HOUSE OF COMMONS

Health and Social Care Committee

Oral evidence: Antimicrobial resistance, HC 962

Tuesday 4 September 2018

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Watch the meeting

Members present: Dr Sarah Wollaston (Chair); Luciana Berger; Mr Ben Bradshaw; Dr Lisa Cameron; Rosie Cooper; Diana Johnson; Andrew Selous; Derek Thomas; Dr Paul Williams.

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Witnesses

I: Professor Dame Sally Davies, Chief Medical Officer for England, Department of Health and Social Care; Christine Middlemiss, UK Chief Veterinary Officer, Department for the Environment, Food and Rural Affairs; and Lord O'Neill of Gatley.

II: Gwyn Jones, Chairman, Responsible Use of Medicines in Agriculture Alliance; Professor Michael Moore, Professor of Primary Health Care Research, University of Southampton; and Dr Sheuli Porkess, Deputy Chief Scientific Officer, The Association of the British Pharmaceutical Industry.

Written evidence from witnesses:

– Department of Health and Social Care

- Responsible Use of Medicines in Agricultural Alliance (RUMA)

- Association of the British Pharmaceutical Industry

Examination of witnesses

Witnesses: Professor Dame Sally Davies, Christine Middlemiss and Lord O'Neill of Gatley.

Q1 **Chair:** Good afternoon and welcome to this afternoon's session on antimicrobial resistance. For those following from outside the room, would our panellists start by introducing themselves?

Christine Middlemiss: I am Christine Middlemiss, the UK chief veterinary officer working for DEFRA. I have been in post since 1 March, taking over from Nigel Gibbens.

Dame Sally Davies: I am Sally Davies. I am the chief medical officer for England and the most senior medical adviser to the UK Government. Of interest in this setting is that the Secretary-General of the UN has appointed me as one of his co-convenors of the UN Interagency Coordination Group—IACG—for AMR.

Lord O'Neill of Gatley: I am Jim O'Neill. I learned to pronounce antimicrobial resistance about four years ago, and I guess I have been immersed in it ever since.

Q2 **Chair:** Thank you very much. Dame Sally Davies, you have set out in very stark terms the consequences of our no longer being able to rely on antimicrobials. The Committee is very keen to hear from you. Perhaps you could set the scene for us—the scale of the problem and why we absolutely have to address it.

Dame Sally Davies: In summary, before we had antibiotics and treatments for all infections—this is about viruses, fungi and so on—at least 43% of us died from those infections, and we lived on average 20 years less. Now, with natural selection—Darwin in action—as we get effective treatments, the infective organisms, to take bacteria, have genetic mutation by chance, but if they are allowed to propagate and multiply in the presence of that treatment, those bacteria, or viruses, are resistant to the treatment. It is the infective organism, not the person. They multiply every 20 minutes and pass this resistance through to their progeny. They are very clever because they can also pass the genetic elements with resistance sideways to aunts, uncles, cousins and friends, which then pass them to their children. You can see how, if you have one resistant organism in a place—I was going to say a human, but an animal, a tree or a fish—it can propagate and take over the system, and it is now a problem.

Jim's work showed that at least 700,000 people a year are dying of untreatable infections. There are horror stories. For example, last year in the States a woman had gonorrhoea resistant to 22 or 23 drugs. In this country, people are dying of resistant infections, or there are those who do not die but double their time in hospital and have morbidity and

suffering. At this time, it costs the NHS at least £180 million every year to cope with the level of resistant infections we already have.

Q3 **Chair:** Could you set out for us how we will notice in this country that we are starting to lose the ability to rely on antimicrobials?

Dame Sally Davies: I hope we will pick it up through surveillance both in the human sector and the animal and agri-environment sectors. We have built a system I am proud of, but it has taken resources and it needs to continue to be resourced.

We will see more people dying of infection. One of the problems at the moment is that families often do not know that their bereavement was due to infection. They are rarely told that the infection was resistant to treatment, because it looks as if the NHS is failing and we shy away from telling that last bit of it. Meanwhile, death certificates do not really collect the data. I would love death certificates to collect data on when people die with infection and whether resistance has been involved, because that would really wake people up to the deaths as they happen.

Q4 **Chair:** In what way will patients notice? What kinds of operations or procedures will no longer be possible?

Dame Sally Davies: We will lose modern medicine. When I had a caesarean section I had prophylactic antibiotics to make sure I did not get the very prevalent infections that people had before antibiotics. We cover major surgery with antibiotics. People with cancer are prone to infection, and cancer treatments reduce immunity immensely. You will be given the choice of having an expensive treatment that is likely to cure you, but you will get an infection that is likely to be resistant and you will probably die of it, so it is your bucket list or try that. Meanwhile, all transplants will be out of the window because they are all prone to infection, and many people have to stay on long-term antibiotics. There will be a lot of suffering and modern medicine will be lost.

Q5 **Chair:** Before I bring in the other panellists, could you summarise the key points in setting the scene that you feel this Committee absolutely has to take note of?

Dame Sally Davies: We have Government leadership in this. I have talked to the Prime Minister, but I would like more visible and active Government leadership, not just from our Department and the Prime Minister, although I would like that; we need it from DEFRA around animals and the environment, and from DFID continuing its global work, because we are not an island. This travels everywhere. That brings in the Foreign Office as well on all the global work. We work well across Government, but we need more of that working.

We need to continue what we started in the first five years and build on it nationally and internationally. I want us to be the equal of the best in the world. The Netherlands and Sweden use far fewer antibiotics in humans, but they have been at this for 20 years; we have been at it for five years.

They have put a lot of resource in, but we know that if you put in the resource you save money. I want UK research and innovation to make AMR a grand challenge and continue to build the research that it has very effectively started to make sure we get the answers we need and move into social sciences; and, in addition, that people who have started PhDs—I met half a dozen today; they are wonderful—can see a career path so they stay in it. I want us to work with industry effectively so that we find a way to re-energise the pipeline, which at the moment is empty, and so that they do not damage the environment, so they need to make sure they are doing environmental audits.

This is a long-term problem. I can bore for Britain on it. We will never solve it, but we need to continue what we have started, and it needs more funding, not just official development assistance through ODA, but programme and resources domestically, and then we can save lives.

Q6 **Chair:** Thank you for that very helpful summary. Do either of the other panellists want to add to that before we drill down into those areas in more detail?

Lord O'Neill of Gatley: I suspect I will have plenty to say in due course, so I will keep quiet for now.

Christine Middlemiss: Sally has set the scene for us very well.

Q7 **Andrew Selous:** Dame Sally, could you say something about tuberculosis specifically and what the impact of AMR could be in the spread of TB? Could we be seeing a large-scale return of tuberculosis in the UK and worldwide as a result of AMR?

Dame Sally Davies: We actually are, so you have hit on something very important. Over 200,000 deaths a year from TB are due to multi-drug resistance. The big change we have been seeing over the past year or so as people catch TB is that in the past they caught it and on treatment it became resistant, probably because treatment was not used effectively. Now people are experiencing multi-drug resistance, and extreme drug resistance is going up. Meanwhile, it is a kind of Cinderella area because there is not that much in the rich countries, apart from Russia, so we do not have drug companies investing, as we need, in novel treatments.

Q8 **Andrew Selous:** Lord O'Neill, what is your assessment of the progress that has been made against your review's recommendations? I have glanced at your article in the *Telegraph* in April this year, which gives me a hint.

Lord O'Neill of Gatley: Here in the UK specifically?

Q9 **Andrew Selous:** Starting here, please.

Lord O'Neill of Gatley: I think I mentioned in that piece—I certainly do in many others—the 27 specific recommendations we made in 10 broad areas, which all connect. I frequently refer to them as the ten commandments. I would say that, since we finished, progress in two of

them has been better than we would have thought. Sally touched on them in a way, through the number of new researchers. When I am up in the north of England, where I spend a lot of my time on a number of things, I often tease people by saying there are more AMR centres in the north of England than regions that have had devolution deals from the Government, which is new.

Probably because of that—this is global—if the amount of early-stage funding that has been announced by various bodies, including the UK-China joint innovation fund, carried on for the next three years, what has happened in the last two would equal the 500 million that we said was necessary in early-stage funding globally. They are the two best developments. If we carry on where we are going on some of the others, my worrying suspicion is that they will turn out to be short-term developments.

On four of the others, there is progress of sorts. On public awareness, we have the ongoing great efforts of Sally and her team and others around the world; on surveillance, we have the Fleming Fund and so on; and on sanitation and cleanliness, particularly in hospital settings, health people—again with Sally's guidance—have announced some important things. To my surprise, I find myself thinking there are more positive developments taking place in agriculture than I thought would be the case. The industry has hit the Government-imposed target. As some people sitting behind me know, my slightly cynical response is that obviously the target was not tough enough if they managed to hit it that easily, but there are developments going on there, including major supermarkets trying to develop their own strategy, which is particularly good to hear.

Of the other four, I will come back to one of them at the end because I think there is a lot of progress, but it is already going into reverse. There are three where there is endless noise about stuff I did not think it was possible to make so much noise about with no progress. They are the model for pharmaceutical companies and the role that the pharmaceutical industry plays in it. They even make my old industry of finance seem capable of not talking as much as they do about some specific thing. There is very little on vaccines, and crucially, despite a lot of noise, not much on diagnostics. Without things on those three, we have serious problems.

The last one to mention—there is no diplomatic way of putting it—is that under the previous Prime Minister Britain had a fantastic voice, power and influence globally on this topic. One of the many reasons why I often said that leading the review was probably the most stimulating professional thing I had ever done was partly that wherever we went around the world, particularly as we went on, the more people praised the astonishing leadership role that Britain was providing. In global Britain, I cannot think of anything more global than that.

Q10 **Andrew Selous:** Are we losing that leadership role?

Lord O'Neill of Gatley: Yes, in my view.

Q11 **Andrew Selous:** What do the Government need to do? What should their top priorities be for their forthcoming strategy?

Lord O'Neill of Gatley: Sally, how often do you do your risk registers? Every year?

Dame Sally Davies: No. It is on the risk register.

Lord O'Neill of Gatley: Because of that, under the Cameron Government—as some people here may know, I was a Minister in the Treasury, coincidentally—I would say it was a top-five policy priority. I am not aware of it being publicly mentioned in any international forum by any of our leading Cabinet Ministers, never mind the PM, since.

Q12 **Andrew Selous:** The profile has sunk right down and we have to put it back up again.

Lord O'Neill of Gatley: Yes. Obviously, because of the role I have had I hear from plenty of people around the world. People do not understand why.

Q13 **Andrew Selous:** You have talked about your review and what you want to see done. In terms of the Government's 2013-18 AMR strategy, what has been good about that? What have we got out of it that you would give a thumbs up?

Lord O'Neill of Gatley: Touching on the two areas of really good progress and the four where I said there was some, particularly with Sally's leadership and her passion, there are ongoing incremental positive initiatives about reducing prescriptions in particular. Sally's team can cite all the statistics on it, and that is really good.

There is modest awareness-building. I often think it is a lot, but when you come across people you do not speak to about this topic, they do not have the slightest idea what you are talking about. It should be much bigger than it currently is, but I add the caveat, which maybe we will come back to in some other part, that I see signs of dilemmas. I have had thrown at me that I am being too callous in my views on what needs to happen, which is that, without diagnostics playing a much more central role, trying to reduce prescription just subjectively, or under general guidance, will create its own problems.

Q14 **Andrew Selous:** Quite a lot of extra money for the health budget has been announced. Where do you think additional Government funding needs to be directed in this area to make a difference?

Lord O'Neill of Gatley: It might have been in the *Telegraph* article, or certainly in another that has been published, that I said that in view of the announced, or implied, additional health funding, it would seem to me an absolutely perfect time to try to devote a lot of that to diagnostics.

There are two other comments about that. If I am pushed, as I often am, as to the single most important intervention that I think would make a huge difference, it would be diagnostics. As an economist/financier, I think about it in terms of supply and demand. We can get all the new drugs we need to get, hopefully, although it does not look as if that is around the corner, but that will only work for a while, until they become resistant for the reasons Sally gave earlier.

What we need to do is permanently reduce the demand, particularly the inappropriate demand. Given where we are with AI and all the things going on in modern technology, it seems to me that on AMR, but, frankly, more broadly—here I have a specific suggestion for you guys to encourage more thought on this—my guess is that the time and cost savings the whole health service could make with proper state-of-the-art diagnostics would be enormous. My suggestion is that there should be a thorough survey or analysis of the system-wide benefits of introducing state-of-the-art diagnostics. By the way, in our review, as some of you may know, we said that by 2020 no antibiotic should be prescribed without them, because one of the dilemmas for individual diagnostic providers is that the cost per item is higher than the pill. Unless the broad system-wide benefits are known to everybody, you will not solve that dilemma.

Q15 **Andrew Selous:** My final question is to Professor Davies. What conversations have you had with the Secretary of State and Simon Stevens about prioritising diagnostics in this area within the new spending being allocated to health, and, if you have, what sort of response have you had?

Dame Sally Davies: My conversations have been broader. While I absolutely agree that diagnostics have an important role to play, and there has been quite a lot of work looking at diagnostics not just as a laboratory test but as algorithms and AI—quite a lot of that is rolling out and we are reducing prescribing—we also have to think about and spend money on preventing infection. I do not want people infected so they need anti-infectives, so that needs very good hand-washing and education; it needs vaccines. The flu vaccine is for a virus, but if people do not get flu, they will have far fewer bacterial infections and will need fewer antibiotics. I have the conversations but they are very broad, because it is very difficult to pick out one bit. We need to work with industry on diagnostics and novel therapeutics.

Q16 **Andrew Selous:** In my question, I was trying to get a sense of how big a priority this is within the Department of Health. Obviously, it is looking at priorities and a lot of new money has been announced. Now is the time to decide priorities. This is an enormous issue, and I am asking what your sense is of how important it is at the top of the DHSC and NHS England.

Dame Sally Davies: It is recognised. After all, they would like me to be quiet occasionally.

Q17 **Andrew Selous:** Recognised is not a very strong word.

Dame Sally Davies: I do not know what will come out at the end. What we need to do is highlight the evidence. The financial incentives put into the NHS to reduce use have shown that they are cost-effective; they pay back. We need to keep pushing on all of these things. I would welcome your support in AMR prioritisation across the broad spread of everything.

Andrew Selous: I think you will have it.

Dame Sally Davies: It is prevention.

Q18 **Luciana Berger:** You have already addressed in some detail the importance of diagnostic services and how they might be improved. One suggestion that has been made is about the commissioning of diagnostic testing in community pharmacies. To what extent do you think that is achievable, and what kind of resources would be required to ensure delivery?

Lord O'Neill of Gatley: Are you asking Sally?

Q19 **Luciana Berger:** Whoever would like to answer; perhaps both of you.

Lord O'Neill of Gatley: In the early days of our review when I got this focused in my head, I would frequently hear, "Oh, it's too difficult; we are years off," and then I got a visit from somebody at Alliance Boots, which was trialling something called strep throat in parts of London and Nottingham, which was the original home town. I gather that is no longer taking place because, linked to why I made my proposal, the cost per unit is too high relative to getting a pill, but the early results I saw from that, in terms of how many people stopped going to waste a doctor's time, were highly encouraging. This is exactly why I believe it should be embedded at the core of every part of our health provision. In my view, you could have a dramatic influence on the inappropriate demand cost.

Q20 **Luciana Berger:** For the purposes of this session, in case anyone may be listening from outside this place, when I was abroad my baby had a strep throat test that took less than a minute, if it is the same test you are talking about.

Lord O'Neill of Gatley: Theirs was probably more like 10 minutes, if I remember rightly, but you obviously went to a good place.

Q21 **Luciana Berger:** It was a viral infection. That is the kind of test you are talking about.

Lord O'Neill of Gatley: Yes.

Q22 **Luciana Berger:** You touched on what might need to happen in primary care and the ambition of not having any unnecessary prescription administered by 2020. Can you give us further information about what you think needs to happen in primary care to address that?

Lord O'Neill of Gatley: As I have often said in various forums since, of the 27 specific recommendations we made, this was probably the most controversial and the one we debated most in my review team. We were only four and a half years off when we made the recommendation, and we recommended it across the whole of the developed world. Not surprisingly, a few countries said it was crazy because it was not implementable. Linking it again to market failure, as you might call it, unless you shock the system and encourage more of the bigger tech players to get into the diagnostics business by giving them a clear sign of its importance, they will never appear on the scene, which is why we ended up doing it. My challenge, as I said at an event to celebrate the 70th anniversary of the health service, hosted by some of Sally's colleagues, is that, if 2020 is not the right year, you come up with your own definition of the year, because it is desperately needed to break this circular dilemma.

Dame Sally Davies: This is the tragedy of the commons, as an economist would call it. We do not pay enough for antibiotics so that they are looked after carefully. That also means we are not getting new ones coming through. How do we protect them? Better diagnosis is clearly part of the answer. Whether it is a lab test or an algorithm, I want to see much more use of diagnostics. The algorithms are pretty effective in general practice, although not absolutely right. Whereas you might not want a pharmacist doing an algorithm, although I do not see why good, well-trained pharmacists should not, we need to diagnose and treat, because we know there is over-treatment.

We are making progress. There has been a 13% drop in GP prescriptions over the past four years, but a much lower drop in hospitals. Of course, the more precious and expensive antibiotics are used in hospitals, but it is more difficult to get a drop there, because throughput, complexity and infections are going up.

Q23 **Dr Williams:** I get the algorithms and the economics of diagnostic testing. I still work as a GP.

Dame Sally Davies: I know.

Q24 **Dr Williams:** For a sore threat, I am very used to using the Centor criteria to help me determine whether or not to prescribe antibiotics. You also mentioned AI. One of the things I notice is that nothing mandates me to use the Centor criteria on my computer system when I make a diagnosis. Presumably, there are some very simple things that the people who provide the software could do. When a code is put in for a sore throat, it could force somebody to go through that algorithm. Is that what you mean by using very simple AI?

Dame Sally Davies: Machine learning, machine prompting and machine blocking could all play a role not only in general practice, as you describe, but in hospitals, as we move to all-digital prescribing. I want the hospital to flag to the relevant clinician, "This patient has been on an antibiotic for

24 or 48 hours and we are stopping it." You restart once you have been to the lab or rung the lab and got the right result, because the patient either does not need it or needs a different one. Doing things like that will change the face of how we do it. It is surprising that the GP systems, of which there are three main ones, have not done more about that.

Q25 **Luciana Berger:** You have already touched a bit on the public awareness campaigns. Can you give us any more detail about the evidence that they are achieving their objectives, and what more needs to be done to raise awareness among the public?

Dame Sally Davies: We have a number. Public Health England runs antibiotic guardians. You are probably all antibiotic guardians like we are. They run a school programme called e-Bugs, which is in 23 languages, and I gather it works well.

We made our first tentative effort this time last year in much greater mass by trying, in the north-west, Dancing Antibiotics, or Look after our Antibiotics. It looked as if it was quite effective in the north-west. We rolled it out at the beginning of the year for six weeks across television. What we find on evaluation is that people are more aware of the issues, but it has not reduced prescribing.

The preparation for it taught us some quite interesting stuff. We hear about patients demanding antibiotics. A lot of patients want antibiotics because, first, they think they will work and, secondly, they validate that they are ill. They can ring work and say, "I'm ill." You have probably come across this. As part of that awareness campaign, Public Health England, with GPs and the community, designed prescription sheets that said, "You are ill, but you don't need antibiotics," and there were ticks about what they needed, so they walked out with a prescription. There was a lot of satisfaction about that.

We are going to rerun Dancing Antibiotics, which I love, this autumn. We will evaluate again and see. Clearly, it needs to never stop; you have to keep going to get it through. I believe we can get there, but if you think back to HIV, it took a lot of effort.

Q26 **Luciana Berger:** In your opening remarks, you gave a figure for what it costs our NHS at the moment.

Dame Sally Davies: It is £180 million.

Q27 **Luciana Berger:** To break it down to specific examples, my colleague Andrew talked about TB, and we know there is increasing resistance to a number of different conditions. We saw in recent weeks an outbreak of carbapenem-resistant organisms at Leicester Royal Infirmary. How much is an outbreak of that kind of bug likely to cost the NHS in terms of delayed discharge, increased care provision and issues around infection prevention?

Dame Sally Davies: We will have to get you some data on that. When I am lecturing, I say that when you get something like a CRE infection it doubles the death rate, doubles the time in hospital and doubles the cost. That is the ballpark figure, but if you would like us to see what data we have, we can try to find it.

Q28 **Luciana Berger:** The Committee hopes later in the autumn to look at sexually transmitted infections.

Dame Sally Davies: That is very important.

Q29 **Luciana Berger:** We know that there are issues in that area as well. For people outside this room, and for us to consider for our report, what should we be concerned about when it comes to those infections, where we are seeing increasingly resistant strains?

Dame Sally Davies: I am very worried about gonorrhoea. It is not just about that American case. We used to have two good drugs to treat gonorrhoea. Now we have resistance arising occasionally to both of those. Then we are into last-resort drugs. Gonorrhoea is a real issue. We can get you some data on that, too.

Q30 **Luciana Berger:** What would that mean in practice for a patient?

Dame Sally Davies: Gonorrhoea is pretty horrible, as your two GP colleagues know. It causes urethritis, eye problems and joint problems. It is horrid. The old-fashioned treatments were not very effective and were even more unpleasant. I do not think you want me to go into them. They involved flushing the bladder with mercury and things like that.

Q31 **Luciana Berger:** It comes at a personal cost. It will not be death, but it can be very personally distressing.

Dame Sally Davies: There is a lot of suffering—and no sex, so they will be upset about that.

Q32 **Diana Johnson:** I want to pick up the issue of prescribing and doctors having time to deal with patients, to go through things and make the right decisions. I note what the BMA said in evidence to us. They talked about the issue of gonorrhoea and the need for properly funded sexual health services. Recently, there has been a lot in the press about cuts to sexual health services and people not being able to access services. You will probably say that you want to send me some information on this, but it seems to me there is a bit of a link, in that people cannot get access to doctors to have the conversations. Isn't that part of the problem?

Dame Sally Davies: I am very worried about our sexual health services. They are part of public health and, therefore, they were given to local authorities. The information I am receiving suggests that the savings are too great and that we are seeing a degradation of many sexual health services.

Q33 **Diana Johnson:** That obviously feeds into what we are discussing today.

Dame Sally Davies: It does.

Q34 **Diana Johnson:** As someone who does not have a medical background, I have to say that this is really scary stuff.

Dame Sally Davies: Those are clinical services.

Diana Johnson: Yes.

Dame Sally Davies: I think the NHS is the home of clinical services.

Q35 **Chair:** One of the areas of focus has been around trying to reduce perinatal mortality. Are you starting to see antimicrobial resistance have a direct effect on rates of neonatal death?

Dame Sally Davies: I am not aware of it in this country. I can tell you that in India 60,000 newborns every year die of sepsis resistant to treatment, so it is there around the world. I am not aware of it as a significant problem here, but we can check for you.

Chair: Diana, do you have any thoughts on this?

Diana Johnson: I was going to ask question 6. I think that has been asked, so I am quite happy.

Q36 **Rosie Cooper:** My question is directed initially to Lord O'Neill. The rest of the panel might wish to come in. How concerned are you by the state of the market for developing new antimicrobials? If you are concerned, what action should be taken?

Lord O'Neill of Gatley: How many hours have we got? It does not function, and it is getting worse. Somebody I respect said to me about a month ago that, if they were a betting person, they would think that there might be no major pharmaceutical company left seriously attempting to produce antibiotics within two years. Since our review finished, more have left than have got involved.

In my view, one of the most authoritative independent assessments of the true stance of pharmaceutical companies and the whole industry on parts of this has come from the Access to Medicine Foundation. I assume you are aware of it; if not, you should be. The foundation published its first ever benchmark in Davos this year. It said that, around the world, there were only eight major pharmaceutical companies that it regarded as showing any evidence of involvement. Two of those have subsequently got out of the business. As a review team, we thought that the foundation was being very generous in saying there were eight. As I said earlier, if you contrast that with the amount of talk, the difference is staggering.

Academically, a central part of our recommendations in this regard were the so-called market entry rewards. From what I can see, the more prevalent academic-based researchers into the economics of drug models have essentially supported the same idea, or some close cousin of it,

since then, but nothing has happened. I do not really understand why in this country, given the leadership shown for a long time by Sally, and for some time by the Government overall, there has not been some kind of trialling of market entry reward. I do not really understand either why the pharmaceutical companies that claim they are interested in doing it have not pushed the Government by volunteering to do it. It is highly worrying.

Dame Sally Davies: I absolutely share the worry. This is quite scary, and one of the scarier bits. The pharmaceutical companies have been working with the Department. There is now a proposal for a pilot of two early antibiotics, to see whether we can manage one of those, but that will need some resource. We come back to resourcing being important, to maintain where we are and to develop.

I want to make two other points. You will not solve this from the Department of Health and Social Care budget. This is a wicked problem that is cross-sectoral. It takes in animals and the environment. It will have to be solved with Treasury funding, rather than funding from the Department of Health and Social Care, and no one country can do it on its own. We need to work together. I have been pushing that very hard, but so far we have not got to the position where we have a model to try, which is why pilots will be very important.

Although many of these companies are colleagues, and many of their members are doing their best to work with us, I am disappointed by the number of them who have said quietly over a drink, "Well, Sally, we know you're going to solve this. The Governments will have to pay, so we're waiting until you pay." There are two issues. First, where is social responsibility? They should be putting in their money, too. The second is short-sightedness.

To go back to the point about losing modern medicine, what is the point of developing the world's greatest cancer portfolio if there are no antibiotics to rescue the patients? Yet they expect that we in the Government and the public sector will fund this, or that it will happen by someone else being corporately responsible. There is a whole set of issues that are very complex, but we continue to push.

Lord O'Neill of Gatley: Can I throw in another brief thing linked to that? The short part is that this is partly why we included, controversially, the so-called "pay or play" option. As somebody who has spent over 30 years in finance, I think the core dilemma is that the pharmaceutical companies are structured in a way that is similar to how many financial companies used to be structured, and a lot still are. Every business line has to hit a certain hurdle rate. By definition, it is really difficult for antibiotics to do that. Something needs to be done to jolt companies out of that way of thinking.

Relating it to exactly what Sally has just said, at some point, all these other supposedly great profitable areas will cease to be so exciting if we

run out of antibiotics, but because of the nature of the competitive pressures, the quarterly reporting and so on, people say, "We'll deal with that when we get to it." From a broader perspective of what the issues are, I find it astonishing that policymakers around the world are seemingly presiding over an accelerating car crash.

Q37 **Rosie Cooper:** Greater minds than mine have looked at this for very many years. When I was reading the stuff, I almost went back to basics and looked at things like bus routes. If a company wanted to get a really expensive or popular bus route, it was challenged to take on one of the others. That kind of system could be scaled up, with a lot more thought behind it. Government, the NHS and the guys at the top must be able to find a way of saying, "You're not going to carry on making those profits and doing X, Y and Z unless you invest in this, whether you do the research yourself or pay into a pool to have it done." There must be some way of sharing the risk and taking the profit out. Can we do that?

Lord O'Neill of Gatley: A lot of what I have said is connected to other parts. It is partly why I bemoan the lack of such a loud voice by this Government. If we had not had the changes that we have had here or in the US, we might have had in place some version of market entry rewards involving the US and, quite possibly, some version of pay or play.

Dame Sally Davies: Yes, we could do it, but we are only 3% of the market. They might say, "We're not going to play. You don't get our drugs. We won't bring them to your market." That is why I want visible leadership and Treasury money to work with regions. The Americans have been looking at something that some of the companies want, which is very similar to your buses. It is a transferable patent voucher.

Lord O'Neill of Gatley: You want an even bigger free pass.

Dame Sally Davies: Yes. You get a patent of 20 years on a drug. If you bring in an antibiotic that we need and that works, we will give you an extra six months on that patent. You can move it wherever you want or you can sell it on. That is trying to go through Congress at the moment. It looks as if it may fall, but we need big markets or comings together to do this. We have to do that, because otherwise the poor countries will not have drugs either. The rich countries need to band together where the big markets are. Then we can show solidarity as a world. We want the poor countries to get access, because we do not want them passing infections or AMR to us, which we pick up very easily.

Q38 **Rosie Cooper:** "Keep it simple" is running around in my head. How do we knock those heads together? How do you get Government and the Treasury to see that there is sense in investing in prevention and helping companies get to that point? It seems so simple that it is daft.

Lord O'Neill of Gatley: I think it is called enlightened self-interest. It comes to economic and financial policy. At a point in time, one

Government somewhere in the west will take some risks by changing the risk-reward for pharmaceutical companies. Apologies; I know that there are some people who work with some prominent ones sitting here now—I think you might be speaking to representatives of the industry later—so this will not be the first time they have heard me say this. When we were going through this, I often thought that they are essentially balance sheet managers who happen to know how to manufacture and distribute pills. That is fine, because that is the capitalist model so much of industry lives in, but there is the rather crucial point that antibiotics go across the gamut. If they are given the core role that, as far as I know, no other entity is capable of playing, it is not good enough.

For example, you could tax marginal share buy-backs, as I was fond of pointing out—much to my other colleagues' irritation, and certainly to the big US guys' irritation. The cost of all 27 of our recommended interventions for 10 years—$42 billion—is less than the leading US pharma companies have spent on buying back their own shares this decade, for example.

Rosie Cooper: I put on the record that I respect the science, but I do not respect the industry. We need them, but we also need a social conscience and we need them to do the job properly. I have this argument with the pharmaceutical industry repeatedly.

Chair: Before we move on to the next section, Derek has a follow-up question.

Q39 **Derek Thomas:** Pharma spends an awful lot of money on research and development. Sally, you have set out clearly the risk and the sheer challenge ahead. Why is there not a financial incentive for pharma to want to develop the next generation of antibiotics? Surely they want to race. Why are they not racing to achieve that, so that they can sell it and make a phenomenal amount?

Lord O'Neill of Gatley: Is that for Sally or for me?

Q40 **Derek Thomas:** I am asking any of you. You are making out that there is no incentive to do it.

Lord O'Neill of Gatley: The whole reason why we recommended market entry rewards and the innovation fund was so that they would all link together. As I said at the start, if we do not crack this soon, the really encouraging progress in the past two years on early-stage funding will vanish, because the people who have appeared there are expecting some kind of buy-out.

Going to your opening statement, many people would observe that, progressively through time, the big pharma companies allow a lot of genuine research to be done by niche companies. When those companies find something, they just buy them out. That is partly why work is going on at an early stage. If you had a market reward of sufficient size—the

one we said—that should be an incentive for pharmaceutical companies to want to do it. The issue is where you get the money from.

Dame Sally Davies: To go back a step, why do you need a market entry reward? It is because we have market failure, because antibiotics cost peanuts. We do not pay much for them.

Q41 **Derek Thomas:** Right now.

Dame Sally Davies: There is a worry that, if you bring in a new antibiotic, it will be costed at only marginally above the ones we have, and they really cost peanuts. I have been known to buy them over the counter in France and Italy, and they are cheap.

Lord O'Neill of Gatley: I perceive where you were trying to delve. As an economist, I find myself accepting that there may be a very valid case for saying that, in high-income countries, we should allow the price of genuinely new gram-negatives to be much higher, as long as they are completely tied to compulsory diagnostics. Then you would be able to solve the diagnostic charge as well.

Q42 **Chair:** Is part of the problem that, when you develop a new antibiotic, it is held back as an antibiotic of last resort, so that by the time it can be in widespread use it is near the end of its patent? Is that part of the reason?

Dame Sally Davies: That is part of it. Another is that, if we did not do that, resistance would develop quite early.

Chair: Indeed.

Dame Sally Davies: Then, as with vaccines, you get into financial possibilities such as advance purchase initiatives, where you guarantee a price to the company, but only use what is needed, to try to protect the effectiveness of the antibiotics. It is a combination of many things.

Chair: We can explore that later with our industry representatives. Are there any further points that colleagues want to raise with our current panel?

Q43 **Andrew Selous:** Can I ask about China? It is a big market, with 1.3 billion people. Are the Chinese going to get on to this and put European and US pharma out of business? Are they going to crack it first? What is happening there?

Lord O'Neill of Gatley: Actually, there is a very interesting story in a number of newspapers today saying the exact opposite. The new, tougher standards the Chinese science regulator is presiding over are opening up the market to western pharmaceutical companies again in China.

On AMR, I assume that we might get on to agriculture, which I have mentioned before. This is a huge part of the problem in many places. In China, the problem is probably at least as big in agriculture as it is in

humans. According to my information, the Chinese banned the use of colistin recently. That was one of our specific recommendations.

Q44 **Chair:** We will come specifically to agriculture next.

Lord O'Neill of Gatley: They are doing some things.

Q45 **Dr Williams:** Jim, what do you think about the advance purchase idea? A pilot is being developed between the Department of Health and Social Care and the ABPI. The concept is that a guaranteed amount of money is paid over the course of five or 10 years, with the notion that the companies still get the money whether or not the antibiotics are used. Therefore, that is a way of encouraging—

Lord O'Neill of Gatley: It sounds like a version of market entry rewards, in a way.

Dame Sally Davies: It is; it is just one of the versions. It is called a cap and collar model. I read about it yesterday.

Lord O'Neill of Gatley: I am slightly worried that it is applicable only to existing antibiotics.

Dame Sally Davies: We are talking about piloting one that has just come on to the market and one as it comes on to the market. That is what I was referring to earlier. Having read the plan, we now need to find the resource to resource the team to make this happen and to work with the companies to find two.

Q46 **Dr Williams:** As you rightly mentioned, we are 3% of the global market. If we guaranteed a price, we could do it alongside all our EU partners, the US and Japan. Is there any talk of having a global fund to do that?

Dame Sally Davies: Not a global fund. I mentioned what the Americans have been looking at. I have been in discussion with the health and research directorates at the EU. They are quite interested in whether we can all club together in some way, but we have not taken it into actual models yet. We keep trying. I will be in Brussels in a couple of weeks.

Lord O'Neill of Gatley: If Congress went back to Democratic control, it would be at least feasible.

Chair: We have quite a lot to get through. Rosie will go on to agriculture and antimicrobials.

Q47 **Rosie Cooper:** I will address this to Christine first and then to anybody else. In essence, how effective have the efforts to reduce the inappropriate use of antibiotics in animals in the UK and elsewhere been? What should the next steps be?

Christine Middlemiss: As Jim said before, we have been effective. DEFRA set a target of 50 mg per kilo for use of antibiotics. We reached

that target within three years of the strategy kicking off. We moved from use of about 65 mg a kilo down to 45.

Was the target not set at the right level? We have been hugely impressed by how industry, which is very disparate in the way species and farming work, has come together to make that happen and has taken it on voluntarily, setting species-specific targets and working with farmers within their organisations to drive down use of antibiotics.

The focus to date has been a lot about reduction, but also about refinement of how we use antibiotics, about using the right antibiotic at the right time and in the right amount. That has been supported by new EU legislation around prophylaxis—not using antibiotics preventively and, if that happens, doing so only within individual species, at the direction of the vet—and metaphylaxis: using antibiotics in a group. There has been a lot of work on reducing the use of antibiotics, and on how we use them.

The next big step for me is the prevention piece—prevention of the insidious endemic diseases that create the need to use antibiotics. We heard from Dame Sally about using vaccines for viruses in people. There is a similar picture in animals. If we can be more specific and use vaccines to prevent viral diseases where we know we have them, it requires less use of antibiotics when you have not stepped in quickly enough with vaccines, and secondary infection occurs.

A big feature of the new look at future farming, "Health and Harmony", on how Government will continue to support farming post-EU exit, is how we can use public money for public benefit. Working with farmers on endemic disease identification, and then prevention, is one of the key drivers we will be looking at.

Q48 **Rosie Cooper:** Looking at the fact that you have got the reduction from 65 to 40 in three years, and knowing that it is RUMA's view that the next strategy should be to move away from targets on antibiotic use in animals, do you agree with that? How would you address the other issues, such as the release of antibiotics into the environment because of poor practice, poor husbandry, human and animal excretion, and inadequate disposal of animals at the end of their life? How does that all come together? If we take away targets, will we just allow this to run away? If you cannot measure, you will not know that improvement is there.

Christine Middlemiss: No. We are looking very much to continue and to improve our surveillance of antibiotic use. At the moment, it is primarily focused, or has been focused, on sales data for antibiotics. Unlike the NHS, we do not have an IT system that is used by all vet practices everywhere. They are independent businesses. Sales data have been the best way for us to understand what antibiotic purchasing has been, but a number of antibiotics are licensed for use in different species. The next step has to be to work on individual species use. Our dairy herd, our pig sector and so on are making good strides in beginning to understand

better actual use in those species. We will continue to drive that down and improve our surveillance.

For me, use goes hand in hand with infection prevention and disease eradication. If we can prevent the diseases that create the need to use antibiotics and eradicate certain infections, not only will we see the productivity benefit for the farmer, but, inevitably, they will not need to use those antibiotics any more.

We need to understand the join-up better—the environment and so on. Part of infection prevention is about better biosecurity, managing risk pathways where pathogens come on to your farm and spread among your animals. We need to understand more how that interaction between the animal, waste, the environment, water and humans drives resistance and what the key pathways are.

Q49 **Rosie Cooper:** Have the linkages become stronger across Government Departments? I have heard that there are linkages, but how strong are they? Are they where you need to be?

Christine Middlemiss: We work together.

Dame Sally Davies: We work together quite closely. We do double acts sometimes. What we do not have is a joint unit, as they have on climate change. I do not think we have managed to bring in environment as much as we want. Clearly, we hope from Health that there will be targets in the animal sector, and we work together a terrific amount.

I lead the international work, but I am quite well versed now in the rest of it. I could talk to you about fish farming; I have been to fish farms. In most countries, they just tip antibiotics into the fish feed. We are very worried. We share the worry that, globally, over 70% of antibiotics are used in animals. Over 80% of that is for growth promotion. I do a lot abroad to try to change that attitude, but the Americans are not keen to move away. They have moved to vet-only prescribed antibiotics, but they are not keen to move away from their high use. While our animal husbandry is improving, and our Scottish salmon farmers are doing a good job with vaccination—I must say that, or they will write me rude letters again—there is more to do in this country, and a terrific amount to do around the world.

Q50 **Rosie Cooper:** Can I go back to the initial premise? Are you happy to move away from targets?

Christine Middlemiss: We can change the targets to be more specific to the next steps we want to take.

Q51 **Rosie Cooper:** Harder, tighter, faster? How will you get the change?

Dame Sally Davies: By definition, they will be, because they will be aimed at the different areas—at least, I hope so.

Q52 **Rosie Cooper:** Who will address that?

Dame Sally Davies: Please advise us to do it. The reason why we are not producing the Government's next strategy before the end of the year—it will be at the beginning of next year—is so that we can take your advice on board.

Q53 **Dr Williams:** I struggle to understand why we are still using any prophylactic antibiotics for animals. Can you try to explain to me why a precious resource that will have a direct impact on human health in most of our lifetimes is being wasted on improving animal productivity?

Mr Bradshaw: Hear, hear.

Christine Middlemiss: Prophylactic use has changed massively, and the EU agreement is now about tight prescribing to individual animals where your professional intelligence tells you it is a bacterial infection and there will be implications for welfare and potential disease spread from not treating that individual animal.

Q54 **Dr Williams:** That is not the current status; that is a proposal, is it?

Christine Middlemiss: That is current in the new EU medicine regulation that passed its sixth trilogue recently.

Q55 **Dr Williams:** Will we adopt that before we leave the EU?

Christine Middlemiss: Yes. The intention at the moment is that EU legislation will be mirrored in our domestic legislation, and that will be included.

Q56 **Dr Williams:** You mentioned that some supermarkets are doing stuff on food labelling. Will there be a label on the front of food that says, "This animal has been given antibiotics"? If people knew that, they probably would not buy the food.

Dame Sally Davies: Until we have left the European Union, there are limits to how we can change food labelling. I know about this because of obesity, but you could recommend that, when we leave, we have food labelling that addresses some of these issues.

Christine Middlemiss: But people want, or are considering, welfare labelling too, and we have to have it right. It is unacceptable to compromise welfare in individual animals because of antibiotics.

Q57 **Dr Williams:** I completely get that, if an animal is sick and a vet has seen that animal and wants to prescribe a treatment course of antibiotics, that is necessary, but the notion that we are throwing antibiotics into salmon feed and that animals are given—

Christine Middlemiss: No, not in the UK.

Dame Sally Davies: Not in Scotland.

Christine Middlemiss: Not in the UK. In the UK, only vets prescribe. There is a withdrawal period before food and things go into the food chain

and there is random testing in slaughter houses and off-product, which has been in place for many years.

Q58 **Dr Williams:** But vets are still prescribing prophylactic antibiotics for animals in the UK.

Christine Middlemiss: That will come under the new EU legislation, with a direction about how it is done.

Q59 **Dr Williams:** By how much will it reduce the use of antibiotics if we take out the whole prophylaxis, move completely away from prophylaxis and just to treatment?

Christine Middlemiss: From where we have reached now, not that much actually, because so much of it has already come out of the system. There will not be that much.

Q60 **Dr Williams:** Why don't we just ban using last-resort human antibiotics as well?

Christine Middlemiss: The use of them has shrunk massively, not that we used a huge amount anyway, but we are now down to 0.02 milligrams of colistin. Again, it is given absolutely on the direction of a vet in an individual animal only when you have information that it is the antibiotic you need to use for this pathogen at this time to prevent disease spread and manage welfare issues.

Q61 **Dr Williams:** Would culling the animal not be better in order to protect the last-resort use of antibiotics for humans?

Christine Middlemiss: It depends on the nature of the animal you are talking about. In some of them, owners have a choice about that to a degree.

Dame Sally Davies: There are pets and racehorses.

Lord O'Neill of Gatley: It was one of our specific recommendations, as you may know. As I said earlier, and I will not take time because I know it is short, I personally feel that over the past two years the agriculture industry in the UK has made some surprisingly good progress, but when I say this to them—some of them are sitting behind me and you are probably going to hear from them afterwards—they say, linked to the supposed reduced usage that there is, that it is too draconian.

Going back to what Sally said earlier, if we are supposed to be the best of the best, I do not understand why we cannot just ban things like colistin. There is a parallel with climate change-type things: how on earth do you expect the likes of India and China to take these things seriously if we are not prepared to?

Q62 **Dr Williams:** Sally, is there anything more you would like to add or anything more you would like DEFRA to be doing?

Dame Sally Davies: We have gone a long way. We have further to go. There is very little done on the environment, and we are worried about the environment, both discharge—because animals, including humans, actually pee out about 70% of antibiotics, and the sewage and high run-off farms have to handle it—and the manufacturing. When the Access to Medicine Index looked at companies, seven or eight had standards but did not release their audit data. In another study, of a number of companies, 13 of them audited. We are going to want, as Europe, and then to spread it, to get regulators to say, "You cannot market your drugs unless you have an environmental audit."

Q63 **Dr Williams:** What is happening? Is a company flushing out the tanks and discharging antibiotics into the environment, and then bacteria breed in that environment?

Dame Sally Davies: Some of it is active pharmaceutical ingredients, the preliminary ingredients that are made generally in China and India, and some is the manufacturing. I do not believe it is our big companies. Much of it is generics companies in those countries.

Q64 **Dr Williams:** I was quite shocked to read in the brief that a study done in India showed that, when people measured water close to a cluster of pharmaceutical factories, they found that the concentration of ciprofloxacin in that water was greater than the concentration needed in human blood in order to be effective.

Dame Sally Davies: Exactly.

Lord O'Neill of Gatley: You may be surprised to hear me say this: our pharmaceutical companies and a small number of the western ones are actually showing some leadership on this. The problem is generics.

Q65 **Dr Williams:** Is there anything more that could be done in waste management?

Dame Sally Davies: We do not do enough surveillance and do not know enough about it, and we need more research about the interactions—the complexities—between the environment, animals and humans. We know a bit about the food chain, but the biggest rise in protein production at the moment is fish protein and its farming, and only salmon and trout are generally, in Norway, Sweden and Scotland, vaccinated. The rest of them are treated with antibiotics and they go straight out into the water table and the oceans. We need to move on that.

We have led the way with the UN environment programme, getting them to take on board the global action plan and stuff, but it is very slow. That is why our overseas development aid, through the Fleming Fund, is so important, because we are helping poor countries develop their laboratories and surveillance systems—One Health—which helps them with better patient outcomes and understanding better what they are doing in the environment and agriculture. I am very proud of that

programme, and I hope that in the next comprehensive spending review the ODA funding is continued so that we can continue our leadership.

Chair: Thank you. Lisa has a quick follow-up question.

Q66 **Dr Cameron:** Yes. It is a quick question about the Red Tractor assurance scheme standards. It seems that they have been taken up quite vociferously by farmers, but there are still 5% to 10% who are not compliant. Do you have any idea why that percentage is still not signed up to the assurance scheme, and what should we be recommending to ensure that we get their compliance?

Christine Middlemiss: Later in the evidence, we will probably be able to give you more detail on it. There are different standards for different species, so they are species-specific. With some, such as pigs, for example, if you want to be a commercial producer selling in the market, you have to undertake those standards.

In some of the other species, such as beef, the assurance programme does not cover whole of lifetime, so that is why you do not see all farms being members of it. I hope, when we look at how we support agriculture post-EU subsidy, that we will be able to make stronger links between being signed up to assurance schemes and access to Government funds, and how you then promote in the market.

Q67 **Dr Cameron:** An incentive. It says in our brief that only 92% of pork producers are working to implement the standards.

Christine Middlemiss: Yes. Not all pig owners are commercial producers. A large number of pig owners have a very small number of pigs, as backyard holders, and they are not members of assurance schemes generally.

Q68 **Dr Cameron:** They are not producing for consumption, but would they still be producers as such, or are those pet pigs?

Christine Middlemiss: They are generally pet pigs. The commercial people who own the vast majority of our pigs are members, but in terms of the number of holdings there are a lot of people who own very few pigs—lots with few pigs. They are the people who are not commercial producers and are not part of the scheme.

Q69 **Dr Cameron:** Surely you would expect that those who have pigs, for example, as pets, would want the very best standards.

Christine Middlemiss: Yes. They are not generally part of the normal livestock industry communication routes about these things, so that is something we need to target, not just in terms of antibiotics but disease prevention and biosecurity. They may take their pet pigs to a small animal vet who has different information, so it is something to target. We have been running a "Trust Your Vet" campaign, so that people understand that if your vet says it does not need antibiotics, it does not need antibiotics.

Chair: We have quite a bit to get through, and time is running short. Diana has a quick follow-up question and then we are going to come to Ben.

Q70 **Diana Johnson:** It is not really a follow-up question, if you will allow it me. To be clear, who in Government is the lead person on this whole area? Who pulls all of this together from the environment, health and business? Who is doing that?

Dame Sally Davies: I end up chairing the committee.

Q71 **Diana Johnson:** Who is the political lead on this?

Dame Sally Davies: I think you are going to have to ask the Ministers.

Diana Johnson: Are we seeing the Ministers?

Chair: Yes, we are.

Diana Johnson: Okay, I will have to ask the Ministers. That says it all.

Q72 **Chair:** Very importantly, are there any Government Departments that you feel should be doing more?

Dame Sally Davies: I feel that we need more resource across the board, but particularly in DEFRA.

Q73 **Chair:** Is it a resource issue or an engagement issue primarily?

Dame Sally Davies: You cannot engage if you do not have the resource.

Chair: Okay, both. Thank you.

Q74 **Mr Bradshaw:** You said there is a lack of engagement by DEFRA. Is that on waste or across the piece?

Dame Sally Davies: They are not able to contribute much on the environment and they are limited from the veterinary side as well. We have not even talked about agriculture, though most of those horrors are abroad.

Q75 **Mr Bradshaw:** Dame Sally, what are the implications for this whole battle, both nationally and internationally if—not when, if—we leave the European Union?

Dame Sally Davies: They remain the same. We share a lot of surveillance data with Europe, and we would expect to find ways to continue to share the data. Short term, there will be drug supply questions, which you would need to ask others about, that I am sure we will overcome. I do not see it as being a big problem, and we will be able to have different labelling. There are some advantages as long as we can manage to work with our friends as a block when we need to on things like market entry and rewards.

Q76 **Mr Bradshaw:** Lord O'Neill?

Lord O'Neill of Gatley: In discussions that we were developing, and there was a flavour of it in our report, some policymakers in Europe—again it is why I talk about the level of political leadership—were exploring the idea of some European, EU-wide market entry reward. Obviously, by definition, that will be much harder to do, not least because a lot of Treasury, and probably BEIS, officials will be guiding Ministers about the whole first-mover-type issue. Particularly in those circumstances, if you are doing something unconventional, it would be, "Arrgh." It would obviously, by definition, be a lot harder.

Dame Sally Davies: Can I add to my list? I mentioned UKRI and making AMR a grand challenge for research. There is also BEIS, of course, because of industry and our relationship with the private sector.

Lord O'Neill of Gatley: Another thing I would add is that on the other side of it, again linked to what I said right at the start, there are committees around this broader location that focus on, "What is global Britain supposed to mean?" If we are serious about trying to develop global Britain with proper content post Brexit, and I have spent a lot of time thinking about a lot of global issues—I am actually now chair of Chatham House where I spend a large amount of time thinking about lots of them—it don't come much bigger than this.

Q77 **Mr Bradshaw:** No. From what you were saying earlier, the impression you gave was that the seriousness with which the countries of the European Union take this issue and the general standards tend to be higher or more advanced than elsewhere. How can we be confident that those standards will be maintained here if we leave the European Union? That is my question.

Christine Middlemiss: In terms of animal health and welfare, a lot of our legislation is from the EU and there is absolutely no intention to reduce our animal health and welfare standards; actually, where possible and appropriate, our intention is to raise them, so we are not looking at watering them down in any way.

Q78 **Mr Bradshaw:** Ministers keep saying that, but they also say they want a trade deal with Donald Trump, and we all know that one of the first things that Donald Trump is going to demand—not request, but demand—as the price of any trade deal is access to British markets for their hormone-treated beef and so on, exactly the things that Dame Sally has just been talking about.

Dame Sally Davies: They use rather more antibiotics than Europe does at the moment. That is something the politicians are going to have to grapple with, and it worries me.

Q79 **Mr Bradshaw:** It worries you that we may be forced to take hormone-treated beef and antibiotics.

Dame Sally Davies: Those decisions will be difficult because you are trading off different economic perspectives, and there will be trade-offs. I would like to put health at the top.

Q80 **Mr Bradshaw:** In your role, are you lobbying the rest of Government to make sure that we stay aligned with the European Union in terms of standards and do not cave in to the demands of the Americans or the Brazilians?

Dame Sally Davies: I do not think I ever stop lobbying.

Q81 **Mr Bradshaw:** You are lobbying to protect our high standards.

Dame Sally Davies: I lobby to protect our standards as we take them back from the EU, because we in the EU have the right standards.

Q82 **Mr Bradshaw:** What are the priorities you think need to be addressed in this area in the next few weeks, basically, if we are going to leave the EU and if we are going leave the EU under the current timetable?

Dame Sally Davies: They are with DEFRA, which is, we are told and understand, addressing them. We must stick to those. It is downstream, when you get to the trade agreements, where there may be trade-offs.

Q83 **Chair:** Thank you. Do any of you have any further points that you have not been asked about that you want to bring to our attention today?

Dame Sally Davies: I did not mention the microbiome and I probably should have done, if I can very quickly. We have more bugs and infective organisms in us and on us as our friends, particularly in our gut, than we do human cells, weighing about 1.5 kilos. The problem, if you get resistance in your microbiome, either by travel or by taking antibiotics, is that it can sit there for six to 12 months if you are a healthy person before you get rid of it, and in old age, cancer and many other conditions, when you get an infection in your blood, it is quite often—most often—from your own microbiome. Why do I not want people having antibiotics or eating them in their food chain? It is because I want to protect their microbiome as well.

Chair: Thank you. Thanks to all of you for coming this afternoon.

Examination of witnesses

Witnesses: Gwyn Jones, Professor Moore and Dr Porkess.

Q84 **Chair:** Thank you to all of our second panel. For those following from outside, could you introduce yourselves and say whom you represent?

Dr Porkess: Many thanks for inviting me to give evidence. My name is Dr Sheuli Porkess. I am a medical doctor by background and worked in the NHS before moving into industry. I am now the deputy chief scientific officer at the Association of the British Pharmaceutical Industry—the ABPI. The ABPI is the UK trade body representing research-based pharmaceutical companies in the UK. Over the last few years, we have

been working with the Department of Health and Social Care to tackle AMR, and I am happy to be here to pick up a number of the really important points that were raised earlier.

Gwyn Jones: Good afternoon. My name is Gwyn Jones. I am a farmer in Sussex and I chair RUMA, the Responsible Use of Medicines in Agriculture Alliance, and one or two other farming organisations.

Professor Moore: Thank you for inviting me. I am Michael Moore. I am a GP by background, a clinical researcher and I work at the University of Southampton, where I have been leading a group researching strategies to help reduce unnecessary antibiotic use in primary care.

Q85 **Chair:** Thank you. Would all of you set out what your key priorities would be for the next antimicrobial strategy for the Government?

Dr Porkess: We very much appreciated the current strategy, and that has gone a long way to raising awareness. The leadership of Dame Sally Davies and Lord O'Neill's game-changing report, which were referred to in the earlier session, were very successful in raising global awareness. However, we are now at a tipping point from an industry perspective. We heard about market failure in the previous session, and I think the next strategy has to address how we move on from that.

As we heard in the earlier session, as an industry we have been working with the Department of Health and Social Care on a new economic model to address the fact that we need more research and development to produce new antibiotics. Getting that economic model to a point of piloting early next year is the key priority for us. In order to do that, we need to ensure that we have collaboration from not just the Department of Health and Social Care but a number of other organisations such as NHS England, NHS Improvement and Public Health England. That collaboration is necessary because we are going to do things differently, as was reflected in the previous session. If we want to take international leadership here and do something different, we need to collaborate to get to the point of piloting early next year and see where the pilot brings us.

Also reflected in the new strategy, we would very much welcome the widespread use of vaccines to reduce infections in the first place. Again, that was touched on earlier.

Q86 **Chair:** Thank you. Gwyn Jones.

Gwyn Jones: I have a very clear vision for agriculture in this country, in that I certainly believe that we should be leading both on antibiotic use and on welfare. It is important that we bear both subjects in mind. We cannot really separate the two.

Lord O'Neill's report was the catalyst for RUMA, which is 21 years old this year. RUMA has been around a long time, which is why we were closer to the target, which is now deemed as being fairly easy, and I do not dispute that; it was not that easy, but it seems easy that we were able to

get to it early and get under. We are not complacent; we have set targets for 2020, as Christine Middlemiss said, for each separate sector. We will continue with that because, coupled with high welfare, I believe that, as a major food-producing country, which is also an important fact, we need to compare ourselves with other major food-producing countries, and we will lead. We are close to being in that position already within Europe, which, as was said earlier, leads the world in this area and is really important. We tend to see that the north-west of Europe leads the south and the east, and then in turn Europe leads the rest of the world. Therefore, it is incredibly important, not just for our own sakes, to show true leadership and to persuade others to follow.

Again, I echo the same points. We desperately need rapid diagnostics—pen-side diagnostics—on farms and greater use of vaccines; it is going up, as usage of antibiotics comes down. We need to look at it in a much more holistic way. That is why it is not simply a case of saying that we want to get rid of targets. We want to go beyond targets. We want to look at agriculture in a more holistic way, whereby what we do with animals, having healthy animals, the proper environment and proper care and training—all of those things—ends up with lower antibiotic use by default rather than focusing on numbers alone.

Q87 **Chair:** Thank you very much. Michael Moore, do you want to add to that? Don't feel that you need to repeat what has been said if you agree with it.

Professor Moore: No. My focus is on primary care. To put that in context, around half of the antibiotics used in this country are used in humans and half are in agricultural use. Of the half used in humans, about 75% are prescribed in primary care. Three quarters of the antibiotics in human use are prescribed in primary care, and the majority of those are for respiratory illness.

If you go to see your GP with a respiratory illness—a sore throat, acute cough illness or ear infection—around 60% of people leave that consultation with a prescription. That is still the case. That is something I have been thinking about over the last 10 to 15 years in my research programmes. That is the kind of background to what I am talking about.

Some of these points came up in the earlier discussion. One was around IT and why the IT systems that GPs are using have not picked up on antibiotic stewardship. There is a complicated procurement process. There are independent companies producing the IT, but they respond to the Department of Health and Social Care procurement process, and it is very difficult to influence that. One of the things I would like to see is a much more transparent and rapid way of implementing new findings, such as the patient scores that we are developing, which help focus antibiotics on the people who really need them. As researchers, we develop these things and they get published, but they do not get implemented. There is a real implementation problem.

Q88 **Chair:** Who should take charge of that?

Professor Moore: I tried to tackle it. One of the things I did earlier in my career was to become the RCGP antimicrobial stewardship champion, and I thought, "This is a great time. I will go off and see the IT producers." I could not even get an appointment to see them. It was just impossible to break into that. They respond by saying, "We are contracted, there is a procurement process and you need to influence that." I have never really understood how that happens, but it would be something I would want to get into, some way of influencing that to translate and implement new findings more quickly into the IT landscape of primary care.

Q89 **Chair:** Having an obligation for them to implement research.

Professor Moore: The research is published, but it just does not get into practice. You are saying, "Why isn't there a thing coming up on my screen to say it is an antibiotic? Why are you prescribing it? Is there a clinical score?" Then you do not label it properly. The NICE guidance said that all antibiotic prescription should be associated with an indication. That is just a simple programming thing, and it has not happened to date.

There is a whole body of work around delayed prescribing: why isn't that easy to do? It was around the mid-1990s when we first published on delayed prescribing. There is no delayed prescribing button on your IT system that says, "How long do you want to delay for?" and prints the information on the other side of the prescription.

Q90 **Dr Williams:** You can do it, but it takes three or four extra steps.

Professor Moore: It is clunky. Why is this stuff not being translated by the IT companies? They are commercial entities, so they will respond to commercial pressures. That is one of the things I would be thinking about.

We have heard a lot of talk about near-patient tests. There is research supporting the use of near-patient tests—testing to see if it is a bacterial infection or a viral infection. Yes, in an ideal world, you would use more of those things. The evidence is not overwhelming that it reduces antibiotic prescribing in primary care compared with using clinical algorithms, but nevertheless we know that for one of them—CRP testing—there is good evidence that it reduces prescribing. The NICE guidance for pneumonia recommended the use of that, but it is simply not being implemented. It is three and a half years since the NICE pneumonia guidelines came out.

What happens is that the costs of those tests are met in primary care, and the antibiotics are paid for at the CCG level. If you say to a general practice, which is a small business, "We want you to use this test," they say that it costs £10 a go, whereas it costs them nothing not to use it. If they are doing 100 of those tests a year, you are asking them to spend £1,000 on that testing. That is an implementation problem. It is about

getting the resource in the right place to get these things implemented.

The third thing is about national levers. There was a successful campaign with the quality premium, but it was very complicated. It was a bundle of elements, and the CCGs could only get the money if they were not in deficit. It did not apply universally. It paid the next year. There was no money that went into practices, so CCGs could get the money next year if they were not in deficit. I asked myself why it worked at all; it worked a little bit, but it could be made much better. More effective levers are needed at CCG primary care level in terms of implementation.

All those things are around implementation of the research we have been doing in the last 15 years. It is still in journals but not in practice.

Q91 **Dr Williams:** I want to ask a little more about near-patient testing. There are many bacterial infections that do not require treatment. Most healthy people have an immune system that is perfectly capable of fighting off a bacterial infection. Is there a risk, or is there any evidence, that near-patient testing might increase use of antibiotics, because people will then get confirmation that it is a bacterial infection and feel in a defensive way that they need to prescribe, yet antibiotics are actually quite infrequently needed?

Professor Moore: If you just get members of the public and swab their throats, between 5% and 15% of them will have streptococci in their throat, so you could treat lots of people unnecessarily. We did a trial where we compared a scoring system with a scoring system plus a near-patient test for strep throats. The scoring system performed just as well as, and probably better than, the combination with the strep-throat testing.

One of the worries we heard about was use in pharmacies, and the trial that was published from the Boots company: they were offering this test in pharmacies and they asked whether people would have seen their GP, but we do not know the actual effect. It may well be, particularly if these things were free at the point of care, which might be the case with an NHS service, that more people who cannot get an appointment with their GP, and who probably do not need treatment, would go off to the pharmacy, have a near-patient test and end up with treatment. It could have the opposite of the desired effect, so you have to be very cautious about implementing near-patient testing in new settings, because it might not do what you expect it to do.

Q92 **Chair:** Could I ask a follow-up point about being able to identify who is overprescribing? Within primary care you can tell where there are outliers in terms of their prescribing, but we heard from previous witnesses that in veterinary practice you can only tell by overall sales data. Gwyn Jones, would you like to see something similar, so that you can see whether there are some vets who are perhaps outliers in overprescribing?

Gwyn Jones: Yes. The VMD—the Veterinary Medicines Directorate—regulates all of this in agriculture, and it gets all the data from the veterinary practices. Therefore, it can see. The difficulty is that veterinary practices are probably prescribing for different species, so trying to split what they have sold and what they have been using between species is not easy. We have an issue with data, especially in cattle and sheep—dairy, beef and sheep—but at the levy body, the Agriculture and Horticulture Development Board, where I am on the main board and I chair the dairy board, we already have an electronic medicine book for pigs, which has over 90% of pigs on it.

We are now running a pilot for beef and dairy cows, and it will be for sheep as well, so we are on our way to getting on-farm data, which is what we really need, not only for accuracy but also to get proper ownership on the farm by the farmer of what he is doing and why. That is on the way and is coupled with Government investment with AHDB at Stoneleigh for a national database. It is many years behind other countries, but we are very pleased that it is now going to happen at last. If we have a national database that actually works, there is so much we can do. It is not just about antibiotics. It is about productivity; it is finding all the things that can be improved and benchmarking against other farmers—all of that. There are some good things happening that will help.

Q93 **Chair:** I think you have all probably touched on much of this, but, if more funding goes into AMR in the next strategy, where do you think we are going to get the biggest bang for our buck, if you like, from investment? Where would you most like to see that investment go?

Professor Moore: I would try to fix the implementation side of things.

Chair: The implementation.

Professor Moore: There is lots of good evidence, but it is not getting into practice. Because incentives are in the wrong place, the money is in the wrong place. I do not even think it would cost much money, but that is where I would focus my intention and investment.

Q94 **Chair:** Implementing what we already know that is not being done.

Professor Moore: Exactly, yes.

Q95 **Chair:** Gwyn Jones.

Gwyn Jones: Surveillance, for sure. We are short of resource in surveillance—the Government bodies that look after that—and in diagnostics.

Dr Porkess: From our industry's perspective, there are some key things: getting the economic model we talked about to the pilot stage; ensuring that vaccines are used as widely as possible; and ensuring that we work with Government on appropriate use strategies. For all of those, we need

strong collaborations with the organisations I mentioned earlier, and to see it reflected in those priorities—for example, to have AMR as a key priority in the NHS 10-year plan.

Chair: Thank you very much.

Q96 **Dr Cameron:** My question is for Michael, although I think you have answered some of it already. It is about secondary care and why it is lagging behind primary care in terms of optimisation of use of antibiotics.

Professor Moore: It is very complicated even to know if they are really lagging behind. There are quite dramatic changes in secondary care in terms of throughput, age and how sick people are who go into hospital, so you get more people who are sicker. There are also pressures for early treatment under the sepsis campaign. People who might have sepsis get immediate antibiotic treatment. There is also a shift to using different antibiotics from broad spectrum antibiotics. Even the way that antibiotics are measured—the unit of measurement—can be different. Even though you are treating one patient, it may look as if you are increasing your antibiotic use simply because the measure of daily dose is different for that antibiotic.

It is very complicated to understand what is actually happening in the secondary care sector. There is a lot of work in that area in terms of getting people and reviewing them at three days to see what the diagnostic test shows and whether they need to continue with their antibiotics. It is more complicated than meets the eye, and I am not sure that they are not doing pretty well, and that perhaps without the interventions their antibiotic prescribing might have increased a lot more.

Q97 **Dr Cameron:** What would you like to see happen in secondary care—anything different at all from what is already being done?

Professor Moore: Because I am a primary care doctor, I do not work in that sector, so I would not want to put my neck out and say what more needs to be done. It is probably about implementation of what we know, which is to get people reviewed and off antibiotics. It is probably about education of patients, nurses and doctors. It is all about medical education, with antibiotic stewardship in the curriculum. It is all kinds of things that will lead to better stewardship in secondary care.

Q98 **Dr Cameron:** Can I ask you about public awareness campaigns? Do you think they are achieving their objectives?

Professor Moore: The evidence is a bit mixed. You can spend a lot of money on public awareness and not achieve much. Awareness campaigns that engage with the profession as well as with patients have an effect, although it may not be very long lasting. They have a role to play. It is a partnership, particularly in primary care, between the patient and doctor. You go in, you are feeling terrible and you want something to make you feel better. If the doctor says, "I have examined you today and I don't think an antibiotic is the answer," the patient has to be on side with that,

and I think they are much more now than perhaps 10 or 15 years ago. That is a much easier conversation to have. People say, "I am really pleased you said that to me because I didn't really want an antibiotic; I just wanted reassurance. What can you give me to get me feeling better?" A challenge for the doctor is to have good symptomatic treatment. You have to have the patients and the doctor engaged in this.

The campaigns that have gone on are useful. All the headlines that we have sporadically are useful, getting it on the front page of the papers that operations are not possible and terrible things are happening. All those things contribute in the conversation in the room with the patient who is definitely sick and unwell but probably does not really need an antibiotic. There has to be a partnership, and an agreed decision, between the doctor and the patient.

Q99 **Dr Cameron:** I suppose when people go to the doctor they think they are the sickest possible at that point.

Professor Moore: You feel terrible, yes.

Q100 **Dr Cameron:** To then be classified as not sick enough is a difficult conversation.

Professor Moore: Yes. It is all about communication skills, because it is not that you are not sick enough; you are sick enough, but actually antibiotics do not make a big enough difference to your illness. They certainly hardly help with symptom relief, and, if you are not going to develop a complication, you probably do not need them.

Q101 **Dr Cameron:** I suppose what I am saying is that it is not just about awareness; it is about attitudes and behaviour change, but you are saying that behaviour change has to be in that partnership.

Professor Moore: It is the partnership. It is changing; antibiotic prescribing is falling in primary care, but we are still prescribing in the UK around double what they prescribe in the Baltic states, Sweden and the Netherlands. Our per capita prescribing in primary care is around double, so there is a way to go yet.

Q102 **Dr Williams:** Can I ask about a couple of other primary care issues before I go on to the question I was going to ask? Vaccines have already been mentioned. What do you think needs to happen from a vaccine point of view in primary care, or is that not your area of expertise?

Professor Moore: It is not my area of expertise. There is vaccine development going on, and some common infections could be prevented by vaccines and that would be great. Obviously we need to make sure that you have good coverage of flu vaccines and childhood vaccinations to reduce morbidity.

Q103 **Dr Williams:** What about pneumococcal vaccine? Do we know what our coverage rates are of pneumococcal vaccines?

Professor Moore: They are quite good, but I am sure they could be better.

Q104 **Dr Williams:** Are there other areas of primary care where antibiotics are being used where guidance is not keeping up to date with all the evidence around resistance? For example, why are we prescribing antibiotics for acne?

Professor Moore: Yes, and what does that do to your biome? We have heard about the biome. What long-term effects does that have? What alternatives are there? In terms of antibiotics exposure, long-term treatment is probably quite a significant contributor—acne treatments and preventive treatments for recurrent urinary tract infection, for instance, where you might have six months or 12 months of an antibiotic rather than three days. It probably has a fairly substantial effect in terms of population exposure. We need to do more work in that area. A research priority would be to look at those kinds of areas.

Q105 **Dr Williams:** Thank you. Dr Porkess, I want to turn to the pharmaceutical industry. What is your response to the latest market exit in this area—Novartis? We are told that there are only four pharmaceutical companies developing new antimicrobials.

Dr Porkess: Yes. Thank you for the question. It would be useful for me to outline what is happening internationally and then look into the specifics of what you said about companies exiting in the research area.

Internationally, the industry is committed to working with Governments on AMR, and it is a key priority for the IFPMA, the equivalent trade association at the global level. Over 100 companies and associations have signed up to commitments on research and development, appropriate use, manufacturing and environment. We saw in 2016 $2 billion of private investment into research and development. However, we also know that we are at a tipping point with market failure, in that we see companies unable to make sustained investment in this area.

Q106 **Dr Williams:** Are they unable to because, as Lord O'Neill described, companies look at their individual product lines, and each individual product line needs to make a profit?

Dr Porkess: If we look at what that investment is needed for, we are looking, in the case of antibiotics, for a molecule that is powerful enough to kill bacteria that know how to evade the other antibiotics that are there, and then researching and developing that, through tests in labs and clinical trials in humans, to be a medicine that is safe and effective enough to be licensed and given to people. For that, companies need really deep expertise, not just in that as a process but in that as a process in infection.

The overall process of research and development is easy to talk about, but you need deep expertise in how we do this in infection and how we do this for antimicrobials. That is where you need companies able to

sustainably invest over time. We have to remember that it is not about having a suite of antibiotics coming next year or the year after. As Dame Sally said earlier, this is a process of evolution. We have to assume that bacteria will continue to evolve and we will continue to need antibiotics in the future. We need a long-term view, and companies need to be able to have sustainable investment in it and the deep expertise.

Q107 **Dr Williams:** What we heard from Sally Davies and Lord O'Neill was that the incentives should already be there. A company will not be able to use its anti-cancer drugs in the future if there is widespread antimicrobial resistance. Even though an individual product may not generate a profit in the context of a future market, there should already be incentives for pharmaceutical companies to develop new antimicrobials.

Dr Porkess: Each company has its own portfolio of medicines it is working on, and therapy areas it is working in, and that is where its expertise is. Not all companies work in all areas, and we do not need all companies to be working in all areas. Only a relatively small number of companies work in HIV, but we have made really significant progress there. It is about having a number of companies that can invest sustainably, can invest in the long term and keep the core bit of their business going, invest in it and continue to learn and work out new ways of developing medicines.

Q108 **Dr Williams:** You haven't quite answered the question. Isn't the incentive already there? As an industry collective—you are representing an industry collective body—isn't the incentive for the industry as a whole to protect its investments in anti-cancer drugs, and other drugs, that you will not be able to use the anti-cancer drugs in the future if you do not have the antibiotics to go along with them?

Dr Porkess: Is the industry committed to it? Yes. We have talked about the $2 billion of investment in 2016, and over 100 companies and associations have signed up to the international commitments. On the specifics for research and development, we need that deep expertise. We do not need each company doing a little bit. We need the deep expertise of core companies, and we need companies to be able to sustainably invest. That is why we have been working with the Department of Health and Social Care over the last two years on an economic model to provide a way of working that addresses the question of market failure and sustainable investment but also supports appropriate use of antibiotics. That is why a key recommendation for the strategy going forward is to pilot that way of working, and pilot the economic model, so that we can look at reversing it.

Q109 **Dr Williams:** Because there is an incentive for the industry to invest collectively, what investment is there going to be in this new economic model from the industry? We heard from the previous panel that industry seems to be waiting for Government to stump up the cash. Is there a collective investment from industry as well?

Dr Porkess: Yes. The investment from industry has been made, in that we already have five candidate products that have been put forward to the Department of Health and Social Care for consideration for the pilot. Industry has already invested in developing those, and we now need to work together on how we get the pilot early next year.

Q110 **Dr Williams:** Can you tell us a little more about the reimbursement model that de-links prices from sales volume? Can you explain the model you are working on?

Dr Porkess: Yes. Maybe it would be useful to go back and look at current medicines. The way we look at them is that companies invest hundreds of millions of pounds in a risky process, in that you have a number of failures—it takes many years to bring a new medicine to market—and then the companies get money each time that medicine is used. Clearly, we are talking about a different situation where we do not want antibiotics used, and the new antibiotics coming through will be very specific against certain types of bacteria; we need to make sure that we are looking after those and only using them when it is absolutely necessary. The new model looks to separate how we value what the antibiotic is from the individual sales, and we are working with the Department of Health and Social Care on the details. That is what we need to work through and bring to pilot.

Q111 **Dr Williams:** But that requires the Government to stump up cash.

Dr Porkess: From an industry perspective, we need the collaboration to make that happen. Yes, it has been great working with the Department of Health and Social Care, but we need to be working with NHS England, NHS Improvement and Public Health England to understand, when we have the model, what it means and how we make it happen.

Q112 **Dr Williams:** The model sounds like a good one, but it is whether or not the industry should pay for the model, in order to protect its other products, or whether the industry is expecting Government to pay for it.

Dr Porkess: As I have explained, in the industry we are absolutely committed to this. The investment in the research and development has brought forward five candidate products that we want to work on with the Department of Health and Social Care. The key thing is that we need to get to the pilot and say, "How is this going to work?" That collaboration is needed to get there.

Q113 **Dr Williams:** If there were a model that guaranteed a payment to industry, for example, how confident are you that that would encourage new entrants into the market and encourage the pipeline of development?

Dr Porkess: Having a new model does a number of things. One is that we have a way to pilot products that are in late-stage development at the moment: we will pilot them, we will refine them, and we will have a way

to ensure that they can get to patients. The model will encourage appropriate use, as we have talked about; that is an important part.

Another thing the model does is to send a very strong signal to companies both in the UK and internationally to say, "In the UK we are looking at things; we are prepared to do something different and we are prepared to work together, as industry and Government, to ensure that we have the antibiotics we need." That international element is not just the UK maintaining its leadership. It is also that, if people internationally see what happens here, other countries may well follow a similar model, and then you get a multiplier effect across a number of countries.

Q114 **Dr Williams:** Whether it happens in one country or at multinational level, if a country has already paid money for a drug that it is then not using, is there a risk that that might encourage utilisation of that drug rather than discourage it?

Dr Porkess: That is why the international thinking about this, not just from a UK perspective but from the international aspect, is really important, and that we make sure the industry has signed up to the international commitments. If we think about appropriate use, for example, of the 100 companies and associations who signed up to the international commitment, over 80% are engaged in awareness and educational activities. Making sure that we have stewardship over the new antibiotics in the future is key.

Q115 **Dr Williams:** It means somebody paying for something that is not being used, which is a good thing. It is the right thing to do with antibiotics, but there is a risk, I suppose, in tight economic times that, if you are paying for something, people might use it rather than not.

Dr Porkess: That is why we have to get it right. As an industry, we are keen to work with the Department of Health and Social Care on the appropriate use and stewardship aspects as well as the economic model.

Chair: Thank you very much. We are going to come on to antibiotic use in animals.

Q116 **Rosie Cooper:** To continue the theme from the first panel, Mr Jones, expanding on your initial remarks, could you comment on how effective efforts have been to reduce the inappropriate use of antibiotics in animals, both in the UK and elsewhere, and what steps you think should be taken next?

Gwyn Jones: Yes. I am not sure I can comment on inappropriate use elsewhere; I am not sure I know enough about it. Certainly in the UK, it depends what you mean by inappropriate use. The veterinary surgeons are the gatekeepers for antibiotics, and this has been as much of a journey for them as it has been for farmers. The challenge we have had is that we are dealing both with farming businesses, which are competitive, operating in a very competitive market, trying to export and being under pressure from imports, and with veterinary practices, which

are also businesses, and there has been a lot of amalgamation and huge expansion in that area. It has been a big journey for both sides. The good thing is that everybody has really grasped this and people have been working together well.

Earlier, there was some discussion about prophylaxis. You often hear the words routine prophylaxis. That is something we are dead against. It is not something we believe to be acceptable. In some sectors, they are now beginning to remove prophylaxis altogether. That includes some risk, of course, but that is probably the only way you can do it. The poultry industry, which has been at this for six years or more, is now a real leader in this field and has it down to very low levels—probably levels that cannot go much lower. It has taken risks and done things such as improving water systems, acidifying water systems and improving ventilation, all the things that help to make sure that the animals are healthy in the first place. Prevention is the key.

Endemic disease is a big target, and you heard Christine Middlemiss, the CVO, talk about that. That is the area we are now working on hard with industry. It is interesting that in agriculture there are very different farms, very different sizes and very different attitudes, yet slowly but surely we have grasped the nettle.

RUMA has now been asked to set up a body for companion animals because, whereas we know very little about the transmission, if any, from food animals to humans, there is certainly plenty of evidence of transmission from pets to people and vice versa. Because many of our members have as much to do with companion animals as they do with farm animals, we are setting up a body to look at that to try to see whether we can influence in the same way. Of course, it is a slightly different model because it is more akin to human health, in a way, in that you are dealing with a patient, and the owner of that patient.

In farming, you can see the reductions that we have achieved, and we are still getting those reductions. We will see good reductions of probably 12% or more in the next result, and by 2020 we will meet our targets, I am sure. That will put us in a very good place, and then we need to progress from that, as I said earlier, to look at a more holistic way of dealing with this.

Q117 **Rosie Cooper:** Do you think we should still be dealing with targets?

Gwyn Jones: Targets for the time being are inevitable, yes, absolutely. As to sales targets, we do not have the data yet, but we are working on that, for on-farm data. Once you have data, you tend to have targets. What I would like to see is this. It is very easy for farming to become a victim, because we have pressure groups and they want to change the way we farm. Some of the extremists want to see us stop livestock farming all together, so we are under a lot of pressure. What I do not want to see is, "Whatever the number is, it is not low enough or good enough." That is the problem. To do what we have done, we have to get

good will and people working with us. If you give them the impression that whatever they do is not going to be good enough, the danger is that they might give up. We have been trying, on the one hand, to pressure them to do all the things they have been doing, but I have been defending them as well. They need defending for doing the right thing, in my view.

Q118 **Rosie Cooper:** Thank you. Some of our written evidence argues that routine preventive use of antibiotics in animals and the use of last-resort human antibiotics such as colistin should be banned. Do you agree with that?

Gwyn Jones: I agree with the first one. As I have said already, we agree that routine preventive use should not be something we do. That has now pretty much gone in the UK and will go in Europe with the new legislation. I do not agree with the ban. The simple reason for that is that we are making such good progress. On colistin, for example, we are now at 0.02 milligrams per kg, whereas the EU target is 2, which is many times more than that.

The simple reason we do not want bans is that we just do not know what will happen in the future. If we were to have a disease outbreak, or some problem where suddenly we needed to use these medicines on a farm or farms, we need access to them. Given that every sector is now targeting reductions of between 25% and 50% by 2020 in this area, we are already in the bottom five countries in the EU when it comes to critically important antibiotic use. We are probably lower than that, because that is 2015 data and we have done a lot since then. The point is that it would be quite a slap in the face for all this work if somebody suddenly said, "We'll just ban that." There is no science to back it. We have an independent scientific group at RUMA now, so everything we do is science-led. That is really important, because people understand and trust it, and we know why we are making decisions; we have the scientific back-up for them.

Q119 **Rosie Cooper:** Does any other member of the panel want to comment on that? Do you agree that it should not be banned?

Dr Porkess: I am representing human pharma.

Professor Moore: Probably that position is reasonable. It should be restricted, a bit like a named-patient basis, where you can have some restriction, but an outright ban probably is not the way forward. I have a question about the competitiveness of UK farming when you are importing from countries that are using antibiotics. If we are not able to label, which we heard about, and all the work that the UK farmers are doing to reduce antibiotic use is potentially going to increase the cost of food production, how do they compete with American imports, say, if there is a trade deal without labelling?

Gwyn Jones: That of course is a worry, because, whatever consumers say, from our surveys we know that this is not that important to them when they are actually shopping. It is all about price and quality. We know that, if American products come in, they will be bought because they will probably tend to be cheaper. That will happen, without question. It is a big challenge for us. We will have to face up to it somehow. That is the reality of commercial farming, I am afraid, but it is something we worry about a great deal, because it is seen as an advantage or a different way of producing food that would give them an advantage over us.

Q120 **Andrew Selous:** When we leave the European Union, to come back to an earlier point, we will be able to label, and I think the food-buying public would be very interested to know whether there is routine use of antibiotics in their food. Once the public are aware that some products from overseas have it and UK produce does not, that should give you a commercial advantage. Would you not see that scenario playing out?

Gwyn Jones: No, I do not think it will.

Q121 **Andrew Selous:** Why is that?

Gwyn Jones: There are two things. I am not sure it is allowed under the WTO.

Mr Bradshaw: Exactly.

Gwyn Jones: Secondly, I am sure that, if we want a deal with the Americans, they will not allow it.

Q122 **Andrew Selous:** Are you saying that we would be unable to label food as having antibiotics in it because of the WTO?

Gwyn Jones: No food has antibiotics in it. Let's be very clear. We have stringent tests on food, so there is no antibiotic in food at all. The question is how we differentiate between different systems, some of which may have had routine antibiotics, hormones or whatever. I am no expert, but I do not think the WTO allows that sort of individual country freedom.

Secondly, we have heard already some of the American politicians speaking over here, and no doubt they would take a dim view if we were to do that. Our deal on other things that will probably be seen as more important than agriculture, which is why this is going to happen, would be jeopardised, so I worry about it. I do worry about it.

Andrew Selous: As a Committee, we probably need to investigate what the WTO says in this area.

Q123 **Chair:** We will try to get some evidence about that from elsewhere because it is an important point. You will have heard the previous panel talking about environmental factors and waste management. How serious a problem do you see that as being, Gwyn Jones?

Gwyn Jones: The truth is that we do not know much about this area. There is a need for research. We simply do not know. I will give you an example. At RUMA recently we put out a notice for dairy farmers saying, "Do not feed milk from cows who have been treated with antibiotic tubes to your calves," because there is a European study that shows that that can have resistance. Then, of course, the big question is: what do we tell farmers to do with that milk if we are telling them not to feed it to their calves? The obvious thing is that it goes with the waste, because, as you heard earlier, between 60% and 70% of antibiotics comes out from treated animals through urine and faeces anyway, so we put it in the same tank.

We have no scientific evidence, and our scientific group said that is the best thing to do, because we know that it possibly has a detrimental effect on the calves. We do not know what happens. It seems the logical thing to do, but we need more research in that area.

We have very good relationships with the VMD and the Food Standards Agency. I would like to have similar relations with the Environment Agency, but I am not sure the Environment Agency is in a place to work on this or do the necessary research or conduct tests. I am not sure what the position is, but it would be good to have similar relationships with the Environment Agency and agriculture to those we have with the regulatory body and the Food Standards Agency.

Q124 **Chair:** Thank you very much. Sheuli, did you want to add anything?

Dr Porkess: Yes. From the pharma manufacturing side, I talked about the international commitments, and they include manufacturing and the environment. As Lord O'Neill said earlier, we have made progress there and we have established a common framework for managing antibiotic discharge. Very recent news is that we now have discharge target levels agreed, and they will be announced formally later this month. That is really good news in that we are doing it in September 2018. Our target for doing it was actually 2020, so we are doing it ahead. This is an area, absolutely, that we are taking very seriously. We have set standards and are measuring how we are doing against them.

Q125 **Mr Bradshaw:** I would be grateful if you could answer the questions I asked the earlier panel and elaborate a little more on what you see as the main concerns and challenges in this area in the event that we leave the European Union. Gwyn Jones, do you want to elaborate on what you were just saying about antibiotic-treated foodstuffs from animals? Are there any other areas about which you want to raise concerns?

Gwyn Jones: The unknowns are the biggest ones. The environment is obviously a big one. We do not discharge to waterways. We tend to apply on land, but we do not actually know what happens once these products are spread on land. It may be completely harmless, but we do not know. That is an interesting one that will need some work. The other

environmental factors are pretty much the same as they would be for any waste in agriculture.

Q126 **Mr Bradshaw:** Have you raised the concerns that you mentioned a moment ago to Andrew about antibiotic-treated animal produce and labelling with the relevant Ministers, and, if so, what reassurance have they given you?

Gwyn Jones: Because we do not know what the deal is going to look like, nobody really has an answer for anything. That is what I find. I have not pressed them that much. The NFU—the National Farmers Union—is certainly asking those questions, and it is probably more for a political organisation such as the NFU to press on those issues, because they see them as a massive threat to the industry across many sectors; not all, but many.

Q127 **Mr Bradshaw:** But you agree with the NFU in terms of their preference to remain as regulatorily aligned with EU standards of regulation and protection as possible in any future trading relationship.

Gwyn Jones: Without being political, it would be a big mistake to drop standards. That is totally the incorrect thing to do, because our consumers, even though they do not necessarily think about these things when they are buying, tend to take them for granted. If they are buying in a particular retailer, they take that retailer's name as a guarantee that they are not buying things that are substandard. I am very keen that, for our own exports, for displacing imports and for our own benefit, the standards need to be maintained and worked on.

I see it as an environmental issue. Continuous improvement is expected, and that is the way it should be. That is where the best margin and the best profit is. That is why I was trying to explain that, if we move away from targets to a holistic way of looking at this, having the right environment, the right management, the right training and healthy animals, well looked after, they will make more money, and you are more competitive, more productive and, by inference, we will have less antibiotic use.

Q128 **Mr Bradshaw:** Would either of the other panellists like to add anything on the Brexit issue and what the priorities should be between now and March, if it is March?

Dr Porkess: From a pharma industry perspective, Brexit represents a considerable challenge due to the uncertainty, and our members are busy planning for various scenarios. Our key areas of focus in the industry are for regulatory alignment, frictionless trade, and making sure we have access to talent, the scientists and the researchers, and that we have ways for international collaboration—the big research partnerships and collaborations. The recent guidance on no deal and the technical notices is welcome and goes some way to help, but the best way to go forward is to ensure that a future relationship contains the elements of regulatory

alignment, frictionless trade and the talent and research side that I mentioned.

Professor Moore: We have a good history of collaborative work in the scientific community across the EU and I think that will continue, but there is a risk that, post Brexit, the UK research community will be marginalised, certainly in terms of leading applications, so that will be damaging, I think, to the research community. There is also an issue around market power and the purchasing of antibiotics as a single state. Obviously, the NHS is still a massive purchaser and you might be able to use that purchasing power to, for instance, demand production standards.

It is good to hear that there may be some effluent standards, but I was equally horrified by the ciprofloxacin story and the effluent. Who is buying the antibiotics from that factory? Probably, we are. Why are we doing that, and why isn't the NHS looking at standards on waste products from those factories?

There was a security issue in terms of supply of antibiotics recently. I am on the APRHAI panel, which is the Government advisory board for antibiotics. One thing that came up there was an international shortage of an antibiotic. It was because there is only one factory producing it, and there was an explosion in the factory and/or some problem that reduced production and the antibiotic became very scarce. Why is the whole world relying on one or two factories making an antibiotic, and shouldn't the EU be making antibiotics to high standards without effluent? It is much more difficult to do that as a single state. That is something that, potentially, should be happening within the EU.

Q129 **Dr Williams:** In your answers to Ben, you all talked about risks. What are the great advantages of leaving the EU in terms of work in the field of reducing antimicrobial resistance?

Mr Bradshaw: You are allowed to say none.

Gwyn Jones: I do not know. That is my honest answer.

Professor Moore: I cannot see any advantages.

Q130 **Dr Williams:** In your industry, Dr Porkess, are there any advantages?

Dr Porkess: As I said, the challenge is the considerable uncertainty that we are in at the moment.

Q131 **Dr Williams:** It does not sound like an advantage.

Dr Porkess: Understanding what the future relationship looks like is really important and having certainty with which we can then plan to make sure that we can collaborate going forward.

Q132 **Andrew Selous:** I very much agree with all you have said about the importance of the UK having and continuing to have high standards, so

let me put the question to you another way. Are there any other areas where, after we have left the European Union, you would like us to improve regulation and perhaps do better than Europe does? The Secretary of State for Environment, Food and Rural Affairs is on record talking about areas of animal welfare that he singled out where he thinks we should do better than Europe. Rather than just tagging along and doing what Europe does anyway, as the fifth biggest economy in the world, which has consistently high standards and a really top-class scientific base, are there any areas where you would like us to do better?

Gwyn Jones: I am not sure regulation is the answer, but incentives, sure, and I think that is what the Secretary of State is talking about. That is the second problem with the question. Leaving the EU is one thing, but we do not know what is going to happen to farmer support. We are pretty certain that it is going to be very different. We have a double whammy, in that we will leave the EU, and it just depends. Market access, of course, is the most important thing of all, especially for the sheep sector, for example, but then it depends whether there are any payments for farmers and, if so, what they are for. Then there is our competitiveness generally, before we talk about cheap imports.

Yes, the Secretary of State has majored on environment and welfare, and those are two good areas. It is how it is done and what they mean by it, and we do not know yet. It will be interesting to see. It is really important to major on welfare. In some of the countries where they have had regulation on antibiotics, they have had some big issues on welfare. We have seen in Denmark, for example, that their Government invested a lot of money with farmers in getting better infrastructure for their pigs. They have very good units for disease prevention and for low antibiotic use, but their welfare credentials are not nearly as good as ours and probably would not be accepted here. In Sweden and Finland, there is very low usage. They are not really big food-producing countries, but half their cattle are still tied by the neck.

There is a lot of information that is not around, and if people could see the whole picture they might see it a little differently. I think we should be proud of what we have. We still have challenges, we still need to do better and we need to strive to raise standards in all of these areas, but I hope that it will be incentivised and that there will be sensible discussion and not regulation. I am not a fan of regulation, because people tend to look for ways around regulation, whereas if you get the mindset changed, as we have managed to do with this, which is an example of how it can be done, everyone works together.

Q133 **Andrew Selous:** Michael or Sheuli, are there any areas where you would like us to do better than Europe, or are you just satisfied with level pegging?

Professor Moore: I think we should be leading the world in antimicrobial stewardship. That should be our aspiration.

Andrew Selous: Good answer. Thank you.

Q134 **Chair:** Dr Porkess, can I ask you about qualified persons? This was an issue that was raised with us in our previous inquiry on Brexit and medicines, devices and substances of human origin. The testers, the people doing the batch testing, are qualified persons. We were told that, if the European Union insists on batch testing medicines that are produced in the United Kingdom, we would see two things: companies shifting their operations to the EU and a loss of qualified persons as a resource. We were told that there are already shortages of qualified persons. Are you starting to see that effect now, and does it still concern you if we leave with no deal?

Dr Porkess: We know that our members, as I said earlier, are planning for all scenarios, whether there is a deal or a no-deal situation. Our members have been making those plans over the last months, and in fact since the referendum. Members are having to enact those plans, which may be setting up duplicate testing facilities and may involve moving people. I do not have data with me on exactly what is happening at this point.

Q135 **Chair:** You do not have an update for the Committee on that. Thank you. Are there any points that any of you wanted to be asked about today that you have not been asked and that you want to make before we finish?

Gwyn Jones: To try to reassure people again on the critical antibiotics, we are working towards using those as absolutely the last resort. Secondly, we know we are unlikely to get any new antibiotics in farming, so we are driven to make sure that we look after the ones we have and that we do not build resistance to them. That is one of the key drivers.

Chair: Thank you. Thank you all for coming this afternoon.