents, so the scale-up seemed a reasonable approach to us. In retrospect, we could have looked at other approaches, but that was the approach we chose at the time.

Q127 **Katherine Fletcher:** I want to thank you for giving us your time. You have one or two things on at the moment, and everyone is extremely grateful. What would be wonderful is to have a one-sentence reply to the lady who wrote to me yesterday, saying, "My wife's a nurse. She's got a cough, and she is frustrated because she wants to go to work and she hasn't had the test." What is the one sentence from Public Health England for key workers who are desperate to work?

Professor Peacock: There are two answers: one is that we are standing up a key worker testing capability and the second is that we are developing home testing so that people who have been sick can be tested for the presence of antibodies, and, if they are positive, they can go back to work. The home-testing programme, which we have not really talked about so far, is exactly for that reason: people can have a test to see whether they have had the condition and have developed antibodies, which would allow them to leave their home.

Q128 **Chair:** Perhaps you could expand on that and say something about the

timing of the availability of the home-testing solution.

Professor Peacock: Yes, I can do that. A small number of tests have arrived for evaluation; they are in Oxford at the moment, and they will be evaluated rapidly. Several million tests have been purchased for use. We need to evaluate them in the laboratory, because they are brand-new products, to be clear that they work as they are claimed to do. Once they have been tested—that will happen this week—and once the bulk of the tests arrive, they will be distributed in the community.

There will be a mechanism to order a test via Amazon. They can be performed at home and sent back to see whether they are positive or negative. There are two different models, and it might require you to go somewhere like Boots, because it requires a blood prick. You can then see if you have antibodies, in which case you will know that you have had the infection. That is not just for key workers; it is for the general population. Over time, we are expecting that a proportion of the population will be positive, which will allow them to get back to work.

Q129 **Chair:** That is very encouraging. You say that several million have been ordered and that they are waiting to be tested, to be released to the public. Is that the case?

Professor Peacock: Yes. I think 3.5 million have been ordered—that is the amount we have—and further millions are being ordered today. But we need to make sure that we understand how they operate, because they are brand-new tests; they have not been used by us before. They will be tested in Oxford, and once we are assured that they work they will be rolled out to the community. We are rolling out a programme alongside that to check that they work in the field, in people's homes. PHE has a study and will recruit people to have a second blood test, to get checked with a gold standard test to make sure that they are truly working as we expect.

Q130 **Chair:** Can you give us a feeling of when you might expect the testing of the tests to be completed so that they can begin to be sent out by Amazon?

Professor Peacock: Testing the test is a small matter, and I anticipate that it would be done by the end of this week.

Q131 **Chair:** By the beginning of next week, should members of the public be able to order their home tests and test themselves?

Professor Peacock: I would be somewhat less categorical about the date, but, in the near future, people will be able to order a test whereby they can test themselves or go to Boots, or somewhere similar, to have their finger-prick test done.

Q132 **Chair:** That will be extremely welcome to many people across the country. If not certainly the beginning of next week, you are talking about a small number of days rather than weeks or months.

Professor Peacock: Yes, absolutely.

Q133 **Chair:** To understand a bit more about the nature of the test, it is a blood test, is it? You prick your finger, and then it has something where you read off whether it is positive or negative. Is that right?

Professor Peacock: That's right. It looks like a pregnancy test, except that you are putting a finger with a spot of blood on it. You will have a lancet, and it can be done by somebody else or at home; you prick your finger like a diabetic would, get a drop of blood and put it on filter paper, and then run some liquid to make the blood run into the test zone. Then you read it to see whether you have two types of antibody. One is IgM, which arises very early during the infection, and the other is IgG, when the body reacts to the virus. You read the lines, or a healthcare worker reads the lines for you, to see whether they are positive or negative.

Q134 **Chair:** You say a healthcare worker. Does it require a healthcare worker, or can you read it yourself?

Professor Peacock: No. You could read it yourself. There is a variety of sticks; some you can read by eye and other sticks need to be plugged into a machine to be read through the instrument reader. The details are being rapidly resolved at the moment.

Q135 **Chair:** Will it be charged for or will it be free of charge?

Professor Peacock: I cannot comment on that, but I would have thought there would be an absolutely minimal charge if there was a charge. It is certainly not going to be about charging the public a large amount of money. It will be a minimal cost, if any cost.

Q136 **Chair:** Obviously, it is very strongly in the public interest that as many people are tested and can either isolate themselves or be confident that they can go out without infecting others.

Professor Peacock: Absolutely. Cost should not be a barrier to the availability of these tests to people.

Chair: Thank you for imparting that news to us.

Q137 **Aaron Bell:** Yes, thank you. I have a couple of further questions on that development. You said there were 3.5 million tests, then some more millions thereafter, but you also implied that people would be able to order it themselves at home. Should there not be some element of prioritisation, or are we confident that we will hit the scale required quickly enough?

Professor Peacock: I think there would need to be an element of prioritisation. We are thinking about how to prioritise and also thinking about how to use the tests very wisely with some people. Tests are never absolutely perfect in their results, so we are being very thoughtful about how we would use them in a highly vulnerable group. If somebody in a highly vulnerable group tested positive, we would take a blood draw from

them to double-check that because, if the test was a false positive and they went out and got the infection, it would be very serious, so we are taking great care.

In terms of population, we are being extremely careful with that group, but we need to roll the tests out in a such way that we can do the study alongside, so we will need to go into people's homes and get another blood draw to make sure that the test is working. It is likely that, at least in the first few days, it will be regional in the first instance, but we hope to be able to make it available for the general population.

Q138 **Aaron Bell:** The second question is about record-keeping. Presumably, this will end up on people's medical records. What is the mechanism for people to go out in the world and say, "I have got these antibodies in me. Therefore I can't pass things on"? What is the risk of people doing that fraudulently, to put it bluntly?

Professor Peacock: Yes, it will need to link to the GP record, and there is work in train to make sure that that happens. I agree that we need a record. These are exceptional times. We would not usually ask people to test themselves at home and to act on the basis of that; it is a unique position. There are plans to make sure that the result goes back to your GP. If the tests are being done at the chemist's, or at a point such as that, the test could be read by the individual in the chemist's, and the result would be recorded in the GP records through an electronic mechanism.

Q139 **Chris Clarkson:** My only slight concern is that, if we are encouraging people to go out to Boots en masse after ordering this test, are we not running the risk that some of the people who have not developed the antibodies are actually exposing themselves?

Professor Peacock: That is true. When I said Boots, I meant "like Boots" rather than Boots. The details are being rapidly established at the moment.

Q140 **Chair:** I assume that guidance could be given that anybody feeling the symptoms could send someone else out to collect it on their behalf.

Professor Peacock: Absolutely. The accuracy of home blood pricks may be lower than its being done by somebody with some training to do blood pricks. It is not right that we send people with symptoms or who have not had the infection into a crowded place. We are going to have to come up with a mechanism whereby, if people needed to go to one place, they could go one person at a time. They could be sent an appointment by text, or something like that. It is key that we do not have lots of people clustering to have their tests done and read.

Q141 **Chair:** We are very grateful for your evidence. I would be interested to understand how the two testing programmes that you described are going to interact with one another. On the one hand, you have a programme to expand laboratory testing at a rate that is increasing

significantly but is done in a different way from other countries, which gave me some concern. On the other hand, you are going to have mass testing available to members of the public within a few days, delivered to the home by Amazon or collected from pharmacies. Will those be done in parallel? Are there reasons why you want two tracks for testing?

Professor Peacock: Yes, they are being done in parallel. The Government plan is a four-point plan. The first point is to have 25,000 tests for NHS patients who are sick; the second is upscaling testing of key workers, with the aim of 100,000 tests or more per day; and the third is home or community-based testing, which cannot be done with an antigen test at the moment, so that is why we are going with the antibody test. That is going to be a much wider population.

The final plank is looking for the presence of infection in the population, for zero prevalence, which is important because some people might have infection with very few symptoms. We are doing those in parallel, and we have different target populations for each of those. So there are four parallel workstreams working together to ensure that we are watching for things like reagents and consumables so that there is no internal competition.

Q142 **Chair:** Finally, are there any other countries that are doing what you have just described to us—mass home testing by mail?

Professor Peacock: Yes.

Q143 **Chair:** Which countries? Which ones are already doing that?

Professor Peacock: The tests are being ordered across Europe and elsewhere and are being purchased in south-east Asia, so it is a widespread practice. We are not alone in doing it.

Q144 **Chair:** They are being ordered by Governments, but are they deployed in populations yet, or are we in the vanguard?

Professor Peacock: I am not aware whether they have yet been deployed in the population elsewhere.

Chair: Professor Peacock, thank you very much indeed for giving evidence to us today. Your role and that of your colleagues in Public Health England is extremely important to all of our lives and around the world. As I said at the beginning of our session, we want to inform ourselves for the purpose of being able to inquire after the crisis has subsided what lessons we can learn in a positive way. It may also be the case that there are lessons we can learn in flight, as it were, so your evidence today has been extremely helpful, and we are very grateful.

Professor Peacock: Thank you very much for listening to me.