HOUSE OF COMMONS

Science and Technology Committee

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

Thursday 16 April 2020

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Chris Clarkson; Katherine Fletcher; Andrew Griffith; Darren Jones; Mark Logan; Carol Monaghan; Graham Stringer; Zarah Sultana.

Questions 212 - 268

Witnesses

I: Dr James Rubin, Reader in the Psychology of Emerging Health Risks, King's College London; and Professor Graham Medley, Professor of Infectious Disease Modelling, London School of Hygiene and Tropical Medicine.

II: Professor Xihong Lin, Professor of Biostatistics, Harvard T.H. Chan School of Public Health; Professor Dr Clemens Fuest, President, Institute for Economic Research, Germany; and Professor Dr Herwig Ostermann, Executive Director, Austrian Public Health Institute.

Examination of witnesses

Witnesses: Dr Rubin and Professor Medley.

Q212 **Chair:** I start our session by reiterating our thanks to everyone in the NHS, the caring professions and beyond working so hard during this crisis to keep us safe and secure. We would like in particular to put on record our thanks to the scientific community for the enormous and intense work that is being carried out in this country and around the world.

Let me say a couple of brief things about the purpose of our inquiry. We want to learn the lessons in this country and beyond as to how science and research can inform the management of global pandemics. We are gathering evidence throughout this crisis for two reasons. One is to be able to gather contemporary evidence so that when we look at the lessons learned it is not all filtered through the lens of hindsight. The second is that, where it is possible, on the way to make some observations and learn some lessons that have relevance to the current handling of the crisis, we want to be in a position to do that and to make them publicly available.

I welcome our witnesses for our first panel in this afternoon's session: Professor Graham Medley and Dr James Rubin. Professor Medley is professor of infectious disease modelling at the London School of Hygiene and Tropical Medicine. He chairs the scientific pandemic influenza group on modelling, known by the acronym SPI-M, which feeds into SAGE, the wider scientific advisory group on emergencies. Professor Medley is here in his personal capacity rather than as a spokesman for either SPI-M or SAGE.

Dr Rubin is reader in the psychology of emerging health risks at King's College London. He chairs the scientific pandemic influenza group on behaviours, SPI-B, which again feeds into SAGE. Like Professor Medley, he is speaking here in his personal capacity rather than as a spokesman for either SPI-B or SAGE.

Welcome to you both. We are very grateful to you for giving us the opportunity to hear from you today. The subjects we are considering today are non-pharmaceutical interventions and measures like social distancing. Many of them were introduced or imposed on 23 March, when the Prime Minister made a statement. Over three and a half weeks have passed since then. The first question, Professor Medley and Dr Rubin, is this: are they working?

Professor Medley: That is a very good question; it is the question of the moment. As sources of information, first of all we have direct epidemiological information on hospital cases and deaths, and we have some information from the behavioural side.

The evidence from the hospitalisations and deaths is that they have slowed considerably. There is some evidence that they are beginning to flatten, if not actually to peak. That is about the right timescale that you

would expect from the imposition of the interventions for the reproduction number now being less than 1. We have managed to damp that down, and we must continue to do so to be able to see the full benefit of it.

All the behavioural data I have seen that has come out in terms of road traffic use and so on have indicated the same; the amount of contact being made by people in the population has reduced a lot. There is one direct behavioural survey coming out of the London School, although I am not personally involved. It is asking people about the numbers of contacts they have made—"How many people did you speak to? How many people have you touched?" They too show a dramatic decrease in the routes of contact that you would expect.

While we cannot be 100% sure at the moment, all the evidence we have points to the fact that the reproduction number is now below 1. The chains of transmission are being broken. There are a couple of caveats to that. One is that we have always been aware that, as in any outbreak or any epidemic, the virus will find core groups and routes of transmission within society. Hospitals remain a concern. Key workers are obviously not locked down, and we do not want them to be. They are one potential for that interaction, so we have to be careful. It is not complete in that we expect this to turn off transmission completely, but all the signs are that it is good.

Q213 **Chair:** You said the R number is now less than 1. How do you know that?

Professor Medley: We don't know it, but all the evidence suggests that it is.

Q214 **Chair:** In terms of hospital admissions and that sort of thing?

Professor Medley: Yes. They would not plateau, flatten and indeed start to turn over unless the reproduction number was less than 1. How much less than 1 it is is a very difficult question. All epidemics in the early stages have this kind of flip-flop behaviour. Either R is bigger than 1, in which case they are growing exponentially, or R is less than 1, in which case they are decaying exponentially. Whether it is above 1 or below 1 is much easier to say than what its actual value is.

Q215 **Chair:** You infer that from the outputs. Dr Rubin, you have done some specific research on the social interactions people had before and after the social distancing measures. Perhaps you might describe them and give your answer to the same question as to whether the measures are working.

Dr Rubin: There is quite a lot of research looking at people's behaviour and whether people are adhering to the various non-pharmaceutical interventions, as you call them, but we call them behavioural and social interventions. It is the same thing.

The answer depends slightly on what kind of behaviour you are talking about and adherence to what. There are various things that the Government have been recommending. There is staying at home as far as you can; there is self-isolating if you are ill; there is self-isolating if someone in your household is ill; then there is the issue of shielding if you are in a particularly high-risk category. You can look at adherence to those various different behaviours.

A lot of polling has been done on adherence to staying at home, using the same kind of methodology with which you will be familiar from political polls, surveying a random sample of the population or an online panel. Lots of the big pollsters have been doing that, and they find very high levels of adherence. YouGov put out data saying that 80% of people had avoided going out in general; 91% of the population avoided visitors to their home; and 84% avoided small gatherings of people.

The Policy Institute at King's College has done its own polling and found similar things, with 87% of the population saying that they completely or almost always follow the social distancing rules. If you look at individual behaviours, it is also very high; 94% of people say they stay 2 metres away from other people whenever they can. We see a steady rise in that across time.

There is data from a polling company called Savanta. It has looked at how often people are deliberately not leaving their home at all. The rate starts off at about 13% in mid-March and rises fairly steadily up to about 50% on 25 March. It has stayed at that level pretty much since—that is people not leaving their house at all. There are obviously some caveats with that kind of data. They are online polls, so there is always a risk that people are trying to present themselves in a favourable light—a kind of social desirability problem.

You can look at more objective data. For example, Google is using its mobility reports—the data that tell you when a restaurant is busy or when theatres are quiet. It is tracking levels of people with Android phones in various locations. Again, we see sharp declines across most locations. There was an 82% reduction of people in retail and recreation; a 54% reduction in workplaces; and a 41% reduction in pharmacies and grocery stores. There was a large decline. It fits in with what Graham was saying about interactions between people out in the community.

Q216 **Chair:** Dr Rubin, you and your colleagues have made an estimate that there has been a 73% reduction in contacts. You made an estimate of the R number—the rate of transmission—coming down from 2.6 to 0.62. Would you say something briefly about the basis of that assessment and calculation?

Dr Rubin: That is the paper that Graham was talking about from the London School of Hygiene and Tropical Medicine. It is another one of these surveys. It was a poll of around 1,300 people, asking them to record how many contacts they had had with other people in the past 24

hours, defining a contact as having a few words of conversation with someone or having physical contact with them. You can compare rates of contact with a survey that was done a few years ago, using the same questions. Based on that, you can calculate how much contacts appear to have gone down recently.

As you would expect from the other data, you see a sharp decline in the number of those kinds of contacts. Based on what you think R was before the social distancing came into place you can adjust for that, and that pulls it down to the figure that the team came up with, which was round about 0.6.

Q217 **Chair:** On this theme, Professor Medley, the trigger for the introduction and imposition of these measures was concern that the capacity of the NHS would be overwhelmed. Are you able to make an assessment as to whether that predicted scenario would have taken place without these measures? Can we say that the NHS has been saved from being overwhelmed by these measures being imposed?

Professor Medley: Absolutely. I think it was very clear early on. SPI-M has a preparedness document, and we renewed it in 2018. I think it was first published before 2009. That document lays out what we call a reasonable worst-case planning assumption that results in large numbers of deaths—800,000 people dying within the space of six months.

It was very clear early on that, although this particular virus might not reach those kinds of levels, it was certainly in the same ballpark. With almost complete certainty we can say that, had nothing been done then, we would now be in the middle of an epidemic of that kind of proportion.

Q218 **Chair:** Is adherence to the measures beyond what you expected in a rigorous sense? Is it beyond what you modelled as being predictable?

Professor Medley: To my knowledge, this has never been done before. It is very hard to model something that has never been done before. Had people tried to submit a publication saying, "We will make everybody stay at home," it would quite likely have been rejected in peer review as being completely unreasonable—that would never happen.

We had no expectations. We can use the modelling to tell us what would happen if—but with no previous experience of this the models cannot tell you what will happen without making very strong assumptions about the impact of the measures.

Q219 **Chair:** Surely the model that was the basis for triggering the lockdown must have had some embedded assessment of compliance with the measures that were being introduced, to be able to project the capacity of the NHS against the demand?

Professor Medley: Yes, but they were pure conjecture. There could have been no evidence to say what those numbers should be.

Q220 **Chair:** Finally, before I turn to my colleagues on the Committee, many of the measures that were introduced were introduced gradually. First of all, there was advice that vulnerable people should be isolated. Then there was advice on social distancing. Schools were closed somewhat later in the process, and large gatherings. It was stated in advance that these measures would be taken, but at the appropriate time. Why was it right to do it that way rather than to implement the measures simultaneously, all at once?

Professor Medley: Good question. We did some modelling early on, or modelling was done in the University of Edinburgh led by Professor Mark Woolhouse, which indicated that ramping up interventions was potentially beneficial. If you know how long the interventions are going to be in place, you can model when is the most optimal over the whole period of the whole epidemic, but of course in the situation that we were in it was very hard to know, because we did not have that timeframe. We did not know how long the interventions were going to be put in. They are novel interventions. Knowing the timing of them is very hard to work out as you are doing it. We do not know how long they are going to last. We did not know how effective they were going to be.

Introducing them in that way was a Government decision. It had some modelling support, but not huge support because we did not know what they would be. As I say, we could not be specific about the timing in the modelling because it had never been done before. Its impact could only be conjecture. It is something that you cannot model with any exact science. I am not sure if that answers the question.

Q221 **Chair:** Was the decision to allow sporting events such as the Cheltenham Festival to proceed, which would not have been possible a matter of days later, the subject of scientific advice in terms of the timing, or was the modelling silent on the precise date of measures?

Professor Medley: We can certainly say something about the impact of large mass gatherings. All the evidence from behavioural studies—how often they occur and how often people go to them—and all the virological evidence about the transmissibility of the virus suggest that the risk to an individual, once you get above a group size of about 50, does not increase very much at all. Being in a space with 50 people is no greater risk to you as an individual than being in a space with 100,000 people. If that space is outside and is of relatively short duration, in fact there is less risk in going to a football match than there is of going to a pub to watch it.

Every behaviour that involves people coming together carries some risk. The question we were trying to answer, which was potentially most relevant to policy, was, if you were going to ban activities, which would you ban? Events like weddings, for example, where people know each other, are much more intimate. At family weddings, people come together and touch each other much more; they are relatively intense and longer duration events. They are likely to be much riskier in terms of

transmission, but they are smaller, so they do not have as much amplification possibility.

I think we have a pretty good understanding about those events. Obviously, the decision about when you ban them is entirely political. There aren't events where we could say, "Don't do that," or, "I wouldn't do that, because that increases the risk either to individuals or to the population as a whole because you get some kind of amplification."

Q222 **Chair:** For all that the view was that mass sporting events were not particularly intense in terms of the possibility of infection, nevertheless they were banned. What makes something that was not going to be terribly impactful and therefore not appropriate to ban at one point appropriate to ban a few days later?

Professor Medley: Again, it is entirely a political decision. I think for many people it feels like nonsense to close schools but allow football matches, with large crowds, to take place. Epidemiologically, I am not sure that that is the case. When to do things and how to do them is up to the decision makers and not up to scientists.

Chair: These are important questions on the reverse side of it, as I am sure you anticipate. It is why understanding some of the triggers and the reasons why steps were taken to close things down might be of great importance and interest in releasing, hence the line of questioning.

Q223 **Andrew Griffith:** Thank you, Professor Medley and Dr Rubin. Hindsight is a wonderful thing. I would like to be as objective as possible in terms of the statistics. What I understand is that there is a lead time between exposure and death. We are obviously working on some preliminary numbers. I looked at the NHS England numbers, and the inference of those was that, of a total of 12,396 deaths in England, 10,161 have happened within the last 15 days. My question, or the point on which I would like advice, is: is it fair to assume that the majority of those were people who contracted the virus or were exposed to it prior to the lockdown?

The leading point on which I would love your reactions—particularly yours, Professor Medley—is, had we shifted the moment of lockdown to two weeks earlier, would we be looking at a number of deaths around 3,000, which is much closer to the German level? Is that a fair inference? How would you articulate it? Clearly, there is a point at which you are looking to slice the top off the pyramid. My inference is that the earlier one applied the lockdown, the more preventable deaths would have been saved, from an epidemiological perspective. There are obviously other political considerations.

Professor Medley: To take your first point, there are delays throughout the process from infection to recovery or death. Those delays are not fixed and they vary. In terms of the last point—numbers of deaths reported—that is subject to reporting delays. The numbers of deaths reported each day are not the numbers of people who died that day but

the number of people who were reported to have died. That extends back by up to 10 days.

As epidemiologists, we mostly focus on the date of death rather than the date of report. We look at when people died, and because it takes time for deaths to be registered and reported, that necessarily means that we do not have a good idea about the number of people who died yesterday—the number of people reported yesterday is not the same number. That means you cannot be precise about when people were infected. It is smeared backwards in time; it is not an exact point.

To your second point about the timing of the introductions, we have known for a long time that if you are going to put a measure in place to reduce transmission, and if it is going to extend across the whole of the epidemic, the earlier you do it, the bigger its impact. We also know that if you have a fixed duration—let's say you are going to do something for eight weeks—the best time to do it is just before the peak of the epidemic, if you know when that peak is. There is a competing choice in doing things. If you know it is going to be across the whole of the epidemic all the time, you do it as early as possible, but if it is something fixed by time period, you do it just before the peak.

With the interventions that have been put in place, we had no experience of knowing how they would work, what their impact would be or how long they would go on for, so the timing becomes much more of a political decision than it can be an epidemiological decision. On the one hand, we would have said, "Do them as early as possible," but on the other hand we would have said, "Yes, but we cannot do them forever so wait until much later."

That speaks to a larger question, which is: what are you trying to achieve during the epidemic? If you are trying to avoid a second peak, clearly, that gives you a different set of priorities than if you are trying to prevent the numbers of people going into the NHS being too large for the NHS to cope with. Again, that is another issue about what you are actually trying to achieve in the management.

This pandemic and this virus is very nasty. It transmits extremely well and there is no simple right answer that says, "Press this button and it will all go away." It is about managing tragic deaths on the one hand with the interventions on the other, and trying to find a way through. I do not think that any country in the end is going to do it the same way, because political, cultural and other things will feed into the decisions.

Q224 **Andrew Griffith:** We are putting words in your mouth, Professor Medley. I do not mean this pejoratively, but you are slightly evading the question. What I have taken from that is that, mathematically, the earlier that is applied, clearly the bigger the potential early impact it will have had.

Professor Medley: Had we gone into the state of lockdown in mid-January, quite possibly we would have had very few cases.

Chair: Carol Monaghan had a question about schools, which were one of the principal interventions.

Q225 **Carol Monaghan:** Professor Medley, we see certain countries now looking at reopening schools or considering it. First, have you done modelling that would indicate what the R number might do as a result of schools reopening? For example, Denmark is talking about reopening schools for the youngest pupils.

Professor Medley: I think they have already, and Switzerland is considering it in the next two weeks. Looking across international comparisons is very useful.

It is still not clear what the role of children is in transmission. The whole point of the lockdown and what we are doing in the UK at the moment is to break transmission links between different places, in particular between households. Closing schools is about breaking the links between different households and the virus's ability to go from place to place. Closing workplaces is the same process. If there is transmission and events happen at work, people will take that back to their homes. Transmission in homes will take it out to schools and then they take it to different homes, and so on.

There is a network thread, so we are trying to break that network. Understanding the role of children in creating that network is clearly important in understanding the role of school closures in the current lockdown. There is conflicting evidence. On the one hand, school closure is probably the thing we know the most about in modelling terms because it is the thing that has been done. We know something about adherence and compliance with school closure. We know something about the impact of it on transmission, but mostly in the context of pandemic influenza and relatively little in the context of this virus. It is certainly something of high priority throughout the scientific world.

A paper has been published looking at the potential impact of childhood transmission. Children do not appear to be central to transmission routes, for whatever reason. Whether they are less likely to be infected or are less infectious, they do not appear to be a critical core group for transmission, and that will feed into decision making about when schools should be reopened. There are other aspects that play into it, and James Rubin may well have something more to say about that. In terms of transmission dynamics, it is still unsure.

Q226 **Chair:** Dr Rubin, do you want to add something on schools and the research that you have done on that?

Dr Rubin: It is just a point to emphasise. We certainly should not think about schools as an on-off thing. It is not necessarily the case that schools returning will return in the same way as they were when they were originally open. There are steps that we could take to reduce infection and transmission in schools when they reopen, which would

need to be looked at as well. There are things like staggering the drop-off and pick-up times to reduce transmission between parents at the school gates, staggering playtimes, and putting better hygiene measures in the school. All of those will have an impact. It is not simply a case of schools open or schools closed. There are shades within that as well that we need to think about.

Q227 **Mark Logan:** I would like to thank Dr Rubin and Professor Medley for all the work they are doing in SAGE, SPI-B and SPI-M.

My question is around public adherence to social distancing. Anecdotally and from speaking with our police superintendent in Bolton yesterday, what we are finding is that people have been following Government advice and there has been social distancing if people are out and about—for example, exercising. My first question is more for Dr Rubin. Did you expect this to happen? Secondly, with the recent report coming out from Harvard University stating that, potentially, in the United States social distancing may have to continue in some shape or form until 2022, how do you think that will impact on how we go about messaging the implementation of social distancing here in the UK?

Dr Rubin: On whether we expected a high level of adherence, as Graham said, it simply has not been done before in this way, so I do not think we had expectations one way or the other. Our group did a rapid evidence review in January and February, looking at rates of adherence to quarantine, and I think the best we could say is that it was good adherence. It is very hard to put a percentage on it because the percentages bounce around all over the place. Reasonably good adherence was what we were expecting and hoping for, but the rates we are seeing are fantastic. You are right: the public are adhering to very high levels, which is great news.

On the second question, about the long-term rates of adherence if this carries on for a long time, again it is very hard to predict. There are different things that feed into adherence. There are epidemiological models that we can use to predict what affects it. There are some aspects, such as risk perception and motivation, which are important, but there are also the practical aspects. That is something we need to keep a key focus on.

Even with the best will in the world and even if you are particularly motivated to adhere to these types of behaviours, there are barriers in your way. There are economic barriers—for example, if you need to go to work. There are issues of boredom and frustration if you are stuck at home and you do not have a garden where you can send the kids out to play, or if you do not have enough money to sign up to Netflix and buy extra computer games and all the rest of it. Those are the issues that need to be looked at if we need to maintain this in the long term. The practical aspects are going to become particularly important.

Q228 **Chris Clarkson:** It is interesting that Dr Rubin mentioned the

psychological effects because that is what I wanted to talk about. Obviously, it is a very different way of living so it is going to have an impact on both physical and mental health. I want to get an impression from both of you as to what you think those impacts are going to be. As an adjunct to that, how effective do you think the Government's communications have been, in particular with regard to mental health?

Professor Medley: I do not have anything expert to say. They are interesting questions but not in my field.

Dr Rubin: I can comment on the psychological impact. Yes, I think you would expect an impact. Going back to the rapid review that we did looking at the impact of quarantine on people's psychological health, we looked at 20 or so studies, and almost all of them identified some form of psychological impact. Those studies only looked at quarantine of up to about two weeks, so inevitably we are going to see an impact on people's health and wellbeing. I think that is definite. We are already seeing some signs of it. I have some more data from polls in front of me. We already have 20% of people saying that it has put a strain on their relationships; 13% of people say they are drinking more; and 49% say they are feeling anxious and depressed. Those kinds of things will build up.

First of all, we need a decent research effort to understand what the impact is. Secondly, we need to understand how to mitigate it. This is not inevitable. There are things we can do to support people. Understanding what the impact is and understanding how to support people better is essential. One thing more than anything at the moment is that we need the research in place to understand what is going on. At the moment, we just have polling data. We need a better understanding of exactly the issues you mentioned.

Chair: Chris, do you have anything to add?

Chris Clarkson: No, it was a very comprehensive answer. The truth of the matter is that, because they are untested waters, we are going to need to do research, as it simply does not exist. It has never needed to exist. It will be interesting to see what the long-term effect is.

Q229 **Chair:** We have established that there was limited ability to assess the level of compliance with the measures, but the public response has been very supportive, and people have gone along with the restrictions that have been imposed. Professor Medley, you are on record saying that lockdown is a "placeholder" that buys time "but it doesn't resolve anything." We have been effective in buying time, but what should the time be used for?

Professor Medley: As I said before about this epidemic process, the suspicion is that we are able as a society to bring the reproduction number below 1. However, that imposes costs in terms of health, economics and so on that are non-trivial; they are big. What we are thinking about in terms of the research is that this is a very blanket

measure and we are asking everybody to do it, but what can we do to change it? That is either in a blanket response, so do we open schools, and if we open schools will that allow transmission to flare up so that R is above 1 and we end up back in an epidemic process; or can we find ways in which we can target it better at places, groups of people or individuals, based on things like contact tracing?

The only thing we have to control the virus is, essentially, quarantine. All we can do is try to make sure that people do not transmit it, so can we find ways in which we have the minimum number of people quarantined at home and still have R below 1? That is the situation until we solve that problem. If we do not want another epidemic, we will have to stay in the position we are in. If everything was released at the same time, we would just be back in the same position of exponential growth. That is really what the time is for. We are buying time, yes. We had to go into this position. There was no doubt about it; we had to be here.

The international comparisons are very good, because no country is going to do it in the same way. We will learn by watching each other and what happens in different places.

Chair: Thank you. That is the subject of our next panel this afternoon.

Q230 **Darren Jones:** The political debate, not just in our country but, as we have seen, across the European Union now, has started to move to the question of the exit strategy from our self-isolation and lockdown. Professor Medley, I wonder if you could tell us a bit more about that from an infectious disease perspective. What are the factors in your mind that would illustrate that now is the right time to start thinking about that?

Dr Rubin, there is an interesting question about the fatigue of the public around self-isolation and not knowing when the end date is. Do you have any views on how and when it would be right for the Government to start to talk about, and maybe even publish, the exit strategy?

Professor Medley: We know how epidemics work. They have been studied for a long time and the mathematics and biology underlying them are well understood. The process by which an epidemic of this virus would happen is well understood.

Epidemics go up exponentially. They reach a point where the numbers of people who are susceptible in the population have dropped sufficiently that the R value becomes 1 naturally, because a lot of people are resistant to infection, and that is when it starts to drop. Without any intervention, that is what would have happened. The imposition of the measures has curtailed that process. Now we are in the position whereby, as I say, if we release the measures, we will just go back into it again.

I am not quite sure what people mean when they talk about exit strategies. Is it exit from where we are now or exit from the whole epidemic? The whole epidemic will be over only when we reach the point when the amount of resistance in the population is enough, or

susceptibility is low enough, and the only ways we know how to do that are as a consequence of natural acquired immunity built up through infection, or vaccination. That is the ultimate end point, be it at the end of this year or in five years' time. That is the point at which the epidemic is over. How to exit from the position we are in so that we can release the social distancing that we have in place is a different question because it depends on where you think you are going.

If we knew that there was a vaccine coming up, it would obviously influence that decision hugely, but we do not know that there is a vaccine coming up, so figuring out which direction you want to go depends on where you think you are going to end up. I am waffling a bit because there is no real answer to the question. There is no manual.

Q231 **Darren Jones:** Thank you for the answer. In a nutshell, what you are saying is that we are still at the early stages and it is not clear yet. You cannot say to me that when factors A, B and C reach these points we know that we are then going to be able to move through. It is not going to be a very simple bell curve in the normal way because of the restrictions we have understandably put in place to try to help resource in the national health service. I do not know whether you can give a timeframe to these issues based on the science, Professor Medley. I suppose the answer is no, right?

Professor Medley: Because it is now under political control, it is up to us and the decision makers as to when that happens. We could remain in this lockdown position all the time, in which case we are relying completely on a vaccine to let us out. I am not suggesting this, but hypothetically you could release them all and we could have a huge epidemic meaning it would all be over by October. That decision, or that process, is no longer going to happen naturally. It is now something that is in policy control.

Q232 **Darren Jones:** A political decision. Thank you for that.

Dr Rubin, from the psychology perspective, our constituents are staying at home, so given the answer that has just been given around the science of this stuff, what is your view about how and when the Government start talking about the so-called exit strategy and perhaps a transient return to normal life?

Dr Rubin: It is very important that people have their expectations set on this. People need to understand, and have a right to understand, what the plan is and what the timelines look like. People need to make plans and preparations for themselves and for their families. I am very much in favour of as much openness as we can have and providing information to people. Where there are uncertainties, and where we do not know what the timeline will look like, I am very much in favour of explaining that as well. I do not think that this stuff should be kept secret in some sense. We should be laying out what the strategy looks like and what the uncertainties are around the strategy as well. That is very important.

Q233 **Chair:** Professor Medley, you said that some of the questions about when we release parts of the lockdown are political decisions. Politicians—the Government, in this case—have said that they would be guided by the science and scientists, and they have been to date. We have taken evidence that suggests that the advice has been followed. Do you expect the scientific community to make recommendations as to what would be the appropriate time to release various of these measures?

Professor Medley: Speaking generally, I do not think it is within our remit. Much more within the scientific remit is to be asked, "What happens if?" or, "If you wanted to achieve this, when would you do it?" It is still the decision maker's choice as to when to do it. There isn't a right answer in that respect. Personally, we just deal with infectious disease epidemiology, but then you have the economics and the other aspects playing into those decisions. They have to be brought together to try to cause the least damage possible.

Q234 **Chair:** Isn't the purpose of SAGE that it brings together eminent people from a variety of disciplines so that all of those perspectives can be brought into unified advice? In previous evidence sessions we have heard that in every material respect the Government were offered unified advice from SAGE. Is that your understanding?

Professor Medley: That is just the scientific advice. Yes, there is multidisciplinary science on SAGE, but societal questions about societal preferences and economic questions are not represented on SAGE, and of course they are huge aspects of making the decision.

Q235 **Chair:** There is no economics representation on SAGE?

Professor Medley: No, I do not think there is.

Q236 **Chair:** That goes to your point. My experience of science is that it is founded on openness through publication, peer review and making available the possibility to replicate experiments and data. It is surprising that we do not know what the disciplines represented on SAGE are and the membership in terms of the people and institutions.

Dr Rubin talked about secret science. That is almost an oxymoron. We expect that the foundation of science is openness. Dr Rubin, given that people are being asked to abide by policies and decisions that are scientifically based, would it help with confidence if there was greater knowledge as to which disciplines, institutions and eminent people were contributing?

Dr Rubin: I guess you are asking about trust—trust in general, when you are talking about disasters, which is my area of expertise, and also more broadly. When you are asking people to do things, and the things that the Government are asking the public to do are difficult and costly, I think it is beneficial to increase trust wherever possible in how those decisions come about.

Trust is one of those words that we all think we know what it means except when we come to write a definition of it. It then becomes very hard because it turns out to have lots of different components—whether you perceive people are competent or whether they are being fair or not. One of those components is openness and honesty and whether you can see people being open and honest. Openness plays a part in this. The more open that Government can be and the more open different decisions can be, the better it is. The same is true of peer review as well. I agree with you your comment about secret science. Science is better when we lay out the foundations of it and seek comment on it. It is not always right and there are always ways to improve what we have done, so the more open we can be, the better it is.

Q237 **Aaron Bell:** To follow up on that, Dr Rubin, I agree completely on the point about trust, but one of the arguments that has been advanced is that talking about getting out of this situation, relaxing the lockdown, is precisely the wrong thing to do at the moment while people are being encouraged to abide by the lockdown. It is all very well saying how long we think it might last, but once we start talking about the measures we might be able to take, is there a risk that we encourage people to jump the gun at all, in your view?

Dr Rubin: That is an interesting question. Honest answer: I don't know. My initial response would be no. If there is a risk of that, there will be ways to mitigate it as well. Just because something is a risk does not mean that we cannot find ways around it. I don't know; I would need to think about it and get back to you, to be honest.

Q238 **Aaron Bell:** Thank you. I want to ask a couple more psychological questions. From the evidence Professor Medley gave us, it seems that we may be in a situation where we have to relax measures and then perhaps introduce them again depending on exactly what we are trying to model and minimise—whether it is the overall state of the nation's health or trying to balance the economy against the pressures on the NHS. What do you think the effect on people's wellbeing would be of that sort of see-sawing activity, where we have to keep relaxing and reintroducing measures? Is that potentially psychologically damaging?

Dr Rubin: If it is epidemiologically necessary—if that is what needs to be done because the epidemic is getting out of control, cases are growing again and the death rate is going up—I think the epidemiology has to lead on this. If that is what has to happen, it is what has to happen. As to whether it has a psychological impact, I suspect it would. My own inclination is that a fairly gradual release of measures is better than a see-saw, on-off, approach.

There are also practical issues as to whether you can actually switch aspects of society off, on and then off again. In practice, people need to have a run-up, with things coming back online and then things going offline again. My inclination is that a gradual easing would be better, but it very much depends on the epidemiology. If a measure is eased and

you see cases grow again, it may well be that you have to put it back on, and we would need to find a way around the implications of that to mitigate the risks.

Q239 **Aaron Bell:** Based on all the evidence available—we have heard lots of evidence about vaccines in previous sessions of this Committee—if it is the 12-month timescale that some people are talking about, do you think the current restrictions, together with some easing and perhaps bringing them back, are feasible for the foreseeable future; or do we have no choice in the matter anyway?

Dr Rubin: Yes, it is feasible, but we need to think about the practical issues. The current measures that we have are definitely having an impact on the population, but they are having a differential impact. That is really important. Some sections of society will be harder hit than others.

There is a lovely paper by a colleague, Professor Helen Ward and co. at Imperial College, looking at the willingness of people to self-isolate during the current lockdown measures and their ability to self-isolate. The two things are very different. Everybody is very willing to do it, but the people who are lowest on the socioeconomic spectrum are least able to do it. If we are to have these measures in place for a long time, we need to think about that. How do we enable people to engage in the behaviours that we are asking of them? How do we facilitate that in the population?

Q240 **Zarah Sultana:** My first question is to Professor Medley. Earlier this month, you urged the Prime Minister to find a way of ending lockdown, citing potential harm to people's incomes and mental health, and domestic violence and food poverty. If the UK ends lockdown measures, how would you suggest we reduce the numbers of fatalities that would bring? In particular, how would the Government address the vulnerability of elderly people and those with underlying health conditions. As we have seen, there is a disproportionate number of deaths of people from BAME backgrounds.

Professor Medley: My urge in talking to that journalist was not necessarily about wanting to end the lockdown. It was about wanting to think about the fact that we are going to have to find a way through this process. The lockdown and the social distancing are having an impact. That impact is very positive in terms of deaths from COVID but potentially very negative in terms of other health and welfare issues.

As a person who works in public health, I know that thinking about equity is always important in terms of disease. Equity in the measures taken against disease is always important. As I was talking to that journalist, I was thinking in those kinds of general terms about how we are going to get through this, and the fact that if we stay in the position we are in now, with this level of reduction of transmission, we are stuck here until we try to find a way out that involves modifying or learning to live with

the social distancing we have in order to avoid the reproduction number going above 1.

That was the discussion I was having. I am not urging reducing the lockdown at all. In any case, it is not my decision. We are in the position we are in, and finding a way through it requires an understanding of where we are going and communicating that understanding. In a larger sense, it is up to us as a population to decide what we all want to do; we are being asked to modify our behaviour by the Government, but to some extent what we do is up to us.

Q241 **Zarah Sultana:** Dr Rubin, how effective have the Government's communication efforts been to reduce the psychological effects of the crisis on the population?

Dr Rubin: That is an interesting question. I am not entirely sure that it is a communication issue. There are things that can be done to reduce the psychological effects on the population. A lot of them are practical issues— for example, economic issues or issues to do with frustration and boredom at home, or tension between families at home. There are things that can be done to resolve or mitigate those.

I would not necessarily say that they are all communication related. I have not seen data looking at the impact of the various measures on mental health, so I could not comment from an empirical point of view. It is something that needs to be looked at.

Q242 **Graham Stringer:** Let me follow up your question, Chair, about SAGE. Do either of our witnesses know whether the secrecy about the membership of SAGE comes from pressure from the members of SAGE, or is it just a Government decision? Has there been a discussion at SAGE about whether the membership should remain secret?

Professor Medley: From my point of view, I do not think that is our decision to make. We do not run the website, so I think you will have to ask SAGE that.

Chair: You are here in your personal capacity rather than as a member of SAGE.

Q243 **Graham Stringer:** I just wondered if there had been a discussion. Going back to what Professor Medley said earlier, there are clearly costs to the current policy—economic costs, health costs and people too frightened to go into hospital when they need to go into hospital. Can you extract from the models when there will be sufficient evidence to know that the benefits of the lockdown are outweighed by the disbenefits?

Professor Medley: The modelling I am involved in is very much looking at the transmission dynamics of the virus. What are the impacts of different interventions and what are the direct health impacts of the virus? The other issues you talk about can also be modelled, but we are

not doing it as infectious disease epidemiologists. Other people are looking at those particular impacts.

It is very complicated. It is what people call a wicked problem in the sense that there is no easy solution. That is not something we are modelling, but it is something that other people are modelling. Those have to be brought together to try to minimise all the harms completely. Public health is about modelling those kinds of things, to some extent.

Q244 **Graham Stringer:** I have another question about modelling. At the start of this process, Public Health England said that there was very low risk of the virus getting loose in care homes, whereas there is evidence from North America that if the virus gets into a care home you can have up to 30% or 40% deaths related to it. How do the models you have been involved in take account of care homes, and which of those scenarios have you used in the models?

Professor Medley: I am unaware of where and when PHE said that.

Graham Stringer: It was in February.

Professor Medley: The infectious disease community has generally been fully aware that, given the age distribution in terms of deaths, care homes were going to be an area of enormous concern from the beginning. When we talked about shielding in the past, it was care homes, to a large extent, that people were thinking of. I am unaware of when PHE said that, but I am astonished that it did, if it did.

Q245 **Graham Stringer:** In terms of the modelling, how do care homes fit into the models that you have been using?

Professor Medley: People have been developing models. We have not used them specifically yet in constructing advice. The care home structure is such that you have to avoid infection getting into the care home. One of the principles of epidemiology would be to try to avoid cross-linkage between them. What you do not want is that infection happens to get into one, because that means it can cascade across a whole group of them.

The ways in which staff are used and potentially move between care homes, or patients move between care homes or go from care home to hospital and back again, are the kinds of issues you need to think about in trying to contain any outbreak within one particular setting.

Chair: Carol had a question on schools that she wants to come back to.

Q246 **Carol Monaghan:** Professor Medley, this is linking your earlier answer with the particular exit strategy here in the UK. Earlier, you said that children are not great transmitters, for whatever reason. We can accept that, but when we look at countries that are considering, or have already had, children returning to schools, it would appear that they all have one thing in common, and that is a robust testing strategy.

Will there be modelling looking at how countries with a robust testing strategy are able to have children return to school and the impact that has, as opposed to countries like the UK that may consider a return of children to school but are still not up to speed with testing?

Professor Medley: Certainly testing is important. It provides information. Testing itself does not solve anything, but it allows you potentially to do the targeting of social distancing more accurately. For example, if you were going to open schools, you might want to test within schools and potentially close individual schools or classes if you thought there was transmission going on.

In modelling, all we can do is include the testing capacity that is available. Much more significant in looking forward at how testing can be used in the future are the delays involved in testing. The value of testing and contact tracing will be to identify people who are infectious in their pre-symptomatic period, because the guidelines on going home when you are symptomatic, staying there and not transmitting, are not going to change. It is just the extra bit of transmission that you want to stop. That only lasts a few days, so even a delay of 24 hours between testing and the result of that test will be a significant delay in the process.

As well as thinking about testing capacity and how many tests we can do, we also have to think about that delay. We are working on the basis of the numbers of tests that can be performed, as well as thinking about how many tests we would need if we wanted to do a particular strategy.

Q247 **Chair:** Returning to one of the questions that Graham Stringer asked, did I understand you correctly to say that the modelling of transmission in care homes had not featured prominently in the models at the early stages? Is that right?

Professor Medley: Modelling infection transmission within relatively small communities is something that has received a lot of attention. We know quite a lot about that. People have been modelling that situation, but I do not think that any models have been published, for example.

Chair: That is extremely helpful. We are very grateful, Professor Medley and Dr Rubin, for your evidence today. It is encouraging that it is your assessment that the social distancing measures have had a major impact on behaviour, and that that can expect to translate into a flattening and a decline in the curve of infection and deaths. What you said about the impact on the R number is very important.

You were very candid in saying that it is not always possible in advance to know everything about what might happen, or even to make assumptions, whether that is on people's adherence to behaviour or some of the aspects that Dr Rubin was talking about. It is a good reflection that in a fast-moving situation not everything is known. The important thing is that advice is given based on the best information available and the best people and institutions available. In that context, we are very grateful for

the work you are doing in your respective institutions and also for your public service in the committees you serve on. Thank you very much indeed.

Examination of witnesses

Witnesses: Professor Lin, Professor Dr Fuest and Professor Dr Ostermann.

Q248 **Chair:** We obviously need to learn from the experience of other countries in managing what is a global pandemic, so I am delighted that we have as witnesses this afternoon three experts from different countries around the world: Professor Xihong Lin, who is professor of biostatistics at the School of Public Health at Harvard; Professor Dr Clemens Fuest, who is president of the Institute for Economic Research in Germany and co-author of two recent very important papers—"Making the Fight against the Coronavirus Pandemic Sustainable" and "The Economic Costs of the Coronavirus Shutdown"; and Professor Dr Herwig Ostermann, who is executive director of the Austrian Public Health Institute. Welcome, all of you. We are very grateful to you for your time today.

Professor Lin, you have studied in detail the case of Wuhan and China, and their experience throughout the pandemic. We are particularly interested today in understanding social distancing measures and what is effective on the way out of them. Obviously, Wuhan has had some recent experience of that, so could you set out your assessment of the social distancing measures that were imposed in Wuhan and, in particular, the measures that have been taken recently to turn them off, as it were?

Professor Lin: Thank you, Chair. It is a great honour to be here. I would be happy to share what I know about the Wuhan analysis.

I will tell you a little bit about what we did. We analysed 32,000 COVID-19 patients in Wuhan until 9 March to study the public health interventions, in particular the non-pharmaceutical inventions, and the epidemiological characteristics of the outbreak. The paper was published in JAMA—*The Journal of the American Medical Association*—last Friday, 10 April.

Before I discuss the social distancing measures, I would like to say a few words about the general principles and the key take-home messages. Is that okay?

Chair: Of course.

Professor Lin: Then we can go into the details. The key messages are probably more important for your Committee and for the general public.

First, as discussed in the previous session, the general principle for controlling an epidemic is very simple: basically, to stop an outbreak you need to reduce the number of new infections. How do you reduce the number of new infections? That basically means that one needs to detect the sources of infection—the infected patients—then isolate those infected

patients to block the transmission chain so that they will not infect others. That is very simple.

In order to measure the effectiveness of intervention, many of you have heard about the effective reproducible number—R value—which measures the average number of people infected by one person. In order to control the epidemic, one needs to bring the R value way below 1, to be close to zero as much as possible. That is the second point.

The third point I want to make is that, to achieve that, multifaceted measures are needed: five pillars, including social distancing, wide testing, contact tracing, isolation of infected patients and quarantine of symptomatic subjects and close contacts, and treating infected patients.

The fourth point is that social distancing, testing and contact tracing greatly help in reducing the transmission but they are not enough, based on analysis of the Wuhan data and other countries. Smart isolation and quarantine, such as the centralised quarantine and isolation used in Wuhan, is needed to bend the curve in a timely fashion and to protect loved ones, save the lives of loved ones and stop the outbreak.

Fifth, it is very important that you analyse real data and make decisions based on real data and analysis of results, and do not just use simulation data. Sixth, detailed implementation of the general principle needs to adapt to each country's own situation and culture. Every country is different, so learning from other countries such as Wuhan, South Korea and Singapore, as well as Italy and Germany, should not be a simple copy and paste. It is also not just about modelling; it needs effective implementation, such as public health implementation, healthcare implementation and societal implementation.

The last point is that it is very important to unite the community. Everybody is a team member, so everybody needs to contribute and work together to fight COVID-19. There has to be a multi-stakeholder approach, engaging Government, international organisations, academia, business, communities and citizens. Effective public education and communication is critically important, sharing the gained knowledge and information with the public and with leaders to help the public and leaders make the right decisions. Wuhan's experience, as discussed in our JAMA paper, and other countries' experience, lets us not start from zero to control the outbreak in a timely fashion. If we do it right and in a timely fashion, we do not need to do it for a year. I am happy to elaborate those key points.

Q249 **Chair:** Thank you. In particular, on some of the recent steps that have been made in Wuhan to remove some of the restrictions, one thing you mentioned was quarantine. How important is that in a regime in which restrictions are being lifted?

Professor Lin: I am definitely happy to talk about that. Let me start with social distancing first. Then I can put quarantine in context. Is that okay?

Chair: Yes.

Professor Lin: Let me first summarise the findings of our Wuhan analysis. We analysed 32,000 cases until 8 March. The estimated R value before the intervention was above 3, and it reduced to a little above 1 after the lockdown, traffic suspension and home isolation or quarantine. It definitely showed that social distancing quickly helped, but it was not enough to bend the curve.

After implementing the centralised quarantine—I am going to explain—the R value dropped all the way to 0.1 on 8 March. The social distancing intervention was launched on 23 January—that is when the city was locked down—and centralised quarantine and isolation was launched on 1 February. All the field hospitals were closed on 10 March and all the patients were discharged. Just 1.5 months after the launch of intervention, which included social distancing plus centralised quarantine, in the first two weeks of April zero confirmed cases were reported. The whole thing took about two months.

In order to talk about centralised quarantine, let me talk about what social distancing does—what it helps and what it does not help. Social distancing has been a primary measure in many countries, including the US, where I live right now. Social distancing helps to break transmission between households, but it does not help break transmission within households. The household here is broadly defined and means people living together, including family members or significant others, or people living in a closed space, such as a nursing home for elderlies and prisoners under law enforcement.

Social distancing definitely helped, by reducing the R value from above 3 to something a little above 1, but it was not good enough. That result has been replicated in multiple countries, such as China. If you look at Italy's data, it is the same thing: the R value stayed at around 1 after 9 March, and also in Spain. The reason is that family transmission is most common. Social distancing helped in breaking the transmission chain between households but it did not fully control within-household transmission, especially for low-income families and under-represented minorities because of their poor housing situation. Therefore, one needs a multifaceted approach—social distancing plus isolation of the infected and quarantine of family members or close contacts. That will help prevent within-household transmission and reduce deaths.

Q250 **Chair:** That involves people within households being removed from the family home and being put in a hotel, a hospital or some other kind of setting?

Professor Lin: Yes. Basically, that is where the country-to-country difference kicks in. There is no one-size-fits-all formula. Every country needs to evaluate its own situation. The principle is the same. We need to reduce within-household transmission as well as between-household transmission, but how to implement that varies from country to country.

I can tell you about what Wuhan did, but every country needs to think about what they should do themselves to reduce within-household transmission.

In Wuhan they realised that it was a problem. The WHO report states that almost 80% of transmissions were within households. In order to reduce within-household transmission and community transmission, they did centralised quarantine, by fully isolating infected subjects, including mild and moderate cases, to field hospitals and quarantining symptomatic subjects to a hotel or dorms. It is very important to emphasise that what they did was hospitalise not only the severe cases but the mild and moderate cases.

The current practice in many countries, including the US, is to hospitalise only severe cases. There are a few issues with that in terms of preventing infections and preventing deaths. In Wuhan, they divided the high-risk group into the following three groups. The first group were the confirmed cases, which included patients with symptoms and a positive test; in particular, they included the mild and moderate cases. Those cases were admitted to the field hospital and were treated and monitored.

There were a few benefits of doing that. One was preventing them from infecting family members—the loved ones—and the second was that they received early treatment. The mild cases were closely monitored for progression to becoming a severe case. If any of them became a severe case, they were transferred to the regular hospital ICU right away. Then they could put be on a ventilator right away. That helped reduce the deaths and reduced the burden on ICUs, PPE and ventilators, and on healthcare workers. That is group one.

Group two included suspected cases and cases that had symptoms but might not be tested yet, because at that time there was a shortage of testing capacity. Those people were quarantined at a hotel. If any of them became a case and tested positive, the person was transferred to the field hospital immediately, and if they stayed healthy after 14 days, after a negative test, they were released.

Group three were family members and close contacts. They were quarantined at a hotel with dorms, and if any of them had a positive test, the person was transferred to the field hospital immediately, and released after 14 days if they had a negative test, and if they were healthy.

One point to make on the strategy of quarantine at a hotel is that it is very important to have medical staff on board to monitor them. Everybody had a private room and a private bathroom and no central air conditioning, because some of those exposed subjects and close contacts with family members were not infected—some of them might have been healthy—so one wanted to avoid cross-transmission. That is the difference between them and the mild cases admitted to the field hospital. Those cases were all infected, so one needed to worry less about cross-transmission. The second point is that children need to stay

with parents. It is important not to separate children from their parents, so small children stayed in the same room as their parents and older children had their own room.

Q251 **Chair:** Thank you. It is very helpful to have that description, that insight into the quarantining aspect. My colleagues have some questions and I want to leave time for that, so let me turn to Professor Dr Fuest.

Professor Fuest, you published a very important and influential paper, which addressed what is sometimes portrayed as a kind of trade-off between lives lost through the pandemic and money lost through consequences of the lockdown. One of the central insights in your paper is that we should not see it that way. Perhaps you will describe your recommendations and the measures that the German Government made yesterday, on which I think your report had some bearing.

Professor Dr Fuest: Yes, thank you very much. The question we addressed in the report was, first, how we could organise and frame the process of lifting restrictions that had been publicly imposed and, secondly, how we could convince people to go back to work and convince companies to open up again.

We started from the observation that the widespread view that we are facing a choice between saving the economy and saving the health of the population is a dichotomy that is misleading, simply because if you open up too early, as was discussed here earlier, and the virus is still spreading, the economy will not flourish. People will not go to work if they are afraid; they will not go shopping and so on.

At the same time, and as was discussed here earlier, the shutdown itself has health costs. We concluded from that that we are facing—if we call this entire thing an exit process—a problem of simultaneously managing different risks. What we have done is distinguish a phase before the lifting of the restrictions and the phase that follows when we start to lift the restrictions. In the phase where the restrictions are still there but we are preparing for lifting them, we have defined a number of conditions to start lifting restrictions. Some of them are pretty obvious: prepare the health system; make sure the capacity of the hospitals is sufficient—that protection gear, masks, are available in hospitals, with priority in old-age care homes and possibly masks for the broader population; and, very importantly, make sure that there is enough testing.

What is needed for exit management is information about the spread of infection and the spread of immunity—in the population, ideally—so we need representative testing not just on a national scale but large enough to get reliable information about regional spreads of the epidemic. We proposed a number of criteria for differentiation across sectors, regions or individuals as far as the lifting of restrictions is concerned. I think it is common sense that one would design the exit process as something that comes step by step. The question is how you decide what to open. We

have suggested a set of criteria, and I think they are pretty obvious, but we can go into them later if you are interested.

We proposed certain organisations. A lot of knowledge needs to be collected—a lot of data needs to be collected, analysed and processed—to provide a sound basis for the political decision makers who then decide on the exit process. We proposed a combination of national and regional taskforces of specialists who would prepare the decisions.

Let me finally mention four points from the report. First, the economic cost of the shutdown in terms of lost value and added loss is very high. That means that very high investment in health measures would be justified, if not for the impact on health, then for the fact that it opens up the possibility to stop or lift some restrictions earlier. The losses are so high that almost every conceivable investment in protection, health protection, protection gear and masks is justified.

Complementary policies are needed, as discussed here earlier, to address the social and psychological problems that arise during the lockdown, such as domestic violence and deficits due to home schooling for children from disadvantaged families and so on.

We also discussed earlier that the opening process is not a process of just lifting legal restrictions; it is very important to convince people that it is safe to go to work and safe to open up companies. In that context, two things are key. One is that opening decisions are often complementary. For example, Germany has just decided to allow the reopening of small shops—a number of shops that were restricted before. One needs to understand that the impact of that will be limited as long as restaurants, theatres and so on are closed, because when people go shopping, obviously, they want to be able to eat something or have a cup of coffee, so step-wise opening has its limitations.

The other thing is that communication is key. That has also been mentioned here. The exit process is complex and citizens need to be won over, so we think communication is needed in line with broadly shared values. The communication should promote a sense of unity, as was just said, and it should be realistic and transparent. It should neither trivialise nor exaggerate the risks.

Very briefly, finally, on the decisions that were made just yesterday on the start of the exit process, in principle, the shutdown decisions taken on 12 March and in later days will continue to remain in place, but there are some exceptions. Shops up to a surface of 800 square metres will be allowed to open provided they have a regime of enhanced hygiene. There are some shops that can open if they are larger—bookshops, and car and bicycle dealers.

There will be partial opening of schools for pupils with final exams this year, and that has been announced for 4 May. Some states envisage different solutions. Bavaria, for instance, will start on 29 April. Every

school will be obliged to submit and implement a regime of enhanced hygiene. That also applies to all companies in manufacturing and other areas.

An office has been set up in the federal and state Economy Ministries to help companies address problems with their border-crossing value chains. That is very important because sometimes permits are needed. There is massive investment in health services. Five health service employees for every 20,000 inhabitants is the objective that has been defined. There will be an expansion of infection testing capacity. We currently have capacity for 650,000 tests. That is quite a lot, but not enough.

Q252 **Chair:** That is per day, is it?

Professor Dr Fuest: I am sorry—per week. It is 650,000 tests per week, but it is not enough, so there will be expansion of immunity testing capacity. An important point is that a national database will be created on hospital treatment of COVID patients to understand how treatments work and get better data. Maybe that is available in the UK, because it is all the NHS, but it was not available in Germany. There is a recommendation, but no obligation, to wear masks on public transport and shops. We will introduce digital contact tracing, but that is also voluntary.

Q253 **Chair:** We are very grateful for that. I have a couple of points for clarification. One of the things that has been reported is the high level of testing in Germany, and you mentioned the capacity for 650,000 tests per week. The UK Government's target is 100,000 per day by the end of this month, so that would be at comparable levels. Is that the right number and a sufficient number? Is there a programme to increase that further in Germany, or has it reached a stable level?

Professor Dr Fuest: That is the current testing capacity. Almost 100,000 per day is the current capacity. It is considered far too low. It will be expanded. I know of no target number, but it is considered far too low because it will not allow determination of the spread of infection at regional level.

Q254 **Chair:** I have another point of clarification. You talked about five people per 20,000 of population. That was five people dedicated to contact tracing. I think that was right; that is the proportion: five contact tracers for every 20,000. Have I understood that correctly?

Professor Dr Fuest: The information I have does not say it is strictly contact tracers; it is public health services focusing on fighting the COVID disease. It might be PPE or people doing other things. I am not sure that they are all doing contact tracing.

Q255 **Chair:** Finally, you talked about the economic costs justifying just about any health measure. I think you said that in your report. You did not advance an estimate for the UK. You said that a single week of extension of the lockdown has a cost of between £16 billion and £35 billion. Can

you say a couple of words about the basis for that? How do you estimate that?

Professor Dr Fuest: Those are just scenarios, and that is important to understand. We used German data that we have on different branches and data collected ad hoc to get an idea about which share of overall production, say, is being shut down. We then considered different scenarios. Our most benign scenario is one where 35% of all value creation is shut down and 65% is running, and the most negative scenario is one where roughly 48% of value creation has stopped.

In a back-of-the-envelope calculation, every month a country produces 8.5% of its GDP; if you shut down 50% of that, you have a loss of a bit more than 4% of GDP, and that is 1% of GDP every week, so that explains the magnitude. But it is very important to underline that these are just scenarios. We do not have a reliable measurement up to now. There is evidence that, in France, GDP at the end of March was roughly one third below February. That is the magnitude for France. What we see from current indicators for Germany is that the decline is probably less sharp. It could be something around 20 or 25, but these are very preliminary numbers.

Q256 **Chair:** Thank you, Professor Fuest. Professor Ostermann, Austria has been in the news, similar to Germany, for having taken some steps to lift some of the restrictions. Perhaps you might give a summary of what is being done and the rationale for it?

Professor Dr Ostermann: Thank you very much, Chair. A very warm welcome from my side and good afternoon. To give you a short idea of how the situation in Austria currently looks, the epidemic in Austria started in late February; then we observed an increase until 20 March, and ever since we are in the phase where we observe that people recover.

Currently in Austria, 14,000 people have tested positive with regard to COVID; approximately 10,000 people have already recovered and the number of active cases is at the level of 4,000. Of those 4,000 active cases, approximately 1,000 are still in hospital, which represents a quarter. You have to take into consideration when you look at those numbers that there are patients who were infected two or three weeks ago and they are still in hospital, and if you look at our ICU capacities, or intensive care, a quarter of those hospitalised patients—approximately 250 patients—are still hospitalised at ICU level. Currently, since the beginning of this week, we observe new tested cases at the number of 100, which is quite low. We observed 800-900 cases mid-March in Austria, so you see a decline in the so-called epidemic wave.

There has been a recent study in Austria, which has been discussed widely, on the prevalence of COVID disease active cases, not persons who had the disease and now have antibodies. We observed in the study only the active cases, via a PCR test, and for Austria it turned out that

the estimated prevalence last week was at the level of 0.3%. A total Austrian sample of 1,500 people were randomly selected and tested, and 0.3% have been identified in the sample, which comes to five people in total.

It is the case that in Austria we were among the countries that were hit by the epidemic quite early, so our Government decided last week to come up with some measures for the first steps towards an exit strategy. Since Tuesday—Monday was a bank holiday in Austria—small shops are open again. We have come up with another limit, as compared with our German neighbours; for Austria, the limit is 400 square metres, which would be 4,000 square feet, I guess. That is the limit for shops to be open.

The Austrian Government allowed DIY and garden centres, which are important now because springtime is arriving in Austria, to reopen. There are other criteria for those shops to open: first, staff of the shops, as well as customers, have to wear masks; the second criteria is that the capacity of customers inside shops, DIY stores, garden stores and so on, is limited to one customer per 20 square metres, or one customer per 200 square feet, and that has to be enforced by the shop owners via security staff. Some have come up with solutions that are quite smart; for instance, our DIY and garden stores limit the number of trolleys to be taken by customers, and only customers with a supermarket or shopping trolley could enter the shop. There are some additional criteria with regard to disinfection of trolleys and at the total shop level. That was the first measure to be taken.

Other measures are planned. By the beginning of May it is intended that other shops, and to some extent shopping malls, will be entitled to open up as well; also hairdressers, which have been an issue, and are obviously prone to personal contact with clients.

With regard to schools, we have come up with a plan to allow pupils in their final year to finish their exams. There have been some amendments and modifications; only written exams are mandatory, and exams are not held in classrooms but in gyms and other large halls. There is currently under evaluation a plan for restarting other schools for pupils at age 6 to 14, and so forth, at the beginning of May. That depends on capacity, and whether we are able to split classes in half, so that only half of the pupils have to attend the school and the other half are in other areas. There is still some debate going on in that respect.

With regard to the impacts of this exit strategy, we have applied some simulation models. It is simulation data, which is a pity, but real-world data is not available on a big scale, so we are still in a kind of experimental phase where constant monitoring is essential. Prior to the Easter holidays, we observed a very modest increase in the movement of the Austrian population, measured by traffic cameras and by daily communication data. That is one indicator we observed in order to assess

whether the measures that were being taken would lead to a substantial increase in movement and in physical contacts again, or whether the increase would be limited, which is desirable from our point of view, obviously.

Austria introduced a general obligation to wear surgical masks not only in shops but on public transport. This is enforced by our executive services—the police. There was some debate about whether surgical masks are effective or not. Austria came up with this step in early April when the WHO and the chairman of the Robert Koch Institute were rather critical—not critical, but sceptical—about the effectiveness of the measure. There was a huge debate in the Austrian scientific community as to whether it was a decision based on sufficient evidence or not.

I stress in this regard that not all measures taken by a Government can always be evidence-based such that there is sufficient scientific evidence, but there have to be informed discussions. At least with regard to surgical masks, the approach the Austrian Government chose was rather pragmatic, in a way, so the plan or intention of the Austrian Government—besides some protective impacts, which the surgical masks have; it might be 5%, 10% or 50%—was actually to make the population aware that there is still a pandemic out there, and our behaviour has still to follow the principle of physical distancing. Such science actually helps a bit: it would not have an immediate effect but, rather, immediate effects with regard to behavioural change.

Chair: Thank you. It is very helpful to have both your perspective and a summary of what is being done. Let me take some questions from colleagues. We have quite a few questions to get through and not much time, so, if everyone could keep their questions and answers relatively brief, I would be grateful.

Q257 **Katherine Fletcher:** Professors, thank you so much for your time. I deeply appreciate it.

Data is absolutely vital. Professor Lin, I heard you mention that your data is based around 32,000 cases. With 82,000 cases registered in China more broadly, I would be interested in your confidence in that data and interested to understand whether the data on the other 50,000 is available to you or if it was a selected subset of the data that you used to inform your analysis.

Professor Fuest, you mentioned the creation of a database similar to one that you purport might be within the NHS. I would be interested to understand what value that database will give to Germany's exit measures.

Similarly, Professor Ostermann, you mentioned that you are making exit decisions based on not necessarily real data, just a reflection of where you would prefer real data versus projection of models. Professor Lin, perhaps I could look to you first.

Professor Lin: Thank you for the questions. I cannot speak for the whole-country data because we only have access to the Wuhan surveillance data. That is where the 32,000 cases came from, so I can only speak for that because that is the data we analysed. If one looks at the facts, the social distancing intervention started on 23 January and the centralised quarantine started on 1 February. At that time, around 16 field hospitals were built to help admit the milder cases. Then by—

Q258 **Katherine Fletcher:** I am sorry, forgive me. That was very clear and your evidence was wonderful, but are you confident that it is good-quality data?

Professor Lin: Yes. I want to provide some context so that I can answer your question. Is it okay that you hold on for a minute and let me finish? If one looks hard at the field hospitals, they all closed on 10 March, so all the patients were discharged. Those are the facts. Based on the facts, at least for the data we analysed, I think the data is very good. I cannot speak for the general data but only for the data we analysed. Is that appropriate?

Q259 **Chair:** That is very helpful, thank you. Professor Ostermann?

Professor Dr Ostermann: When it comes to decision making on a governmental or policy level, you first of all have to have evidence, where evidence exists, and then you have to come up with some kind of informed decision making. Currently, the evidence we have on exit strategies is limited to a couple of observations we have on other countries. It is not always a question of what to do; the difficult thing is how to do it and how to implement specific measures. I would not say that we are living in a black box. We have assumptions on how the behaviour of the population would adapt after a specific measure, but we then need real-time monitoring capacity—a now-casting system in a way—to assess whether the measures we have taken have resulted in the behavioural effects that were intended.

In our forecasting models, our microsimulations, we can change the level of social distancing gradually. It depends on whether social contacts are increased by a factor of 10% or by a factor of 20%. It also depends on whether a measure impacts only the pupils in school in their final year, which is, for the Austrian case, 50,000 pupils, or whether you open up schools for the total public, when you have about 1.2 million pupils, with all the implications for public transport and so on.

I think the database is currently quite good. In Austria, we are lacking registries as well; we have a similar situation to Germany. From a scientific point of view, it is a bit disappointing that our researchers cannot participate in the international effort of bringing up evidence on how the disease evolves, how ICU patients could be treated in the most appropriate way and so on, but when it comes to the broad idea of how to devise policy measures, and on how to monitor the impact of those policy measures, I think we have very sound and very good data.

The important thing is to bring it all together and to come up with good regulations, because, as I tried to point out, we took a simple measure. First of all, shutting down was quite simple—advising hospitals only to admit patients who suffer from severe diseases, accidents and so on—but now it is getting tricky and difficult. The "dance" is the difficult thing. We have to come up with recommendations for our hospitals on who is now to be admitted from their waiting lists, which patient has to be treated on a priority level, and so on. That is far more difficult than the closing down.

Q260 **Chair:** Thank you. Professor Fuest?

Professor Dr Fuest: Your question was about the database I mentioned. It is a database on hospitalisation of COVID patients and their treatment, whether it is ICU, yes or no, and if so, what is the treatment that takes place and what is the outcome. The objective, if I understand correctly, because I am not a doctor, is understanding the impact of treatment.

You may know that we have a current debate, for instance, about the effectiveness of ventilators, which has been called into question. It is just one example. We currently do not have that data in Germany, as I said. I imagine that the NHS, because it is more centralised as a system, has the data, but we do not have it; and if it is not there in the UK, it should be. That database is needed.

Q261 **Andrew Griffith:** My question is a process one. You talked about some very sensible, it seems to me, science-led decisions—for example, opening garden centres with a social distancing measure. I have never understood why social distancing can work in a tightly stacked supermarket but cannot work in a very widely spaced garden centre.

My process question is: who are the advisory groups? Who are the sources of advice to Governments that are putting together these detailed measures? They are at a more granular level, and, as we try to restart the economy, you are right that it is easier to throw the off switch than it is to gradually turn the lights back on again. From a process perspective, what can you or Professor Fuest tell us about that process of working out who moves and when that takes place? Thank you.

Professor Dr Fuest: That question is directed to me, thank you.

Andrew Griffith: It is to both of you actually.

Professor Dr Fuest: Germany is a special case; it is a federal country. The competence and principle are with the state. The different state governments have a mix of commissions and advisory boards advising them. What we proposed in our report was a more centralised structure with a national taskforce that would be in touch with the state-level taskforces to get better co-ordination and better information flow. What we currently have are very ad hoc structures, different advisory boards, reports being submitted to the federal Government, to the state

governments, and then the key decisions are taken jointly by the Prime Ministers of the states and the federal Government.

Q262 **Andrew Griffith:** Are businesses represented on those advisory boards?

Professor Dr Fuest: Yes, they are, but a lot is also going on informally, with businesses handing in papers and so on.

Professor Dr Ostermann: In the Austrian case, we have the advantage of being a rather small country, in that we only have about 9 million inhabitants, even though we also have a federalist element, with fairly strong regions. What happens for the Austrian case is that advisers are involved at various levels. I am the director of the Public Health Institute. I directly report to the Minister of Health and we advise the Ministry of Health. Sometimes, in big consultation roundtables, we are part of the expert group that then advises more members of the Government and the Chancellor. It is rather an informal process in which there are many experts involved.

Our task, at least with regard to the public health scene and academia in the area of public health, is to organise academics in the public health area and bring together the best evidence with regard to the measures. I think the structure is the challenge we have now. We have come up with a kind of policy document, which is always shared with our Minister and his staff at the cabinet level, to distinguish the difficult measures and then ask who is affected, when is the measure planned to go into regulation, what are the certain conditions, what are the advantages, what is the intended effect, where are the risks and is a specific testing strategy necessary? Take, for instance, nursing and long-term care facilities: you need a specific testing strategy for the staff at nursing homes and for those who live in nursing homes, some measures on how to monitor the effect of the measure and evidence from other countries.

That is how we as the Public Health Institute try to put together evidence for the decision makers, to support them to come up with an informed decision.

Q263 **Zarah Sultana:** I am conscious of time, so, if possible, this is to all three panellists. Predictions for the UK, where social distancing started comparably later than in other European countries, are that we could be the worst affected country in terms of COVID-19 deaths. Based on the experience of China, Germany and Austria, what should social distancing measures in the UK look like in the next three months? What should we be doing in preparing to lift restrictions, and, Professor Fuest, how can we identify the regions and sectors that you mentioned in your report that are high value and low risk?

Professor Dr Fuest: How can we identify the sectors? Identifying sectors with very high value added, for instance, is not difficult. Identifying sectors that have low priority because they have a lot of

workers working from home is easy, so applying the criteria is relatively straightforward. That is statistical information.

To understand the regional spread of the virus, I suppose we need testing. I am no specialist there—that would be for an epidemiologist—but we need large-scale testing. It is key to start preparations for the lifting process during the shutdown. I think that is absolutely key. The German experience is, for instance, that now, as we are starting the shutdown, we are starting a programme to prepare schools. Why did we not do that two weeks ago? That is an error that should not be repeated, so the preparation, such as enhanced hygiene regimes, needs to be done now; organisations need to get ready.

Q264 **Chair:** Thank you. Dr Ostermann, briefly.

Professor Dr Ostermann: One thing is capacity building for the "dance". We share similar ideas to Germany with regard to mobile contact tracing teams. The next thing is to prepare for a threefold challenge: first, to control the epidemic; secondly, to prepare and save the health system, in order not to collapse—we observed that in France, in Spain and in Italy; and, thirdly, to prepare for future operations. That is something Professor Fuest pointed out as well. The difficult thing is that you have to do all three things at the same time, and capacity at governmental level is limited.

Chair: Thank you. We are almost out of time. Darren, you had some questions you wished to put.

Q265 **Darren Jones:** It is a very short, specific question further to Zarah's question. I am keen to understand if any of you have a view about the density of testing and tracing that is required to give you confidence in assessing risk around the lifting of restrictions on a regional or sectoral basis. Professor Fuest, do you want to go first on that?

Professor Dr Fuest: I am not a specialist on this. We are currently running a project where we envisage testing a cohort of 13,000 people nationwide. That is clearly not enough for the assessment of regional risks. Our view was that we would have to do broader testing, of at least 30,000 people, but that applies to Germany. It depends on the regional structure, which is completely different in the UK, so I do not think I can answer that question reliably.

Q266 **Chair:** Thank you. Dr Ostermann?

Professor Dr Ostermann: The impact of testing is overestimated when it comes to the general level—for instance, to detect regions that have a specific risk and so on. It is still a disease with relatively low prevalence; it may be 1% of the population or 0.3%, which is our estimate currently for the Austrian case. Testing strategies are always difficult. You have to take into account typical measures like sensitivity, specificity and so on, but I think it is a bit too optimistic to think that with a broad testing strategy of 50% of the population you can control the epidemic. More or

less, it is distancing and all the measures that Professor Lin described in her first statement.

Q267 **Chair:** Thank you. Professor Lin, you placed quite a lot of emphasis on testing, I think.

Professor Lin: Yes, definitely.

Chair: What is your perspective?

Professor Lin: Thank you for the opportunity. I would like to make a few comments about testing priorities and how to make decisions about lifting restrictions. Is that okay?

Chair: Yes.

Professor Lin: Let me start with testing priorities. Right now, as we know, many countries, including the US, have a shortage of testing capacity. You might have heard that one of the major issues is a shortage of swabs. Therefore, one needs to think about priorities and how to set up priorities, given the shortage of testing capacity. I would think that priority needs to be given to high-risk groups, in particular healthcare workers, the elderly in nursing homes and workers in nursing homes, their family members and close contacts and low-income families and under-represented minorities, including those who have mild symptoms. That is very important, because, if we wait for them to develop severe symptoms and then test them, it will be too late. We need to reduce the number of deaths by early diagnosis.

Many countries are considering lifting restrictions because that has an important impact on public health and on the economy. The guiding principle, I would think, is that there has to be high confidence that the public are not put at significant risk of infection and that the public are safe after lifting. That is why it is important to analyse real data. For example, the UK has outstanding epidemiologists and statisticians, and they can help to analyse the real data to evaluate whether the outbreak has been contained successfully using the current measures, in particular whether the curve has been bent, what the R value is right now and how to make the R value close to zero; and then proceed with caution, in a tiered system, to prevent the second surge.

How do you implement this? I think the California model is very good. California developed six indicators for lifting the stay at home orders. Basically, the guiding principle is that we ensure the public are safe and that social and healthcare capacity is provided for what is needed. They evaluated the ability for monitoring and protecting communities, which included testing, contact tracing, isolation and quarantines, as well as preventing infection for high-risk groups and evaluating the ability of hospitals to handle new surges and their treatment ability. There is physical distancing in schools, businesses and childcare, and plans for when to issue the second stay at home orders.

China's strategy is the following. In Wuhan in particular, they decided to reopen the country and reopen Wuhan, for example, after at least two weeks since confirmed cases were zero. That is very important. The data we analysed only concerns the confirmed cases. They decided to continue some degree of social distancing after the lifting. As you know, Wuhan reopened the city last week.

There is another emerging and important issue that all countries need to think about, which is asymptomatic cases and how to handle them. In our paper, we analysed that about 60% to 80% of daily new cases were asymptomatic. This was very interesting. A *New England Journal of Medicine* article was published earlier this week. In that study, they tested pregnant women in New York City. Among 215 pregnant women who tested positive, 85% were asymptomatic. Yesterday in the news there was a report on Boston homeless shelters: among a couple of hundred people who were tested, all those who tested positive were asymptomatic. This is worrisome. It means that, when the decision is made about lifting the restrictions, one needs to think about the strategy—how to detect asymptomatic cases and how to isolate them.

It is very important to conduct serological studies to understand how antibodies work, what proportion of the population have antibodies and whether people who have antibodies are really immune. It is very important to conduct that kind of serological study before a decision is made about lifting restrictions.

Q268 **Chair:** Professor Lin, I am very grateful for that. What you said at the end about the emerging evidence that a majority of COVID-19 positive patients may be asymptomatic, or people with COVID may be asymptomatic, obviously has very important implications for some of the decisions being made, and we are grateful to you for drawing that to our attention.

Professor Lin: Yes. Can I make one quick comment following that point? What that means is testing, testing, testing. We need to increase testing capacity.

Chair: On that note, we are very grateful, Professor Lin, Professor Fuest and Professor Ostermann. It is very important that we should learn the lessons of what is being done elsewhere, what methods have been used and what success or otherwise they have had, to inform our decisions. Science, as we know, is international. You have contributed to our analysis of the situation, and we are very grateful to you for spending the time, at what is an extremely busy time in your own institutes, to advise our Committee today. Thank you very much indeed.