HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: My Science Inquiry, HC 618

Wednesday 19 October 2022

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Tracey Crouch; Rebecca Long Bailey; Graham Stringer.

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Witnesses

I: Andrea Lucard, Executive Vice-President, Corporate Affairs, Medicines for Malaria.

II: Professor Jo Slater-Jefferies, Chief Executive Officer, National Biofilms Innovation Centre.

III: Dr James Dowden, Associate Professor in Synthetic Chemistry University of Nottingham.

IV: Professor James Ebdon, Professor of Environmental Microbiology, University of Brighton and Member of Applied Microbiology International (formerly Society for Applied Microbiology.

V: Professor Louise Jones, Chair of the Genomics Reproductive Service specialist Advisory Committee.

VI: Dr Sarah Gordon, Chief Executive Officer, Satarla.

Examination of witness

Witness: Andrea Lucard.

Q1 **Chair:** This is an unusual meeting of the Science and Technology Committee, in that, as we consider our future inquiries, we wanted to open this up to the community of science research and innovation and take some suggestions on what we may conduct an inquiry. One of the great privileges of this Committee is that there are so many interesting things to research and inquire into.

To that end, we had a number of pitchers who followed a process of written submissions—thank you to everyone who made them—and will this morning give submissions in person. We intend to hear from six of the leading contenders for inquiry.

The format will be a presentation of five minutes from each of the pitchers, followed by questions from, principally, one member of the Committee, and possibly others, for another five minutes. At the end of the meeting, the Committee will reflect on what we have heard.

I am delighted to welcome to give the first pitch Andrea Lucard, who is executive vice-president for corporate affairs at the Medicines for Malaria Venture.

Andrea Lucard: Thank you very much for this opportunity to speak to you this morning, and for taking the first line of my speech, which was to introduce myself.

Medicines for Malaria Venture is a not-for-profit pharmaceutical enterprise—a product development partnership that exists to reduce the burden of malaria around the world. Along with some 400 pharmaceutical, academic, and endemic country partners in 55 countries, we work to develop high-quality medicines and deliver them to affected countries at an affordable price.

Over the last five years alone, MMV has benefited from British scientific excellence by working with some 80 UK partners and consultants. Each £1 invested by MMV is transformed into approximately £3.50 through direct and in-kind contributions from our industrial partners.

During the covid-19 pandemic, the UK expedited existing product development pathways to contribute life-saving medical interventions to the rest of the world. If product development pipelines can be sped up to tackle infectious diseases such as covid-19, the UK can maximise its expertise to help end major poverty-related diseases, including one of the world's deadliest: malaria.

For health innovations to have their full impact, however, they must reach those in need. This job of achieving access goes well beyond the laboratory and clinical settings and is a multifaceted endeavour requiring consideration of issues such as financing, manufacturing, policy, pricing and regulatory improvement.

The policy and regulations surrounding the product development pipeline are complex, which is why it would benefit from parliamentary scrutiny. On behalf of Medicines for Malaria Venture, the Liverpool-based Innovative Vector Control Consortium, and Malaria No More UK, I ask the Science and Technology Committee to call an inquiry into how the UK can create an enabling environment for a strong product development pipeline to tackle the world's deadliest diseases, including malaria.

Why now? Despite recent progress, malaria killed over half a million people in 2020. The vast majority were children under the age of five, and pregnant adolescents and women.

The disruption to medical services during the covid-19 pandemic has meant that malaria deaths are at their highest rate in a decade. This has had a direct impact on affected populations, but also raised health security threats to countries such as the UK and its trading and political partners. Emerging challenges pose further risks to the malaria and infectious disease fight on several fronts, including biological and technical challenges due to drug and insecticide resistance.

To both contribute to global health security and fight back against these areas of resistance, now more than ever new tools and medicines are needed urgently to get progress against infectious diseases back on track—progress that we lost during covid-19. Product development partnerships such as mine play a core role in making this possible, because we engage with the private sector, academia and NGOs.

We are very fortunate that the UK is a long-term supporter of malaria research and innovation, but we have also seen that the time taken from development to delivery is hindering life-saving interventions from reaching the communities that need them. We can eradicate malaria in our lifetimes, but to do so we need the UK science and research community to get life-saving interventions to those who need them faster. We therefore propose five areas of investigation to strengthen and speed up the development pipeline.

First, to assess whether the current research methods required are fit for purpose, based on the UK's experience of covid-19, by asking important questions from what we have learned. For example, are randomised control trials always necessary to develop products and protect human health? Are the regulatory models that are used for vector control and med-tech currently useful, from what we now know?

Secondly, to make recommendations on how the UK economy and life sciences sector can make it more attractive for the private sector to work in partnership to solve the problems of infectious diseases and poverty.

Thirdly, to review the UK's soft power opportunities to influence both in-country capacity building and streamlining approval processes within regulatory bodies such as the World Health Organisation.

Fourthly, with LMICs also wanting to benefit from this innovation, how can we leverage UK leadership in support of uptake of the products that serve LMICs?

Finally, to strengthen the agenda on equity and R&D as part of UK leadership in global health. We know that equity is important—you have seen it; we have seen it. You can help us all get there.

Q2 **Chair:** Thank you very much indeed. You are pretty much bang on time, so thank you for the calibration of that presentation.

I will start with a couple of questions. From what you said about the regulatory environment, you obviously know that what this Committee can principally do is to make recommendations to the UK Government. They are not obliged to enact our recommendations, but they are obliged to respond to them.

Obviously, the research into malaria is global. How relevant is a UK regulatory perspective, and to what extent is the UK regulatory structure holding back opportunities?

Andrea Lucard: That is an excellent question. I am not a regulatory specialist, but the UK is second to none in its regulatory expertise, and we work closely with UK regulators on challenging our models—certainly the European Medicines Agency. The relationship between the UK bodies and the EMA is very important; it serves as a reference body for many of the endemic countries that are strengthening their own regulatory systems—for example, the African medicines regulatory agencies that are coming forward.

It would be helpful to work with UK regulators to help the African Medicines Agency as it moves forward, and to help us work with the World Health Organisation. In neglected diseases and poverty-related diseases we go through multiple layers of regulation—not just the stringent regulatory authorities. We go through a stringent regulatory body and then to the WHO, and the delay between a stringent regulatory authority and the WHO prequalification of a medicine can take years—in some cases, even longer. Certainly, in their vector control partners we have seen something similar. That would be very helpful.

Q3 **Chair:** In improving that, does that not imply that any recommendations would be more usefully directed to the WHO than to the UK Government? Are there any particular regulatory problems in UK control that present themselves?

Andrea Lucard: One of the most interesting questions is whether the ways we are currently conducting trials with what we now know from covid-19 will be appropriate for regulatory authorities moving forward. The UK did magnificent work during covid in managing regulatory processes to move things forward—for example, by moving from full random control trials to human challenge models. Is it possible that we can have those similar conversations with UK regulators?

Q4 **Chair:** I will ask whether my colleagues have any supplementary questions, but you have been very comprehensive so far. Perhaps I could ask: why this Committee? This is clearly a very important project and it is very important to answer the questions that you ask. Are there other bodies that you think could equally take on this inquiry—this task?

Andrea Lucard: One of the fascinating things I found when I came to Medicines for Malaria Venture was that, frequently, the area of neglected tropical diseases or diseases of poverty fell between the cracks of various committees and departments. In most countries, this work is funded, as it is in the UK, through overseas development aid and through the ministries of trade, for example. But these are scientific and medical questions. Frequently, when we are dealing with very skilled, technical people—probably the most skilled globally are in the FCDO—we still have scientific and technical questions. These are not only humanitarian questions.

Q5 **Aaron Bell:** Thank you very much for coming in. Some of our best evidence sessions in other inquiries were when people argued against each other with different ideas. Do you think that would happen in this inquiry, or would most people be pushing for the same sorts of things?

Andrea Lucard: That is a wonderful question. I think there would be some very good arguments. Having worked with my medical colleagues, I imagine that questions such as, "What is sufficient evidence to fast-track a medicine?" would require some fairly good armour and broad shoulders to answer.

Chair: Thank you. We are bang on the 10 minutes. We are very grateful, Andrea Lucard, for your presentation. Thank you very much indeed.

Examination of witness

Witness: Professor Jo Slater-Jefferies.

Q6 **Chair:** I now invite Professor Jo Slater-Jefferies to join us. She is the chief executive of the National Biofilms Innovation Centre. The floor is yours.

Professor Slater-Jefferies: Thank you. Thank you for giving us the opportunity to speak to you this morning.

In 2021, the Taskforce on Innovation, Growth and Regulatory Reform reported that the UK should take the lead on the development of global standards, which would allow the UK to benefit from knowledge transfer and de-risk innovation.

In 2015, the Centre for Economics and Business Research examined the British contribution to standards. The report highlighted that standards contribute 28.4% of annual UK GDP growth, which equates to £8.6 billion.

Although there is already work looking at the opportunities for Britain to lead the way in standards—for example, with battery technologies or autonomous vehicles—we represent a field that encompasses multiple different sectors. We suggest that there is an opportunity for the Science and Technology Committee to explore ways to catalyse efficient knowledge transfer between scientists, industry, standards bodies and regulators in the field of biofilms.

You introduced me. I am the chief executive officer for the National Biofilms Innovation Centre. Our role is to catalyse the links between academic biofilm research and end users in industry and in healthcare settings.

The National Biofilms Innovation Centre brings together the research strength of 63 academic partner institutions across the UK, and links them with over 150 small, medium and large industries.

Biofilms are natural biological structures assembled from and by micro-organisms, such as bacteria or fungi, evolving and growing as a collective. You will perhaps be familiar with them as the slime that can form in the bottom of your shower tray or in plug holes, but they are natural communities of microbes that can be both harmful and beneficial.

For example, we use biofilms to process our wastewater in treatment facilities. They offer other opportunities for remediation and for energy production from waste, and they are essential for soil health and crop production.

But microbial biofilms can also be a problem in many different contexts. They can lead to contamination of foodstuffs in food processing plants, which therefore require stringent cleaning protocols. They can lead to degradation of large-scale infrastructure through microbial-induced corrosion. In healthcare settings, microbial biofilms can lead to infections that are very difficult to treat.

Overall, biofilms have an estimated annual impact of £45 billion to the UK alone. There are very few recognised industry standards available to assess products for biofilm control or eradication. Those developed from microbiology more broadly are not applicable to microbes in their biofilm forms. As a result, there is a lack of clarity about how to develop and progress claims for products to treat or prevent biofilms, and this in turn stifles innovation.

The UK has an opportunity to take global leadership in the development of new regulatory standards and guidelines, which will lead to the development and adoption of new products and services. The National Biofilms Innovation Centre is a founding member of the International Biofilm Standards Task Group, which will enable dissemination of knowledge and innovations to the wider global community.

We believe that the Science and Technology Committee can play a role by undertaking a programme of work to investigate how biofilm innovation currently reaches UK citizens, and how a new regulatory framework could bring down barriers to market and de-risk innovation while minimising the potential for its abuse.

We believe that biofilms represent an attractive target for further investigation, given the impact on a wide variety of industries and industry sectors. With potential input from different standards bodies and regulators, and the potential for knowledge exchange from one to another, we ask the Committee to investigate ways in which this transfer of science to standards, regulators and industry can be streamlined to promote rapid innovation.

Thank you for your time.

Chair: Thank you very much indeed. Again, that was a very concise exposition of a fascinating area. Our colleague Rebecca Long Bailey will ask some questions.

Q7 **Rebecca Long Bailey:** Thank you very much for coming to see us today. You stated that there are very few recognised industry standards available. Can you briefly explain the current state of play with regulation, and why this is such a problem?

Professor Slater-Jefferies: There are a few standards that specifically mention biofilms. I can probably provide further information—again, I am not a regulatory expert—but many look more at planktonic bacteria, so they are not in their biofilm form, as I said in my pitch. We are working with the BSI on a working group to help to develop the standards themselves, but obviously they then need to be translated into regulation.

At the moment, there is not that breadth of knowledge within the regulatory space. It is early days, and we will be here a long time if we do not have your help in looking at this more quickly, which would enable us to get those products to market.

Q8 **Rebecca Long Bailey:** Thank you. One area of huge concern, which will probably resonate more with people who do not yet know about biofilms, is healthcare. There is a huge problem in healthcare settings, and in drinking water, in trying to safely eradicate biofilms, which can sometimes become impenetrable with certain products. Can you give us a brief overview of why this is such a problem for healthcare and drinking water?

Professor Slater-Jefferies: Yes. Particularly in healthcare, once there is a biofilm within a replacement joint, for example, it is very hard to eradicate in situ, which means that usually the patient has to go back in and have that joint removed and completely replaced. It cannot be treated in situ.

There is also an issue around detecting biofilms in healthcare situations, on which the scientists at the Biofilm Innovation Centre and their academic institutions are working very hard. That is detection—early stage—but if you wanted to take that through to a product and it is not clear, particularly in the healthcare settings, what claims need to be made to do that, that will also slow down help getting to patients.

You mentioned drinking water. With biofilms in water systems and within pipes this is a problem not just in drinking water but even in infrastructure for oil and gas. Again, detecting biofilms in situ is extremely difficult. Understanding where a biofilm is and where to eradicate the problem is difficult, and usually whole sections of pipe need to be removed to eradicate it. If we could find a way to find that biofilm in situ, and a product to help treat it in situ that has gone through the necessary regulation, again, we would speed up innovation and get help to the people who need it.

Q9 **Rebecca Long Bailey:** Is it also true to suggest that the problem of antimicrobial resistance, particularly in healthcare settings, could be alleviated with a more detailed knowledge of biofilms and more investment in research and development in the area?

Professor Slater-Jefferies: Absolutely, yes.

Q10 **Rebecca Long Bailey:** You mentioned that industries are pushing for standards. Are there particular sectors that are pushing more than others? Are you receiving any resistance from any other sectors?

Professor Slater-Jefferies: The National Biofilms Innovation Centre held a workshop in April focusing on the medical device sector, so we have heard a lot from them. We know that this is complex and that diverse sectors and their applications will need different types of standards. One of the outcomes from that workshop was that a practical approach to dealing with this would be to have a component approach, looking at the different standards that are required in different settings.

Guidance on how and when to use them would also be quite critical. I am sure that there will be resistance from certain industries, but we have to deal with it head on and listen to what they are saying. In particular, we have heard from both the medical and the food industries that this is a barrier to them innovating.

Q11 **Rebecca Long Bailey:** I will very briefly ask in the last 10 seconds about new applications. You mentioned soil. What emerging markets and areas are there for biofilms?

Professor Slater-Jefferies: We are going to speak to a group in Argentina about soil production. It is another very complex area. How we improve crop production is something that we can work on in the biofilm community.

Chair: Thank you very much indeed. Again, that was very succinct and

comprehensive. We are very grateful.

Examination of witness

Witness: Dr James Dowden.

Q12 **Chair:** For the next pitch, I invite Dr James Dowden to join us. He is associate professor in synthetic chemistry at the University of Nottingham. The floor is yours.

Dr Dowden: Good morning. Thank you for inviting me to talk. I should point out that, although I am from the School of Chemistry at the University of Nottingham, I am representing myself and am not invested in any of the technologies that I will speak about, apart from by my existence on the planet.

The headline is that I would like the Committee to inquire into the potential capacity for methane recovery from biowaste. Methane is many times more potent as a greenhouse gas than carbon dioxide. It is estimated to be around 25 times, although estimates vary, and it is much more significant. Despite the fact that it has a relatively short lifetime in the atmosphere of around 12 years, its concentration has more than doubled in the last 200 years due to human activity.

It is estimated that methane is responsible for about 25% of global warming, so there is an incentive to reduce methane emissions. That could have a significant effect on climate targets.

Despite that, methane has economic value, as we all know, not least in the form of natural gas. The price of that has increased recently due to contemporary problems. There is an economic incentive to harvest methane emissions if we can, and that incentive has probably never been stronger.

One source of methane emissions is anaerobic digestion of organic waste, which happens both naturally and in plants. It is estimated that about 20% of global methane emissions come from things such as sewage and food waste, including within landfill, and a further 40% or so is from agriculture practices, a slice of which will include farm slurry.

In the UK, we already benefit from a well-established infrastructure for the removal of human waste and its anaerobic digestion. Companies such as Severn Trent Water in my area have developed methane capture facilities that use anaerobic digestion plants. That gas stream can then either be directly burned or further purified for connection to the national supply—although that has exacting standards that have to be met. I believe that farms have also invested in plants to recover methane from agricultural slurry. Incidentally, the waste from anaerobic digestion is nutrient rich, and when sterilised it can be used as fertiliser—another commodity that is expensive to come by at the moment.

The fact that high chemical oxygen demand waste is still being discharged into river courses suggests that not all of the potential value is being realised at present. Ideally, the UK should aim to recover as many of these methane emissions from biowaste as possible, because that would have a significant effect on our climate targets.

In order to know how far we are getting with that, we need to be able to co-ordinate and collect data, and we need to discover among ourselves what the best practice is so that all users can be informed of it. This seems to be ideally suited to an inquiry from this Committee.

The key questions are as follows. What are the estimated total emissions of methane from human waste and farm slurry in the UK? How much of this methane is currently recovered, and how much can be recovered, practically, given that there are some technological barriers to adopting this? What are the financial and technological barriers that would prevent people from collecting this methane? What research is required to optimise these processes? The policy area is probably to do with infrastructural investment, but perhaps this can pay for itself in the current climate.

On the face of it, capture of methane from biowaste seems to be a win-win process for everybody. We remove methane from the atmosphere, we provide a source of energy and we generate nutrient-rich by-products that can be used as fertiliser. I commend this inquiry to the Science and Technology Committee.

Chair: Thank you very much indeed, Dr Dowden. Tracey Crouch will ask some questions.

Q13 **Tracey Crouch:** Thank you very much for your presentation. There is no denying that this is a really interesting area. The science and the technology are fascinating, but why do you think this Committee should look at this, and not DEFRA or BEIS?

Dr Dowden: I think they have looked at it. There are reports, but they are all from a purely economic perspective. The Science and Technology Committee has a data overview and the ability to bring through the investigative expertise to recommend technology applications, where required. It is the overview and ability to co-ordinate the numbers.

Q14 **Tracey Crouch:** Are you saying that there are still gaps in the progress of the technology that need to be investigated and channelled?

Dr Dowden: Yes. It is very difficult to compare just numbers. The Office for National Statistics will declare gigawatt-hours for biomethane, but that is the energetic value; it does not tell you how much methane is being recovered, and there are CO_2 equivalents. There is a need to put the data into a common language or at least be able to interconvert easily.

Q15 **Tracey Crouch:** As the Chair said in one of his opening questions, the

role of this Committee is to put forward a report containing recommendations. From this inquiry, would there be substantial opportunities to put really quite solid and concrete things to the Government?

Dr Dowden: I imagine that, if you are a farmer, you do not have the time to invest in researching biowaste solutions, for example. You may not have the financial clout to be able to make the initial investment. Policy could help to reduce those energy barriers to adoption. The same goes for the water companies.

Q16 **Tracey Crouch:** Obviously, this is a global issue. If we were to conduct this inquiry, would we be able to see other parts of the world that are doing things better and from which we could perhaps draw examples?

Dr Dowden: Yes, there will be other countries that are doing very similar things right now.

Q17 **Tracey Crouch:** Is this a particularly time-sensitive inquiry?

Dr Dowden: I think that it is timely because the price of natural gas at the moment gives you an economic incentive to put in place the solutions.

Q18 **Tracey Crouch:** It would obviously take a significant amount of time for that to—

Dr Dowden: But how long? I think that it could be quite quick.

Q19 **Chair:** In your scientific research, I am sure that you have hypotheses at the outset that you then test against the data. In approaching this inquiry, do you have a prior view on the sorts of recommendations that you think would come out of it and that we would then test by taking evidence from experts?

Dr Dowden: I think that the recommendation would be along the lines of using as much biowaste as possible, establishing what percentage of methane from biowaste can be recovered and having a mission to recover it. I appreciate that not all of it will be, but, from my point of view, it seems like a no-brainer to make that recommendation, as long as you have the data. As I said, the other recommendation would be to have at least some mechanism to find out whether the financial barriers to adoption can be lowered.

Q20 **Aaron Bell:** Obviously, this is not new. You mentioned that Severn Trent is already doing this stuff with sewage. You mentioned landfill. I know that landfills already collect methane and so on. What evidence base is already there that we could interrogate to try to understand better what is going on at present?

Dr Dowden: First, it is about knowing how much is currently going on. From the ONS statistics, it is difficult to see, but it looks like about 2% of natural gas generation, so there must be capacity for more. People like Severn Trent almost certainly have very good expertise that could be

shared and rolled out. They will also have ideas about where the technological barriers to achieving this are. There are clearly things that would get in the way of people adopting methane recovery.

Chair: It says that there is one minute left, but we started it a minute late, so we are not cheating you of your time. Thank you very much, Dr Dowden.

Examination of witness

Witness: Professor James Ebdon.

Q21 **Chair:** I ask our next pitcher to come up. We are pleased to welcome Professor James Ebdon, who is professor of environmental microbiology at the University of Brighton and a member of Applied Microbiology International. I hope that I have got that right. Over to you.

Professor Ebdon: Excellent. Applied Microbiology International represents microbiologists from industry and academia.

Antibiotic resistance poses a significant global threat of far-reaching proportions. According to a 2019 study in *The Lancet*, it is estimated that drug-resistant infections will lead to 4.9 million deaths a year, 12,000 of them in the UK. That global figure is likely to rise to 10 million by 2050. Unless we act now, common diseases will become untreatable and life-saving procedures riskier. The economic impact of uncontrolled antibiotic resistance will result in a dramatic rise in healthcare costs and will further increase poverty and inequality.

However, following years in the wilderness, phages, or bacteriophages, are the focus of renewed interest as an attractive alternative to be used with conventional antibiotics.

Phages are the most abundant biological entity on earth. They naturally regulate bacterial populations, as enemies of bacteria. One of the amazing things about phages is that they have evolved to be very selective about the types of bacteria that they choose to infect. I have one here. They do that by landing, much like a lunar landing module, on the bacterial cell. They then inject their genetic material—their DNA or RNA—into the bacterial cell, turning it into a mini-phage factory producing multiple copies, to the point where the cell explodes and they move on to the neighbouring cells.

This ability of phages to target disease-causing bacteria was first observed just over 100 years ago and has been harnessed most notably in Georgia, the former Soviet republic, where they are routinely used in human health.

In the UK, phages have been used for a variety of applications. My lab uses them for tracking pathways of groundwater contamination to understand human sources of water pollution, but they have also been used to control pathogens in agriculture and in aquaculture.

However, phages are currently permitted for use in UK patients only on compassionate grounds, for life-threatening conditions and where all other treatments have been exhausted. Although the UK has a very strong research base in this area, including several world-leading academic groups working on clinical phage applications, we, like many other countries, have been slow to recognise the full potential of phage therapy. This is due largely to a lack of definitive guidelines and regulations, making phages financially unattractive to big pharmacy, which has been reluctant to come forward with the necessary clinical trials.

Current uncertainties remain about how best to administer phages, what doses we need, what concentrations to use and how long the therapy may take, but those are surmountable.

One of the major stumbling blocks has been in how we actually classify phage therapy. In the eyes of the EU, they are currently biological medicinal products and advanced therapy medicinal products. In the US, they are classified as drugs and in Poland as an experimental treatment. What is more, current legislation is very much geared up for regulating off-the-shelf, industrially produced pharmaceuticals, not tailor-made phage therapies.

We would like the Committee to launch an inquiry better to understand the regulatory barriers and opportunities associated with phage therapy in the UK, to explore whether the regulatory authorities need to reconsider phages as a form of life that may best be handled separately from existing pharmaceutical products. That would help the UK to be best placed to navigate the regulatory landscape on this exciting journey into the age of phage and would secure a pipeline for future phage treatments that are needed to improve the health outcome of future generations.

Chair: Thank you very much—and thank you for coming with the ingenious prop. Graham Stringer will lead the questions.

Q22 **Graham Stringer:** We did an inquiry into antimicrobial resistance not long ago. I cannot remember from our sessions anybody mentioning phages at all, given the size of the problem. The Government must have considered that this kind of treatment is happening in Poland and Georgia. Do you know what their reason for not going forward with phage treatment is at the present time?

Professor Ebdon: There have been two inquiries on antibiotic resistance, one in 2014 and one in 2017. I found one tiny reference to phages at the back of the 2014 report.

Q23 **Graham Stringer:** I missed that one.

Professor Ebdon: They did not feature heavily in that, and they do not seem to appear in the Government's 20-year strategy for dealing with antimicrobial resistance.

One of the challenges has been the piecemeal way in which phages have been rolled out. I mentioned Georgia. They have not been subjected to any clinical trials in some of the countries where they have been used, so there is a lack of evidence. They have also been used when antibiotics have been used as well, so it has been very difficult to see the efficacy of the phage treatments by themselves.

That has made it challenging, but there is some real evidence emerging. There are trials under way. The US Food and Drug Administration has just started a trial looking at biofilms in medical joints and using phages to target those sorts of infections, as well as infections in pacemakers.

Q24 **Graham Stringer:** This is the Science and Technology Committee. We are interested in scientific development and investment. There is a Health Committee. Why would it be appropriate for this Committee to look at it from a scientific perspective, rather than the Health Committee?

Professor Ebdon: I think that having an overview of the Government Office for Science and of the Department of Health and Social Care is important, because this is going to require the setting up of facilities for phage libraries for the maintenance of phages and how we use those.

Making sure that we get that right is important. This will involve looking at both some of the financial issues—some of those barriers—and some of the technological barriers. I think that the Science Committee is well placed to do that. It falls within the remit of the Committee to look at that broad range of challenges. It brings in some of the technological aspects, as well as things like funding streams and how we make those financial incentives.

Q25 **Graham Stringer:** How much expertise do we have in this country?

Professor Ebdon: There is a great deal of expertise. There is the UK Bacteriophage Centre, which is led by the University of Leicester. It is gathering information about our current lab capacities, capacities for setting up and maintaining phage libraries and, importantly, phage purification—how we purify phages to good medicinal production standards. There is a great deal of experience of a variety of applications of phages.

Q26 **Graham Stringer:** This is a slightly unfair question, because it is really our area of expertise. You are describing a very large area. Would you expect this to a be a long and detailed inquiry that looked at both the biology and the regulatory framework, or a short one-off: there is one problem here, on regulation, and this is our recommendation?

Professor Ebdon: That is a tricky one. I think that we need answers to how we recognise the capacity that is in the UK, how we regulate the phage products and how we regulate the establishment of phage libraries. Those sorts of things are very specific.

We also need to look at funding. Some really innovative funding structures are being rolled out at the moment. Instead of buying a box of antibiotics, the healthcare provider funds a subscription. That yearly subscription is based on benefit to patients, but also savings to the NHS. This is being used by the NHS, the Department of Health and Social Care and the National Institute for Health and Care Excellence.

We should look at whether it can be transferred to phages. One of the issues with phages is that they need to be maintained. If it is a medicinal product, that means going all the way back to clinical trials again. If a minor update to the products is needed, perhaps that could occur without having to do that.

Chair: Thank you very much. The five minutes are up. There might have been more questions, but it was a very rich presentation.

Examination of witness

Witness: Professor Louise Jones.

Q27 **Chair:** We now go to our fifth pitch. I am pleased to see Professor Louise Jones join us at the podium. Professor Jones is the chair of the Genomics and Reproductive Science Specialist Advisory Committee at the Royal College of Pathologists and professor of breast pathology at the Centre for Tumour Biology at Barts Cancer Institute, Queen Mary University of London. Thank you very much for coming. The floor is yours.

Professor Jones: Good morning. Thank you very much for the opportunity to present. Today, I am representing the Royal College of Pathologists of Great Britain and Northern Ireland.

What I want to talk to you about today is genomic medicine and how we are going to implement that across the UK. Genomic medicine is probably the most important innovation in medicine that we have had since the discovery of penicillin. It is going to impact on absolutely every aspect of clinical care: diagnosis, treatments, prevention and screening strategies for multiple disease types.

Genomics analyses our inherited genetic make-up, but it also analyses the acquired aberrations that we develop through life and that can lead to the development of disease. In certain situations, we analyse those in parallel. As a result of the very successful 100,000 Genomes Project, the UK is leading globally in the field of genomic and precision medicine. Within the 100,000 Genomes Project, we analysed rare disease—which actually affects more than 5% of the population, so it is not that rare—and found that we could make a new diagnosis in around 25% of our candidates. Over half of those would not have been identified using other technologies.

This is life changing. I want to give you one example of a young girl—a 10-year-old—who had had more than 300 admissions to hospital during

her life. Then she had a whole-genome sequencing done, which gave her a diagnosis, and underwent a curative bone marrow transplant. It transformed her life.

In cancer, we found potentially actionable changes—by which I mean alterations within the DNA that we can target with a therapy—in 40% of cases. That is game changing in terms of how we treat our patients.

The 100,000 Genomes Project laid the foundation for our NHS genomic medicine service. This is the first country to implement genomic medicine systematically across an entire service to deliver equitable precision medicine for the whole population. It is remarkable. It is wonderful.

So why am I here? The reason why we are here is that we are in a very unique position, because the science and technology of genomics far exceeds our social and clinical capacity to implement it.

There are many challenges. I want to highlight just a few of them. The first is the knowledge gap. We know what we know today, but we do not know what we are going to discover in the future. A normal test today—or a test that we would deem normal—may become abnormal in the future, as we discover more. The thing about genomic medicine is that we do not test just for what we know—we test for everything. There is a knowledge gap. We need evidence and information about the level of that gap and how to deal with it.

The second thing is that there is a real need to develop education and a workforce to deliver genomic medicine. This is particularly acute in pathology, because pathology is central to delivering on testing. We need to understand, to recognise and to address that.

Thirdly—I do not want to underestimate this in any way—there are logistical challenges. This particularly affects pathology, particularly in the field of cancer. When tissue is removed, in normal diagnoses—not just across the entire UK, but across the world—it is placed in a preservative, which allows us to move it around. We cannot carry out genomic technologies on that tissue. We have to have fresh tissue, which is an enormous challenge. There are other technologies, and we should be examining that evidence to see whether we can implement those.

Finally, but not least, there is engagement with the public. How do we bring the public along with us? Genomics is often regarded with suspicion. It is a bit Big Brother—a bit threatening. We believe that we really need to engage and educate the public, to get them to collaborate with us on the genomic medicine service to deliver its potential. Clearly, the NHS and the medical profession are addressing some of those issues, but we believe that this Committee is very well placed to help to bring together the evidence, to review that evidence, to generate and guide on policies and to help us to engage with the public so that we are able to lead a world-leading genomic medicine service within our NHS.

Chair: Thank you very much. That was another very compelling pitch. Tracey Crouch will lead the questions.

Q28 **Tracey Crouch:** I had my own breast cancer tumour genomically tested to see whether I needed chemotherapy, so you can understand why I put my hand up first to ask you all the questions on this. Both my consultant and my oncologist are signed up to the need for an expansion of this, but they are signed up very much on the basis that this could save the NHS a significant amount of money. Therefore, my first question to you is: why is this a Science and Technology Committee inquiry and not a Health Committee inquiry?

Professor Jones: It has come to this Committee because if we can implement this, and at scale, it will save money and allow targeted treatments—the right treatment to the right person. However, there are challenges to implementing it. We can do the pitch and tell you how marvellous this is in theory, but there are severe challenges along the pathway that are preventing us from implementing it at scale.

One point that I want to raise is that right at the core of the genomic medicine service is equity of access. While it is possible currently to deliver genomic medicine in a state-of-the-art tertiary referral centre with a research environment attached to that, we need to be able to deliver it to every single patient across the NHS. That is what we cannot do, because the technology that we currently have to use requires such massive changes to our infrastructure that we are not in a position to implement it. That is why we need to look at other technologies to be able to deliver.

Q29 **Tracey Crouch:** One of the questions that we are asking is: does this subject matter lend itself to proper debate? Do you think that there would be a proper conversation or discussion in front of this Committee? Will that enable us to put very strong recommendations to Government?

Professor Jones: There is quite a lot of debate around this within the medical profession. It sounds like a no-brainer, but there are people who believe that this is really not required—that it is over the top and is a vanity project, if you like. I think that there is a very healthy debate to be had and that there is a ground to come out that will tell us when this is appropriate, which patients this kind of genomic testing is appropriate for and how we should actually use this technology. I think that there is a very strong debate to be had.

Q30 **Tracey Crouch:** Would we be able to draw on experiences abroad? Are there any international examples that we would be able to look at?

Professor Jones: There are international examples. There are examples of extreme good practice, which could definitely inform us. As I have already said, our unique challenge is that many of those examples of good practice internationally are in big centres, but we very much want to be able to roll this out across the UK. I think that we have a lot to learn, but we have unique challenges as well.

Q31 **Tracey Crouch:** You talk about the 100,000 Genomes Project. It has concluded now, but follow-up progress is still going on. In an inquiry of this sort, would we end up interrogating some of that project and seeing whether there are still things that ought to be done, whether it was good value for money and so on?

Professor Jones: As you say, the 100,000 Genomes Project has completed, in that it has completed recruitment, but all that data is in a research environment and there is ongoing pooling of clinical data, which allows you to interrogate the genomic data to find out what it actually means. It remains a very valuable resource.

Actually, the genomic project is continuing. We are diversifying and looking at what other genomic tests we should be doing—what information they add—and what the package for individual diseases is. I think that we have a lot to learn, both from the existing 100 k and from ongoing work that is happening right now.

Q32 **Tracey Crouch:** You may be aware that the Committee has done two inquiries into genomic medicine and commercial genomics. Do you think that this is additional to them?

Professor Jones: I do think that it is additional. I am sorry if I sound like a broken record, but it is because we are trying to implement it for the whole population. These commercial entities are very much directed towards a particular set-up that can support it. Our big challenge, both in understanding science and in developing and exploiting new technology, is to be able to do it globally.

Chair: Thank you very much. The time is up. We are very grateful for that pitch.

Examination of witness

Witness: Dr Sarah Gordon.

Q33 **Chair:** We now come to our final presentation, moving from medicine to the field of mineral supply. We are very pleased to welcome Dr Sarah Gordon, the chief executive officer of Satarla. Perhaps you might say a bit about what Satarla is.

Dr Gordon: Thank you very much. It has been absolutely fascinating to hear the different pitches here today. As you said, my name is Dr Sarah Gordon. I am here representing the responsible raw materials community as an entirety.

We require huge volumes of materials just to live, from the copper wiring in the walls through to the myriad elements that we require in our mobile phones. Where we cannot grow it in the forms of animals and plants, most of this material is originally taken from the rocks beneath our feet.

We have lots of materials in circulation today. However, only a tiny fraction of them are available for reuse or recycling at any one point in time. Of course, our world's population is growing and our technology keeps evolving. Therefore, the diversity and volume of materials that we need keeps increasing.

We can layer on top of that the challenge of climate change and the significant volume of infrastructure that we will need to be able to address our energy transition. It is estimated that across the world we will need a sixfold increase in the volumes of rock that we dig out of the ground just to address the energy transition. For more specialist elements, such as lithium, there could be an increase of as much as 70 times the amount of material that we are currently digging out of the ground.

What does this mean for the UK? Let us just look at electric vehicles. In order to be able to meet our targets for electrifying our fleets by 2035 and 2050, we will need half of the global copper supply just for electric vehicles here in the UK. We will need two thirds of the world's annual lithium supply. We will need all of the annual supply of dysprosium, which is one of the rare-earth elements, and double the world's supply of cobalt.

Therefore, we have a little problem. How are we going to be able to address our energy transition when we need so much more raw material to be responsibly sourced and to enter our supply chains?

These supply chains are long and complicated. Not only are there significant environment, social and governance threats throughout the supply chains, but there are significant timescales involved with them. When a geologist finds a rock in the ground, it is not unusual for it to take at least 20 years for that finding of the rock or exploration to result in a commercial mine. Therefore, we have a time factor loaded into our need for all of these materials as well.

What this means is that all nations around the world are in competition for the same materials. Some countries have a head start. For example, China enacted its raw materials strategy many decades ago. As a result, it now controls mineral flows with regard to rare-earth elements, as well as cobalt. More recently, the US and Europe have published or updated their own mineral strategies, again prompted by the requirement for these materials for the energy transition.

Here in the UK, we have not been ignoring this challenge. The first ever critical materials strategy was published back in July 2022 by a cross-Whitehall group that was led by BEIS. The strategy highlights many different factors, but one of the key areas of emphasis is around the need for us to enhance and share our scientific and technological expertise both within the UK and globally. This is particularly special because we have a lot of legacy with regard to mining here in the UK. We have seen where it has gone right. We have seen where it has gone wrong.

Therefore, perhaps we have a duty to share this prowess with the world, to ensure that where we are digging new raw materials out of the ground we do it in the most responsible way possible.

Why have we brought this submission here to the Science and Technology Committee when so many other parts of government should be and, perhaps, already are involved? The key to the UK's success in securing the materials that we need is in science and technology. We also have a stock of materials, either beneath our feet or within our waste piles, which we can recycle, but we still need a vast flow of materials to come into our country.

Our key to unlocking that is to share our science and technology expertise with the rest of the world, thereby unlocking global supply chains, trade deals, responsible markets and so on. Therefore, we need to come together as a wide variety of scientists to lead the way in recycling methodology, in designing of products, so that they can be reused and pulled apart, and in ensuring that we truly dig this material out of the ground in the most responsible way possible.

An inquiry would therefore ask three questions. First, are we as the UK truly set up to fund and run cross-science research projects into raw materials? Are we truly set up to do that?

Secondly, are we funding the right levels of research with regard to our technology readiness levels, especially given what has happened with Brexit and the change in our access to European research funding?

Thirdly, are we enabling our universities and institutions to educate the scientists of the future who can address these raw material challenges, despite negative social sentiment towards the mining sector?

For us as a country and as a planet to achieve the energy transition in a manner that truly benefits society as well as nature, we need to utilise fully our scientific and technological knowledge to work out how to find, extract, process, recycle and respect those materials that we dig out of the ground.

Chair: We need to stop there, I am afraid. Thank you very much. We have gone on for a little while, so I will take a bit of time off the questions. There was a lot to get through. Aaron Bell will start the questions.

Q34 **Aaron Bell:** Thank you, Dr Gordon. It is obviously a very important area. As you acknowledged, we have just published a critical minerals strategy. The role of this Committee is to make recommendations to Government. Obviously, we have not done the inquiry, but the Government will just point to the critical minerals strategy and say, "We are already on this." What extra do you think we could add by having an inquiry now?

Dr Gordon: We are already late to the game in making sure that we are part of the raw materials discussion and that we have that supply.

Therefore, we need to get on with making sure that we are unlocking where we have access to these materials.

From a science and technology perspective, one of the key problems that we have at the moment is that much of the research funding is bottom up. You have people in different research councils proposing research projects that might pertain to the environment or to other areas of engineering.

The problem that we have here is cross-disciplinary. As we heard from some of the other pitches, the key is collaboration. At the current moment in time with regard to raw materials, the research councils and the way in which we fund research here in the UK are not set up to push forward those interdisciplinary and cross-scientific approaches.

Q35 **Aaron Bell:** Where is it set up to do that elsewhere in the world? Are there other countries we would take evidence from that do this much better?

Dr Gordon: Yes. For example, in Canada they have a much more mature approach, perhaps, with regard to looking at cross-science funding. It is not something that has not been discussed here in the UK. In fact, if you go back to previous inquiries with regard to this, there has been encouragement to look at cross-science disciplinary research funding across all of science. It has just not happened in raw materials perhaps because, of course, mining traditionally has a bad reputation here within the UK.

However, the exciting challenge for us is to make sure that we—as the UK, when we are digging materials out of the ground, be it here or abroad—ensure that we only do it in the most responsible fashion, so that we enhance the benefit to the environment and society rather than just harvesting those materials out of the ground.

Q36 **Aaron Bell:** The fundamental question again is: "Why us?" You have acknowledged the BEIS element, but it also seems that this is a task for UKRI to get on top of. We obviously see UKRI regularly and we can make recommendations to them. Is it not for them to be organising this, given that there is already a Government strategy document out there on the problem? Is it not really UKRI's job to put this in place?

Dr Gordon: Yes. From a research perspective, UKRI are absolutely key in order to make this work. However, with this as well, we need to be able to provide these materials now. We have these net zero targets that are staring us in the face. While research is a critical part of this, we also need to get on with the rest of our consulting services—for example, out into the rest of the world.

That is something where, from research in science and technology, UKRI is absolutely fundamental to this, but needs to be held to account in making sure we are getting these cross-science conversations and research funding happening.

Then, we must also make sure that we are having those discussions that are pushed forward by industry, as well as by Governments, as well as by civil society and all the other stakeholders that are required within this mix to hold ourselves to account to say, "Let's not create a bigger disaster than climate change could pose to us at the moment." We could dig these materials out of the ground and decimate communities and decimate the environment.

We should not do that. On absolutely no basis should we do that. Instead, we have the opportunity to evolve and innovate technologies that allow us to create benefit, environmentally and socially, as well as, of course, providing those raw materials.

Aaron Bell: Thank you.

Chair: Thank you very much, indeed. Any of my colleagues? Rebecca, yes.

Q37 **Rebecca Long Bailey:** In a nutshell, would you agree that an inquiry would need to focus on, first, regulation around the sustainability of mining methods so that the industry was clear about best practice?

Also, there is reprocessing and regulation around industry about the need to have specific regulation in place to allow such minerals to be removed from products at the end of use. I do not think that exists at the moment.

Dr Gordon: Yes. The circular economy discussion is absolutely phenomenal with regard to this area. It requires us to be able to ask, when we are designing new products, can we then pull them apart? At the moment, it is incredibly difficult to pull apart some of those elements with regard to the alloys that are in at the moment.

Yes, there is a requirement in terms of how we design and how we build those products. There is also the requirement in terms of how we recycle products. At the moment, if you take a vehicle and it goes for steel scrap, the lower quality of scrap has lots of contaminants in it, but those contaminants are the likes of 0.38% copper. That is copper that we could be extracting and putting in as a pure raw material at the front end.

There is a lot of work to do, there is a lot of innovation that is needed. Some of it is regulation, some of it is research and we need to get on with it now. Thank you.

Chair: Thank you very much, indeed. Excellent.

That brings us in the blink of an eye to the end of our six pitches. May I thank, on behalf, I am sure, of all my colleagues, the six representatives for absolutely fantastic presentations and clear answers to our questions? Courtesy of Mr Speaker, you are going to sit in the public gallery for Prime Minister's Questions now, so you may want to give an appraisal of the pitch and the questions and answers in a little over an hour's time there.

We have a very difficult job to do. I have said to my colleagues before, of all the seven-hour meetings with Prime Ministers and chief advisers, the most difficult ones are where we are choosing our next inquiries because we are spoilt for choice. You have made that task happily more difficult for us today.

I warmly thank you for the time that you put into making your presentations, coming to give them in person and, of course, with your colleagues in your teams, the amazing work that stands behind what you presented to us today. Thank you very much indeed.