



HOUSE OF LORDS

Revised transcript of evidence taken before
The Select Committee on Science and Technology

Inquiry on

GENETICALLY MODIFIED INSECTS

Evidence Session No. 7

Heard in Public

Questions 65 - 74

TUESDAY 3 NOVEMBER 2015

10.40 am

Witness: Professor Christopher Whitty

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on
www.parliamentlive.tv.

Members present

Earl of Selborne (Chairman)
Lord Cameron of Dillington
Lord Fox
Lord Hennessy of Nympsfield
Lord Hunt of Chesterton
Lord Kakkar
Lord Krebs (co-opted)
Lord Maxton
Baroness Morgan of Huyton
Baroness Neville-Jones
Lord Patel (co-opted)
Lord Peston
Viscount Ridley
Lord Vallance of Tummel

Examination of Witness

Professor Christopher Whitty, Professor of Public and International Health, London School of Hygiene & Tropical Medicine

Q65 The Chairman: Welcome, Professor Whitty. It is very good of you to join us today. I know it was at fairly short notice. You are on your own. We were hoping you would have some support from elsewhere, so thank you for that. We are being broadcast by the web camera. Would you like to introduce yourself for the record? If you want to make an introductory statement, do feel free to do so.

Professor Whitty: I am Christopher Whitty, Professor of Public and International Health at the London School of Hygiene & Tropical Medicine. I should state for conflict of interest reasons that until six weeks ago I was also Chief Scientific Adviser at the Department for International Development, although I am not in any way representing the department now. I am a consultant physician at UCLH and the Hospital for Tropical Diseases and I chair a variety of specialist committees such as the Advisory Committee on Dangerous Pathogens.

The Chairman: We are very familiar with your expertise, particularly in the international development field. Let me start with a general question. Would you give us an overview of the current impact of insect-vectored diseases internationally, particularly the mosquito-borne diseases? How is international development funding from the United Kingdom used currently to control vector-borne diseases?

Professor Whitty: A very large number of the classical tropical diseases are insect borne, of which the biggest by some distance is malaria, although there are others. Then there are some more recent emerging infections, in particular dengue and chikungunya, which are also insect borne. The combined impact of these on global health is very substantial. Taking the latest WHO figures, most of which are from the last couple of months, so this is relatively up to date—and one can criticise the exact figures, but I think these are as good as you are

going to get—for malaria, the current estimate for the last year for which there is data is that there were around 214 million cases of malaria and around 438,000 deaths. That sounds a very large number, which it is, but it is a 60% reduction in deaths in the last 15 years. When I started in malaria work around that time, we reliably quoted over 1 million deaths a year, so that is a very major improvement.

For dengue, which is probably the second major vector-borne disease, WHO figures indicate there were between 50 and 100 million cases. It is quite difficult to tell because there is quite a large burden of asymptomatic or unrecognised infections, and they estimate around 22,000 deaths. The difference is that dengue is on the increase. Dengue has increased 30 times over the last two to three decades. Alongside it—and this has had rather less coverage from the witnesses you have seen so far—is chikungunya, which is a major vector-borne disease from the same vectors as you get for dengue. It has caused over 1 million cases in the Americas and the Caribbean. It does not kill very many people, but it does cause significant arthritis and long-term problems for people. They do eventually resolve but it can certainly last for years.

Alongside those are the classical diseases: filariasis, trypanosomiasis, sleeping sickness, lymphatic filariasis, which causes very significant disability, onchocerciasis and trachoma, which are two blinding causes. The mosquito-borne one of those is filariasis, but other insects are important, such as the tsetse fly for the trypanosomiasis and the simulium black fly for the onchocerciasis group. There are a number of more specialist things. Then there is a whole range of arboviruses, which are viral diseases passed on by mosquitoes, of which Japanese encephalitis is probably the best known. I could spend the rest of the Committee meeting listing out the exotic names of all the others, such as o'nyong-nyong, but I will not.

Q66 The Chairman: It would be difficult for the record to get the spellings right. Could you tell us something about the role of DfID, and particularly international development in the United Kingdom, and this control of disease, and who the other major players might be, whether Government or charity?

Professor Whitty: Yes, with the clear caveat that I am not speaking for the Government on this; I am simply giving an observation. There has been a fantastic reduction, particularly in malaria but also in the other vector-borne neglected tropical diseases, which is a whole group and includes things such as sleeping sickness. Let us start off with the UK and then move more widely. The UK in general and DfID in particular put a very large emphasis, on trying to reduce these diseases, both with financial support—it is widely on the record that the UK spends around £500 million a year on malaria control activities in the round—but also looking at neglected tropical diseases. The other thing, and importantly for this Committee, is that not only do they support the research behind this financially, but the UK has some of the leading thinkers, from the most basic biology right through to the most applied areas in almost all of the major infective vector-borne diseases. So the UK's contribution is substantial. The other major player is the United States, by a variety of different means, and then quite a lot of other donor countries contribute—countries which are not primarily affected. Increasingly and encouragingly, the burden of both preventing and treating these diseases is being borne by the countries themselves. The number of countries that are entirely or largely donor dependent is much smaller than it was 10 years ago.

The Chairman: Do international charities have a role in this?

Professor Whitty: Yes, they have a very major role both on the delivery side and on the research side. On the research side, clearly the Gates Foundation is the pre-eminent one, but the Wellcome Trust, here in the UK, is a major supporter of the science behind this, alongside the MRC, although that clearly is not a charity. Very many of the major advances have come from those three groups—so funding from the Gates Foundation, the Wellcome Trust and the MRC. There are also charities and NGOs which are involved very heavily in the delivery side: Save the Children, Médecins Sans Frontières under certain circumstances, and a variety of others. This is a cross-sectoral area. If you move on to the neglected tropical diseases, the private sector has also played a very much bigger role than is often appreciated, donating many of the drugs for the control programme, so it is a cross-sectoral approach.

The Chairman: Given that it is a cross-sectoral approach, how would you describe the degree of collaboration between these different partnerships on the international scene?

Professor Whitty: It is surprisingly good, at least at the applied end. The group of people involved in the delivery works well under the WHO aegis on the whole. Quite a lot of the funding comes from a small number of funding groups—Gates, Wellcome, DfID and USAID in particular—and the groups of people which fund and give the technical advice tend to know one another and are relatively cohesive in their approach. My experience is that the join-up is pretty good compared to many other areas of both international development and science. The UK has its own group called the UK Collaborative on Development Sciences—UKCDS—and that tries to co-ordinate the UK efforts of the various bits of government, the research councils and government departments, but also the Wellcome Trust.

The Chairman: Given that this is an emerging technology, with lots of regulatory issues clearly emerging—and we find this in the evidence we have been taking—do you feel there is a role for these stakeholders that you have just been describing to collaborate and ensure that an international dialogue can be undertaken on how the possible benefits and disbenefits can be assessed and regulated?

Professor Whitty: In principle, the answer is yes. In a sense, within your question there is a whole series of assumptions, some of which I accept and some of which I do not fully accept. One of the assumptions is that this is an important technology for public health. For the sterile male technique equivalent technologies, it is possible but at the moment it is looking relatively niche. That may improve. For the replacement technologies, I have to say it is pretty speculative. The question is whether you are starting from a public health impact point of view or from a science point of view. From a public health impact point of view, this is a footnote on a footnote at this point in time. That does not mean it will necessarily remain that way. If you think about it from a science point of view, these groups of people are largely in the “How do we solve the practical problem?” end of co-ordination rather than the “How do we start with the best basic science?” end of the problem, which tends to be more in the research council space.

Lord Peston: I want to make sure that I understand what you have said. For example, you said that the number of people dying from malaria in the relevant countries has gone down. I think you said that categorically. Am I right then to say that is not to do with the research into the insects that we are looking at but is to do with other things? In other words, the research into the insects, which I assume our report will be about, has yet to have a payoff. Would that be a correct interpretation?

Professor Whitty: It would be a correct interpretation only in the narrow sense of GM insects. The incidence of new cases of malaria has gone down by about 37% and the number of deaths has gone down by about 60%. I just quoted the deaths. The incidence has gone down almost entirely due to advances in the management of the vectors—the insects—whereas the deaths, which are obviously on top of that, are on the human side. When you think about the problem of all these diseases, there are two sides of the equation you can operate on: the human side and the vector side. For some of them, you only operate on the human side; there is absolutely no point in going for the vector side. For example, we can control yellow fever completely with the yellow fever vaccine and we do not need the vectors, but for malaria it is a mixture of both.

Lord Peston: Thank you. That is very much a clarificatory answer.

Lord Maxton: What exactly are the technologies being used to reduce the incidence of malaria and the deaths from malaria at the present time?

Professor Whitty: Let us start off with the incidence, because that is clearly the one that is most relevant to this inquiry. The most important one is attacking the malaria vectors, and the majority of malaria vectors which cause the majority of the disease are in Africa. Fortunately, the great majority of them bite in a relatively stereotypical way—at night usually between midnight and 3 am, although there is a spread around that—and the most important of the mechanisms has been insecticide-treated bed nets. The big advance in the last 10 years is not one in basic science but in manufacturing—first in the manufacturing of long-lasting nets and secondly in the distribution. In 2000, about 10% of people were under bed nets, but now the figure is up to 40% to 60%, depending on which country you talk about. It is the science of doing it better plus a bit of engineering, using a technology—the combination of insecticides and bed nets—that has been around for quite a long time before that. That is the main one.

Lord Maxton: What insecticide is used in the bedding?

Professor Whitty: For bed nets specifically, it is a group of insecticides in the pyrethroid class of insecticides. If you are doing residual wall spraying, which also works very well for reasons I can explain if that would be useful, you have the opportunity of using DDT, which is a long-lasting insecticide. The problem we face is that there is insecticide resistance developing quite strongly now to both these insecticide classes in the mosquito populations of Africa. The impact on disease is not yet there, but I think it is only a matter of time before it becomes a very serious problem. If I can say what the clear and present danger is at the moment, it is the thin pipeline of new insecticides, which is due to a whole variety of issues, including political and regulatory issues. That is our immediate problem, but clearly there are other areas as well.

Q67 Lord Krebs: My question follows from that because you said, if I can quote back to you, that at the moment GM insects and the kind of technologies we are looking at are a footnote on a footnote. Why do you hold that view? Given what you have just said about the present mechanisms of using insecticides, bed nets and so on in relation to malaria, if they are beginning to run into problems, ought not GM insect technology be part of the armoury, and it may become much more important in the future? Then there are diseases other than malaria to which you alluded, where perhaps the kind of control measures you referred to

for malaria may be less effective. Could you unpack why you said it had such a small role at the moment?

Professor Whitty: Absolutely. Let me stick to malaria. I want to be clear that when we come to dengue and the Aedes-transmitting mosquitoes, the opportunities for GM technologies are greater, but for malaria, my own view—and I think this is a pretty middle-of-the-road view—is that, even potentially, the opportunity for these technologies is small. Let me explain why that is. Lord Krebs, given your background, I hope you do not mind if I do a very simple bit of maths to explain why it is I think these technologies are unlikely to be very major. If R_0 , the force of transmission of malaria, is 1, then one person gives it to one person who gives it to one person and the disease is stable in the population; if it is less than 1, it is dying out; if it is more than 1, say 2, then two people give it to four, and so on. In very large parts of Africa the R_0 formula is over 100, so you have to come down a very long way.

Probably the most useful mathematical model in infectious epidemiology is a very simple one and a very old one. It was devised by a combination of Ronald Ross, who won the first UK Nobel Prize for Medicine, but for a different purpose, which was for his discovery relating to mosquitoes, and George Macdonald in the 1950s. It basically says—and I am simplifying it, but not much—that the vectorial capacity, which is the R_0 equivalent, is proportional to m —density of mosquitoes— a^2 , their man-biting habits, squared because they have to bite once to acquire and once to transmit, and then p —probability of survival after they have bitten—to the power of n , which is the number of days in the intrinsic cycle.

I am sorry I have hit you with maths, but the reason for that is that if you want to reduce malaria by killing mosquitoes, you are going to have to kill a lot of mosquitoes. It is very inefficient as a way of delivering malaria control. However, if you shorten the life of a mosquito that has bitten a human or is about to bite a human—you get several hits at this, because at any time between the time a mosquito bites and it becomes infected and the time it becomes infectious, which in tropical countries is between nine and 10 days and in Europe is higher than that—that mosquito does not transmit. Because it is to the power of nine or 10, that is enormously efficient. With the most efficient methods, which include bed nets and indoor spraying, you can reduce their probability of survival by, let us say, 20%, but because it is to the power of nine or 10, that is massively efficient in reducing transmission, whereas reducing the number of mosquitoes, which is what we used to do, is extraordinarily mathematically inefficient, leaving aside the very large populations involved. That is a fundamental flaw with any method that seeks to reduce numbers as its basis. It is not a very efficient method. There is a number of other reasons as well, but that is the fundamental one.

Lord Krebs: But the maths could be different for different diseases.

Professor Whitty: The maths is different for different diseases, but the basic equation is applicable to the majority of vector-borne diseases. This is the big difference with vector-borne diseases compared to, let us say, screwworm, which is often used as the example from sterile male technique working. The problem with screwworm is the screwworm itself, whereas for vector-borne diseases the problem is not the vector; the problem is the disease you get, so these mathematical advantages from intervening at different parts of the cycle start to be a lot more important.

Lord Fox: You mentioned that the pressing need is probably more for insecticides rather than other technologies, not least, I guess, because, as you just said, it is part of that barrier

at that point. Is there any sense that the technologies we are talking about—GMO insects—are distracting from the resources or attention to the insecticide development which you feel is more important?

Professor Whitty: No, I do not think there is any reason to think that, because it is a relatively niche product. Those who are supporting them, including the Wellcome Trust and the Gates Foundation, all say this is a niche product. It is possible that we may find uses for it in due course, but no one is diverting large amounts of resources or anything else. My slightly bigger concern is that, if you read some of the colour supplements, you get the impression that GM mosquitoes are going to solve the problem. What we found in the past is that, whenever you have a technology where people grow to believe that something can solve the problem when it will not, that can reduce people's feeling of urgency, and there is serious urgency to deal with this.

Lord Fox: That was really the sense of my question.

Professor Whitty: There is no diversion of resources that is in any meaningful sense a worry, no.

Q68 Viscount Ridley: Thank you for the clearest seminar on population dynamics since Lord Krebs taught me the subject 40 years ago, which I have forgotten in between. Can I bring you to dengue in general and chikungunya, as well as Europe and the UK? First, you said that dengue has increased 30-fold. I presume this is largely because of the spread of the mosquito rather than the disease—the day-biting tiger mosquito, the Aedes, or am I getting muddled here?

Professor Whitty: No, you are not getting muddled at all.

Viscount Ridley: How much further is that going to go? Is it going to travel to the UK? I do not want to be too parochial about it, but give us a feel for that question.

Professor Whitty: There is a certain amount of hand-waving about exactly what the reason is, but it is a combination of the spread of mosquitoes, which is due primarily to transport links rather than anything else, plus changes in habitat. Many human habitats, particularly ones without piped water, are perfect for the major vectors. There is a major and a minor vector for these two diseases, both of which are Aedes species. Aedes aegypti is the major species in most of the tropics and is an efficient vector for the mathematical reasons I gave earlier, which are that it takes most of its blood meals from humans and that is squared, which therefore makes it more efficient. Aedes albopictus is the other vector.

The reason I have differentiated those is partly that the GM technology around—the Oxitec technology—is aiming at Aedes aegypti, which is the major vector in many countries, and also that the Aedes albopictus, which is the Asian tiger mosquito, can overwinter through its eggs, which Aedes aegypti cannot. Although, from time to time, Aedes aegypti can establish itself in the UK, and we have had reports of that going back to the 1910s, it dies out, whereas Aedes albopictus, in principle, can overwinter in the UK—probably in lowish numbers, but it can do it, and certainly it has started to move up through Europe for a variety of reasons. The contribution that climate change adds to that is very debatable but the fact is it has moved. That is the vector of these diseases which is probably the bigger concern in Europe.

Viscount Ridley: Both dengue and chikungunya?

Professor Whitty: No. Just as from time to time there are transmissions of malaria in Europe, and in theory there are mosquitoes in the UK that can transmit malaria, from time to time there are transmissions of dengue and chikungunya in Europe, but so far they have not taken off as a major problem. With the number of albopictus there are now in southern Europe, there is at least the potential for epidemics—not on the Latin American scale, because, as I say, it is not a hugely efficient vector, but certainly on a significant scale.

Viscount Ridley: Could you touch on the West Nile virus?

Professor Whitty: West Nile virus is a Culex-transmitted virus. The main vector in this part of the world, ie Europe, is Culex pipiens. There are no major ones in the UK. There is a sub variety that lives in the London Underground, but I do not think that is a major worry. As far as we know, it is not a vector, but certainly some of the more efficient vectors are there in central Europe. There is a slightly higher risk that those could move to the UK but I would say slightly, not very.

Q69 Lord Cameron of Dillington: As usual, Professor Whitty, the enthusiasm of this Committee means that even if I am asking only the third question, it has already been answered. If I was an anti-GM campaigner, I would probably pick up on what you have been saying so far and say that GM is not worth very much and there are other more effective methods of controlling malaria, for example. Could you outline some of the drawbacks? How effective is bed netting? You have talked about the reduction of cases. Where are the weaknesses and where do you think GM mosquitoes in the future could have more effect?

Professor Whitty: To be clear, I have gone firmly on record saying that where GM is useful we should use GM. I am not an anti-GM person at all on this, but always you have to balance both sides of the argument: do not overstate the disbenefits but do not overstate the benefits either. If any GM person grabbed on to what I said to say we should not do GM, I would strongly reprimand them, if I had the opportunity.

We have quite a large number of efficient ways of dealing with malaria at this present time, with the big caveat about the rise of insecticide resistance and, in due course, drug resistance. I think, personally, neither of those is going to be solved by GM insects. When it comes to Aedes on the other hand, I think the number of options we have is much smaller, so the ability to target Aedes is poorer. There are broadly two approaches. The first is to reduce the habitats, provide people with piped water, cover pots and so on, but also in epidemics to do fogging, which is where every couple of days you push insecticide up into the air. That has a whole series of pretty obvious ecological downsides to it, because these are non-specific, broad spectrum methods.

In those kinds of areas, the advantage of a more targeted approach, which is what GM potentially offers, has some very clear attractions. The other potential attraction of GM technology is that it is the only technology when you are trying to eradicate or eliminate an insect which gets more efficient the closer you get to the end point. I am talking about the sterile male rather than the change in population method. That is because you start off with a situation where, let us say, your sterile or soon-to-be sterile males are one to one with the population and, as time goes by, the number of sterile males stays the same, the wild type goes down and eventually you end up overwhelming them with numbers. That is the theoretical advantage. In reality, the evidence that this is an effective method has still to be

case proven, but there are some attractions to it. It is for those kinds of relatively niche but quite important areas that I think we should be considering this.

The Chairman: You say that there are some attractions, but it is important that we do not overstate the opportunities. We must keep a clear view that has to be looked at on its own merits. You described it earlier as a footnote on a footnote. Would you explain how you reconcile those two observations? To my mind you have sold it quite well, but a footnote on a footnote seems to be of vanishingly small relevance.

Professor Whitty: I used to enjoy reading my footnotes. The thing to understand is that there are multiple other experimental technologies and techniques which are being used. Let us take dengue. There are two completely separate strands of work which have multiple sciences attached to them, one of which is around dengue vaccines. We now have a vaccine that is probably about 60% effective and 80% effective at preventing severe disease. That probably means we can improve on that, so the human side is improving.

In Aedes control, there is a whole variety of new methods being used, ranging from giving ivermectin, which is something which any of you involved in farming will probably be very familiar with, as seed corn to birds so that when the mosquitoes bite the birds they die, through to wolbachia infections with bacteria, which prevent the mosquitoes becoming infected via another form of biological control that works pretty well but has some quite serious side effects, through to trying to infect them with a variety of new fungi. This is one of a very large number of approaches, most of which will probably bite the dust in reality, because what you want at the end of the day is something that is effective, cost-effective and able to be maintained for long periods of time. It is possible that GM mosquitoes are one of the technologies that will see its way through to the finishing line, but there is a high chance, in my view, it will not. I think it is worth exploring just for that reason. What I would not want to do is think this is the only experimental technique. There are lots of others.

Lord Fox: You have singled out the sterile male technique. Is that because you dismiss the others or because that is the only one that is far enough down the track for you to assess?

Professor Whitty: I was using sterile male in the very loosest sense, as in anything which aims to reduce the population via mating, whether it is sterile male or through to the Oxitec mechanisms, which I think have some attractions. I must admit as a public health person I have quite a bit of scepticism—this is a personal view—about the population replacement models.

Lord Fox: The gene drive-type things.

Professor Whitty: There are multiple steps in the logic that these things have to work, for each one of which the probability is significantly less than one. It has to work by reducing transmission. You have to have a gene drive system that works as well. That gene drive system has to have nothing attached to it that you do not want. That is a big risk. The gene drive system has to get through huge populations which are incredibly well adapted and fit. The population of Anophelines in Africa is massive. It has to have no significant resistance early on in a situation and no disbenefits that you realise too late when you have let the thing go. Then it has to be cost-effective. To get a high score in each one of those boxes strikes me as not impossible but fairly improbable.

Q70 Lord Patel: Thank you for your evidence. It is very revealing on the science side, but I am going to be a bit more challenging to you. You said that your view about GM insects is a middle-of-the-road view. Is that correct?

Professor Whitty: That is correct.

Lord Patel: What is the mainline view?

Professor Whitty: What I have said is that if you took 100 entomologists and asked them these questions—but under anonymity so they were not going to have their grants removed by people who back this more strongly—the majority of them would say, “This is a lovely theory. I think the science is great. I hope they get an FRS, but this won’t have any impact on disease”. That is my own view.

Lord Patel: Why should we invest in the science of this technology at all?

Professor Whitty: There are quite a lot of things where you should invest on the basis that this is an interesting bet and it might have an impact in due course that you do not know about. For example, whilst I am cautious about some of the claims made for malaria, let us say theoretically a zoonosis emerged that could be transmitted by insects unknown, where those insects took up residence in the UK and where this was an efficient way to eliminate the insects from the local population; we would then be thankful we had gone quite a long way down the technological line, without necessarily believing the rhetoric that these things were going to solve current problems. The idea that this is going to solve current problems, apart from dengue, under certain niche conditions, strikes me as a low probability, but the possibility that this technology might become useful at some later stage strikes me as entirely plausible. For that reason, I am certainly not against investing in it, but what I would not want to do, to go back to a previous question, is take money away from, let us say, investing in getting new insecticides into this technology on the basis that these are somehow comparable. That does not strike me as realistic.

Baroness Morgan of Huyton: I am intrigued by what you have been saying about insecticides. I am not a scientist, but it sounds to me as if you think insecticides are almost neutral and there are no negatives associated with them, whereas I think it is right to say we have received a fair amount of evidence from other people of a concern about needing stronger and stronger insecticides in order to combat these diseases. Is any part of you anxious about our overdependence on insecticides?

Professor Whitty: Let me be clear that I differentiate very sharply between insecticides for human disease use—if you have a disease which is killing over 400 thousand children a year, that is a serious problem—and spreading insecticides more widely for marginal gains in agricultural use. I am not saying even that the second of those is inappropriate; I am just saying there is a spectrum. The insecticides we are talking about are used under very narrow circumstances. They are used in houses, either on walls or on bed nets. The environmental impact is completely different from using them in cotton production. Again, I am not knocking cotton production; I am just saying clearly there is a risk. No one is going to use an insecticide if there is no disease, but the trade-off between the risk of malaria and the risk of insecticide is so hugely on the side of using insecticide appropriately that I do not think anyone rational looking at it is going to say we should not be doing that. Clearly the trade-offs become more balanced the more widely they are used and the lower the marginal gain you are going to achieve. That is where I would differentiate. Incidentally, the difficulty we

have with insecticides for human use, on the other hand, is they have to be safe for humans. If you put a bed net around a child, that child is going to suck that bed net. Having an insecticide which kills insects but also kills children is not good news. Our problem is designing effective insecticides that are also non-toxic to humans.

Q71 Lord Peston: We may have pre-empted some of Lord Cameron's question, but he still led us into an important area. Again, I would like some clarification. Do you agree logically that the fact that something is working or doing some good does not mean you should not look at other things as well? To take an obvious example, what many of the countries in sub-Saharan Africa with which we are concerned need is access to clean water. If I was asked what I would spend my money on first, I would say, "Guarantee a clean water supply for everyone in those countries". The second thing they need is a decent transport system if they need to get to hospital quickly. I would not infer from that that all the interventions you have talked about therefore are a waste of money. I take it that a multi-intervention approach is what you are trying to get over to us. Is that right?

Professor Whitty: That is absolutely right. If you take malaria, clearly everyone would agree that we need to have a combination of things that would: reduce the incidence via vector control; reduce the incidence via controlling cases early, because that also has an impact on number of cases, though a lesser impact; reduce the number of people who are getting severe disease; and reduce the number of people who are dying. Each one of those has a slightly different approach and in reality you need several approaches for all of them. You have a bundle of approaches. My caution about GM for malaria specifically is largely because I do not think the mathematics stacks up compared to alternatives, not because in principle I am against the idea that you should have a portfolio of things you are doing—clearly you should.

Viscount Ridley: Just to follow up on that, are you guiding us towards saying, "Look, this may not be a terribly important technology at the moment for human vector-borne diseases but, for example, for insect pests in agriculture it could be a far more important one"? You mentioned screwworms and things like that. I know that is not your area of expertise but, given what you said about insecticides in agriculture, and the fact that this technology should work better when you are trying to target the insect directly rather than as a vector, are we right in concluding that this technology could be very valuable in agriculture but might only be a niche thing in human vector-borne diseases?

Professor Whitty: Starting with agriculture, I certainly think the logic of using it when your main aim is to reduce the total number of insects because it is a pest makes it a lot more attractive, because there is not an alternative, whereas when you are dealing with vector-borne diseases, you are dealing with mathematical non-linearities that favour alternative approaches, essentially. That is a rather pompous way of saying that it is not very efficient just to kill lots of mosquitoes. That said, I do not want to imply that there is no role for this in the management of *Aedes*, which is what Oxitec is doing. The role of it is not yet clear. Fundamentally, it is going to come down to the question of under what conditions and what is the most cost-effective or ecologically non-damaging approach compared to alternatives. I do not want to say that it is completely useless at all; that is not my point. My point is simply that it is a relatively small product at this point for that disease. Where I get nervous is when people make wild claims, in my view, for diseases such as malaria, where there are multiple alternative routes which seem the more logical bundle of things to do.

Q72 Lord Hunt of Chesterton: You have mentioned dengue once or twice. I have been to meetings on climate and, as I understand it, dengue is one of the diseases that, as you commented, in central and eastern Europe is a growing danger. In those areas with a greater propensity in Europe or eastern Europe, are those countries looking at research on this? Are they taking this idea of GM insects as one of the techniques, or what is being done about it?

Professor Whitty: I regret to say—and this is ignorance on my part—that my knowledge of GM insect research in central Europe is zero. I am not aware of any, but that does not mean it is not going on. It is not an area I have looked at. It is not my own area of research.

Lord Hunt of Chesterton: You did say, as I understood it, that dengue was a disease where this technique might be useful.

Professor Whitty: Yes, that is the case and if I was worried in Europe I would not be going down the *Aedes aegypti* line; I would be going down the *Aedes albopictus* line. I would be aiming to look at this particular technique but in a different mosquito vector.

Lord Krebs: I would like to come back to this question of efficacy. When Oxitec submitted evidence to us, one claim from their trials in Brazil was that it has reduced the population of the vector by more than 90%. Could you help us to clarify whether a 90% reduction in the vector population is an effective way of controlling dengue or whether this other point you referred to in relation to malaria about the lifespan of the individual vector is more important?

Professor Whitty: There are two sides to that. First, it has a relatively effective but linear impact on disease. The Ross-Macdonald equation works potentially for all vectors. The time in the mosquito is shorter for dengue, so the advantages are smaller. It is probably seven to nine days rather than nine to 14 days. You should also remember that killing *Aedes* is not in itself that difficult. The problem is that they rebound incredibly quickly. They have a very fast regeneration time so, essentially, you have to maintain the pressure on them for very long periods. The problem with killing *Aedes* is not killing them; it is killing *Aedes* in a cost-effective way that does not cause other damage due to the very widespread use of insecticides.

Lord Hunt of Chesterton: My second question was to do with how the scientific community is dealing with this question in discussion. Does the scientific community advocate more regulations? There is the government world that you were in but now you are a scientist in this other world and, obviously, the non-governmental scientific community has some input into policies and regulations. Do the issues we are talking about here have a good and effective focus in the non-governmental scientific community?

Professor Whitty: I would not want it to stand that being in government means that you are not a scientist; I think it is possible to be both. My view is that there are at least two and possibly three different discussions going on, and they do not get connected. There is a group of discussions by people who are in public health and they start from, “Okay, we have got this problem; what are the multiple solutions we could use and what is the most efficient bundle of them that is going to get us there?”, and they do not tend to talk about GM mosquitoes much for the reasons I have just given. Clearly there is then a group of people who are interested in insect biology, and they talk a lot about this because they are interested in the fundamental science. As I say, I do not want to imply that there are not potentially very significant spin-offs from that, but they do not tend to be starting from the

problem. They often talk about malaria or dengue in their grant applications, but that is only two lines and the rest is fundamental science. There is nothing wrong with that, but that is the way it is. You have those two conversations going on. The closest there has been to joining them up is the WHO document, in which I had no part, so I can say this without any conflict of interest. I thought it was a pretty thoughtful and sensible attempt to be balanced in its approach. It does not say anything about regulation but it does provide a framework for thinking about these matters in a broader sense.

Lord Hunt of Chesterton: The WHO is effective in bringing the scientific community and the governmental side together.

Professor Whitty: As it should. My view is that that is very much part of its central function. I think it is one of the things it should be doing. In this case it seemed to me a sensible and appropriate document.

Lord Hunt of Chesterton: In many of these United Nations agencies, which I knew about, they have the regular programme and then they have extra-budgetary programmes. Does the UK contribute to both?

Professor Whitty: I am in danger of getting into what I am not allowed to do which is to defend the UK Government.

Lord Hunt of Chesterton: I just asked what they did.

Professor Whitty: My simple answer is that the UK Government do both. There is a more complicated answer, which I think you need to ask a Minister about.

Lord Hunt of Chesterton: That is useful, thank you.

Lord Maxton: You mentioned the difference between agricultural use and human use. Is agriculture the only industry? It springs to mind that the tourist industry is affected by insect bites. In the west of Scotland it is the midge, but more particularly it is the side effects of drugs you have to take if you go to places such as Kenya, for instance, in order to combat malaria, which has an impact upon the tourist industry.

Professor Whitty: Absolutely. Let me take two examples, one from human health and one from potentially human health. On human health, an area where a sterile male or equivalent technique for *Aedes* would strike me as very attractive is in tourist islands in the Maldives, where they depend on tourism very heavily for their economy. It is an island so therefore you can eliminate an insect and its re-invasion will take quite a long time. It is controlled. It is not going to go anywhere¹. That seems to me an ideal example of the kind of area where a sterile male technique might be the right tool. That is one example.

The midge is an interesting one. Clearly, it is a pest. Being a detribalised Highlander myself, I am well aware of the downsides of Highland midges. What we do know is that the last two serious animal diseases into the UK—bluetongue and Schmallenberg—are both midge transmitted. That has demonstrated the principle that midges, of which the UK has a lot as opposed to other vectors, can transmit quite serious diseases. There is no principled reason, in my view, why in due course a disease could not emerge that was midge transmitted. In that situation we would not just think about this as a tourist problem; we would see this as a public health problem. We have to think a little bit ahead about this.

¹ Following the evidence session Professor Whitty added: using insecticides near coral reefs is not ideal.

Viscount Ridley: Would you be prepared to comment on Lyme disease? I know it is transmitted not by an insect but by an arthropod.

Professor Whitty: There are a number of potential and real tick-transmitted infections in the UK. It is the one area where we do have that. Lyme disease is the most important but it is still a relatively small number. The PHE numbers are around 1,000 a year. Clearly, the true numbers would be higher than that, but nowhere near what you would believe if you read some of the more hysterical press commentary. It is not a huge problem in the UK, but it is an issue. That is a sort of bacterial disease and we have a viral disease, louping ill, which affects primarily sheep and red grouse but can infect humans from time to time, and, in theory, we have a parasitic disease, babesiosis. Tick-borne diseases exist already in the UK and, in principle, there is no reason why there could not be others.

Q73 Lord Fox: You have indicated quite clearly that you think this is a niche, but you have also indicated that we should perhaps place a bet or buy a potential insurance policy for what may happen. Who and where should that money come from? Clearly with the Gates Foundation and the Wellcome Trust we are seeing philanthropic organisations and we have heard opinions from some of the evidence that it is not really a business model. Should this come from the international development funding from the UK rather than medical research? Where should we invest from in this?

Professor Whitty: I need to be careful in answering that I do not appear to be giving advice to my very distinguished and able successor in my previous role. However, with that caveat, I would separate out a variety of different issues. Let us take malaria as an example. DfID has taken the view that its primary aim is to reduce the number of people who die from malaria and the number of pregnant woman who get malaria and so on. The Gates Foundation has taken as its primary aim eliminating malaria, where it can be eliminated. Those lead to very different strategic and then tactical decisions about what should be backed. If I think about elimination, I would think a bit more seriously about GM products because they may have niches in areas where nothing else works. If I am trying to stop children dying from malaria in northern Nigeria, it is about getting new insecticides and about how to get children not sleeping under a bed net to sleep under one. I would be cautious about diverting that away. On malaria that would be an answer.

Dengue has a slightly different set of answers. I will defend a decision that I took about the advice I gave around a dengue vaccine. I was doubtful that UK development funds should be put into a dengue vaccine, not because I did not think it would work—I thought the science was moving in the right direction very rapidly—but because this is primarily a disease which has affected middle-income countries with highly developed biotechnology systems, such as Brazil and India, and where there is a big travellers' market, so it seemed to me likely that the private sector would move into this and they would happily take our money, but whether or not we were there, they would deal with this. That is indeed what happened. Sanofi Pasteur, which did the first vaccine, refused public money I gather, because they did not want to be bound by all the conditions on pricing that would come with that. There are slightly different arguments depending on what it is you are talking about.

Lord Vallance of Tummel: Is that a generic approach that a government department would take? In other words, it would look to see whether the private sector would take something up before it decided to put public money into it.

Professor Whitty: I would be very cautious about speaking for other government departments. My own logical answer to that would be that the question is whether all you are doing is providing money which they would have used anyway, so in a sense it is completely fungible money, or whether you need to pump-prime or provide some degree of subsidy essentially to get something through that you want. I realise that is a very bland answer.

Lord Vallance of Tummel: You take a judgment as to whether the market would work or not.

Professor Whitty: Yes.

Q74 Lord Hennessy of Nympsfield: Given your warnings about the danger in overselling GM techniques, how do you think the public debate should be shaped about this? Do you think it needs stirring up or is the worry that it might spill over into a version of GM foods and the Europeans then get agitated in their role of congenital snag hunters?

Professor Whitty: I wrote an editorial for *Nature* in which I said we should be trying to make sure that Africa and Asia do not catch the European irrationality on GM for crops. In my own judgment, there is a danger on GM that we had people on the one side massively overstating the risks and disbenefits but also people on the other side overstating the potential benefits, and then they are easy to shoot down. The public sit in the middle. If they feel you are being very straight with them and saying, "Let us not exaggerate the benefits, as there are some clear benefits here, but also let us not exaggerate the risks", that seems to me the right approach, and that is what I am arguing for here. Let us not get carried away but also let us not dismiss it.

Lord Hennessy of Nympsfield: May I have a footnote on a footnote? It is the midge question. Is the science there to eradicate midges in the Western Isles and the Highlands? This could save the union, you know.

Professor Whitty: The short answer is no, without doing things that would be so draconian and environmentally unacceptable that it would simply not be a runner.

Lord Maxton: That is a way of eliminating it.

Baroness Morgan of Huyton: Could I go back to the previous question? You were describing the type of public debate that is required, with which I suspect we all agree, and that is to get the balance right. Who on earth is going to orchestrate that? Who the public are going to believe is one of the questions we are grappling with.

Professor Whitty: The kind of report that I suspect your Lordships will come up with is exactly the kind of thing that is needed, which does the—

Baroness Morgan of Huyton: On the one hand and on the other.

Professor Whitty: —on the one hand and on the other, but we are being serious about this. We are not believing the most extreme on one end or the most extreme on the other.

The Chairman: Let me confess my own concerns about the danger of the public debate which I think you are encouraging us to recommend. It might be captured either by people who overstate the benefits or other people who might overstate the disbenefits or the risks. If the debate was held at the European level, one only has to see what has happened on GM crops to realise that that is not necessarily a very successful forum in which to conduct this particular exercise, and yet of course competence in this area lies to a large extent at the

European level. We must not overstate any potential beneficiaries, but you suggested there might indeed be niches where this could be usefully deployed, although it remains to be seen. Surely such beneficiaries should have a stake in the dialogue. It is quite difficult to structure a dialogue where some of the beneficiaries might be places such as the Maldives, as you have described, or it might be somewhere else. How would you like to see such a dialogue structured where we have the opportunity for people who are not going to take extreme views but who have a relevant interest to participate, so that eventually when policies have to be made by national Governments or organisations, such as the European Union, they are informed by that sort of debate?

Professor Whitty: I am straying beyond my own skillset as a scientist, but let me point to the role that small island states have had in the debate on climate, where they have been one of the most powerful advocates for getting the science right and understanding the impact of climate issues. Certainly Brazil, where the Oxitec experiments are going on, is more than capable of having serious debates around technology. They have one of the best science/technology/research nexuses in the world and, although one can call them out about the politics, the fact is that Latin America has been surprisingly successful in having technical debates between scientists and the public, often cutting out government completely in doing so. I do not think it is impossible to do, but I am definitely not the expert to say how it should be done.

The Chairman: Who should advise us on this issue?

Professor Whitty: I suspect the people around this table have a much better idea on that than I do.

The Chairman: That is a very helpful answer, thank you. We have probably come to the end of our questioning. I am very relieved that you were on your own because you have been able to impart so much information to us in a relatively short time and we would not have wanted it diluted by a further contribution. Thank you very much, Professor Whitty. You have been enormously helpful to us.