HOUSE OF LORDS

Science and Technology Select Committee

Corrected oral evidence: Ageing: Science, Technology and Healthy Living

Tuesday 4 February 2020

11.35 am

Watch the meeting

Members present: Lord Patel (The Chair); Lord Borwick; Lord Browne of Ladyton; Baroness Hilton of Eggardon; Lord Hollick; Lord Kakkar; Baroness Manningham-Buller; Baroness Penn; Viscount Ridley; Baroness Rock; Baroness Walmsley; Baroness Young of Old Scone.

Evidence Session No. 12 Heard in Public Questions 95 - 106

Witnesses

Professor Ann Blandford, Professor of Human-Computer Interaction, UCL; Professor Esther Rodriguez Villegas, Professor in Low Power Electronics, Imperial College London; Professor Ferdinando Rodriguez y Baena, Professor of Medical Robotics, Imperial College London; Dr Ewa Truchanowicz, Managing Director, Dignio Ltd.

Examination of witnesses

Professor Ann Blandford, Professor Esther Rodriguez Villegas, Professor Ferdinando Rodriguez y Baena and Dr Ewa Truchanowicz.

Q95 **The Chair:** Good morning, ladies and gentlemen, and thank you for coming to help us with our inquiry today. We appreciate it very much. We are not too sure whether the parliamentary television channel will continue to televise us or whether it has found something better in the House of Commons, but we will pretend that it is continuing. However, this session is certainly live-streamed on the internet.

Before we start, if you do not mind, and starting from my left, perhaps you could introduce yourselves for the record. If you have any comments to make, please feel free to do so. Once you have done that, we will continue with our questions.

Professor Ferdinando Rodriguez y Baena: I am professor of medical robotics at Imperial College. I lead a group called Mechatronics in Medicine, which has been operating for almost 20 years. I recently became the director of a larger centre called the Hamlyn Centre for Robotic Surgery, which basically covers a range of technologies from the foundational to the translation stages in the areas of sensing, imaging and robotics. Clearly, my technical expertise is predominantly in robotics, but I have recently acquired additional oversight over some of the other activities in this space.

Professor Esther Rodriguez Villegas: I am professor in low power electronics at Imperial College London, where I also founded and lead the Wearable Technologies Lab. In the lab, we identify big social problems that technology can solve and we develop wearable technologies as medical devices. We solve the problem from the beginning to the end—all the way to the patient. As a consequence, I founded two start-up life sciences companies. One of them specialises in creating wearable medical devices with a focus mostly on chronic respiratory conditions.

Professor Ann Blandford: I am professor of human-computer interaction at University College London. Human-computer interaction means that I focus on how people interact with technology in the real world, so listening to the previous session was fascinating. I am also deputy director of the UCL Institute of Healthcare Engineering, focusing specifically on digital health, and I am on the executive of the UK Computing Research Committee.

Dr Ewa Truchanowicz: I am the managing director of Dignio Ltd, which is the UK branch of Dignio AS, a Norwegian connected healthcare company. The Norwegian parent company has been around for 10 years. We have a connected healthcare solution which is user-centric at both the patient and the clinician ends. We see our solution as part of a greater puzzle. We talk to other systems, which can send our data to other destinations. We are very interested in interacting with AI and big data projects.

We are also very interested in removing barriers to the uptake of digital technology. Our solution is software as a medical device, so it not a well-being app. It is a medical device-grade software platform with a patient-facing app called MyDignio, and there are third-party hardware medical devices that are all clinical grade. Our purpose is very much to prevent, but when we cannot prevent it is to detect deterioration in a patient early on to remove any potential worsening of their condition.

Our purpose is also to support patients in managing themselves and their living. The ultimate goal is to allow people to stay in their own homes, live independent lives and have unobtrusive devices that are not attention-grabbing but provide solutions for the patient. We aim for solutions with nice-looking designs that enable patients to remain independent and economically active for as long as they choose to do so.

Q96 **The Chair:** Thank you very much. That was an interesting introduction. It has made me deviate from my question to ask you what the environment is like in the United Kingdom for you to do this kind of research—to develop technologies that will help people to live independent lives in old age. What technologies do we already have available, and if they are not used, why is that?

Professor Esther Rodriguez Villegas: I think the environment is sub-optimal. There are a lot of things to improve. Unfortunately, when we deal with wearable technologies, we have to differentiate between wearable technologies with wellness applications—I call those gadgets—and wearable technologies with medical applications, or medical devices.

Wearable technologies for wellness are not regulated, and because they are not regulated it does not really matter what the output is. Manufacturers do not have to commit to providing a level of accuracy—the output is uncertain. With a medical device, we have a regulatory framework. The technology is linked to an intended use and, as manufacturers, we need to guarantee that what we say is correct so that patient safety is not damaged. Unfortunately, we are trying to use those wearable technologies for quasi-medical applications, and that is where I think we are going wrong.

In terms of wearable medical devices, very little is available. They are limited to hearing aids, insulin pumps, some rehabilitation devices and devices to reduce pressure ulcers. Some other things are about to be introduced, such as intelligent underwear for incontinence, but that is it.

Why is there not more? The answer is that it is very difficult to create a wearable medical device, and the system does not help. I can elaborate on the reasons if you want or I can let others answer that.

Dr Ewa Truchanowicz: We have some current projects, because as a company we have a very innovative mindset. We always look to collaborate with academic institutions, and we look at Innovate UK grants and other streams of funding. The issue is that the funding is not always 100%, which immediately puts a barrier up if you are a small or medium-sized enterprise. Also, some of the requirements and expectations of the outputs can be quite burdensome for some. The administration required

to run some of the recent grants has varied across the different funding streams. Some funding streams are so loosely worded that you can slot pretty much anything under the research questions.

In my opinion, there should always be a requirement for collaboration with academic institutions and the NHS, and potentially also with social care. Our philosophy as a company is to work very much with the users at both ends. We want clinicians to be able to use and be happy with our system and to be fed information that is clinically relevant to them, and we want patient users to be able to use the devices and the solutions efficiently and easily.

From that point of view, for any funding that is available to develop medical devices, if the end-user is a patient at home or someone who can become a patient—we are all patients in one way or another—interdisciplinary collaboration and interinstitutional collaboration should be encouraged to get all the different viewpoints from varied stakeholders. There also needs to be encouragement for the research outputs to be applied in the marketplace to support the uptake and deployment of the innovation.

Professor Ferdinando Rodriguez y Baena: As a complement to what has already been said, on the positive side I think the UK is in a very unique position, because the public health service is one service and is large, and it is rather well funded.

Our opportunity as technologists is to widen the pool of cross-contamination and get people working and paddling in the same direction to a greater extent than we see in other countries, such as the US. In my specific areas, I think the UK is rather better placed for trying to understand some of the very difficult problems that my colleagues have described quite well.

Professor Ann Blandford: Building on the last conversation from the previous session, I think that UKRI and the development of the integration of the different research councils is definite progress. It is starting to join the cracks between the different research funders in the UK, but UKRI is still not linked to the NIHR—the funding body most concerned with the implementation of technologies related to healthcare.

So there are still gaps within the funding mechanism. There are also some gaps between Innovate UK and the rest of the research funders, particularly in their focus on innovation rather than on the broader picture of which technologies are the right ones to develop, what people really need, and how we develop the care system so that the technologies and the care system fit together.

Finally, the previous session also mentioned ethics. Getting Health Research Authority (HRA) ethics in order to be able to conduct studies in full collaboration with the broad population who most need the technologies is often a really big barrier.

The Chair: What I get from what you have just said is that there is a gap in co-ordinating the funding, whether it is from UKRI or the NIHR, because the NIHR ought to be the implementer. However, you did not

comment on the gap between innovation and commercialisation.

Dr Ewa Truchanowicz: A phrase that is widely used is "the valley of death". It is used by various people at various stages of product development, and a lot of it sits within the space that you have just identified. The innovation is ready, it has its proof of concept, it is safe, it could be rolled out to the market, but then there is no support for companies to take development of the product further. There are a lot of discoveries and a lot of wonderful technological solutions that sit at that stage, but there is nothing to bridge the gap between having an idea that works and making it commercially available and market-ready.

A point was made in the previous session about health economics and being able to demonstrate that a device is value for money for taxpayers and the NHS. We are searching for an opportunity to do this robustly. There are various sources of information, but there is very little financial support to fund the health economics work.

The Chair: Who should be doing this health economics?

Dr Ewa Truchanowicz: It should be people who understand the outcomes that they are looking for. There is a lot of health economics academic expertise in the UK. Certainly, various institutions specialise in health economics applied to different therapeutic and medical devices versus medication and so on.

In terms of who should do it, it could be the NIHR, or an organisation that stems from that organisation, because it sits so much within the NHS. It is the research arm of the NHS. It knows the needs of NHS organisations and it knows what makes a product or a service solution value for money for those organisations. It knows what evidence they are looking for. Very often we are asked for a type of evidence that we cannot provide as a connected healthcare company. There is a misunderstanding of how we can prove that our solution provides gains for the healthcare system.

Viscount Ridley: I want to pick up on something that Professor Rodriguez Villegas has said. It implied to me that consumer wearables such as Apple watches and the step counter on my iPhone are perhaps useless and not doing a great job. Does that contradict what Dr Truchanowicz is saying about the importance of prevention through these devices and the sorts of things that we heard in the previous session about wearables being useful for old people?

Professor Esther Rodriguez Villegas: In fact, yes, I am going to contradict what I heard in the last session. Somebody said that we should use existing technologies and not create any more. I do not agree. We should stop using existing technologies for purposes that they were not created to fulfil. These wearables were created with an intended purpose, and they are for technology-savvy consumers.

Why is that? It is because it is much easier for those companies to address the market. We have a completely different problem. Those wearables were not created for use by the average old person. So, first, if you are trying to tackle the problem of an ageing population, you have to

create wearables that take into account the characteristics of old people. Secondly, sticking to what I said before, the output of those wearables has not been validated for anything medical. Manufacturers have to set certain standards.

Viscount Ridley: But if it is making me walk another mile or two a day, by all the evidence from all the nudges that we have had, that is not a bad thing.

Professor Esther Rodriguez Villegas: All the latest evidence shows that there is absolutely no conclusive indication of any positive health outcome associated with these wearables. I have just read the latest systematic review published in 2019. Do not get me wrong—I am not saying that it is a bad thing that you walk more with a wearable, but the applicability is very limited. As a society we need to recognise that wearables have a much larger potential than that. We need to think bigger and to go to the root of the problem. We have to determine what the challenges are.

The Chair: Viscount Ridley appreciates challenges like that.

Q97 **Lord Hollick:** I wonder whether the distinction between a gadget and a medical device is as hard and fast as you say. A number of companies are now making devices where people can take a blood sample, put it on a little piece of plastic and put it in their mobile phone. It then gets sent and their blood can be checked for diabetes or their INR can be checked.

Will there not be more products like that? The product that I have just described is in fact deployed in Kenya so that the health service can be extended to rural areas. Wherever you go in the world, people have these devices. Sometimes they are expensive and sometimes they are not so expensive, but they seem to provide a pathway to becoming a medical device—to provide medical data. We heard in the previous session questions about who will be taking up and reading this medical data, but it seems to be a very important pathway to develop.

Professor Esther Rodriguez Villegas: That is why I said that the potential is massive, and it is why I do my job, but we need to identify the problem. Every medical problem is a problem in isolation. Thinking of it as a general thing will not lead us to a solution. If you want a wearable to diagnose chronic obstructive pulmonary disease, you need to create a wearable for that. If you want a wearable to monitor your glucose levels, you need to create a wearable for that. Yes, the mobile phone will be the platform that allows you to be connected, so it will help in the development of that wearable. However, it is an emerging technology; it is not yet a wearable.

Dr Ewa Truchanowicz: I would like to provide clarification on that. We should not classify and be very binary about wearables, bad being well-being apps that provide a little bit of fun versus high-grade, hardcore medical devices. Yes, the former will make you walk, but it is useless medically speaking, and no clinician will take it seriously.

The main difference is that there are certain regulations, legal constraints and obligations that sit upon you as a manufacturer of medical devices. As a manufacturer of software, we have certain obligations. The hardware devices that we bring in—we are device/brand agnostic—will connect to our system, and some of them will be wearables. We would look at the Apple watch as a potential solution, because it has some wonderful sensors that can be useful, but we would be very careful in checking that they fed the data that they claimed to feed and that there was a degree of accuracy acceptable to our clinical users. If clinicians tell us, "This is good enough for my patient group", we will put it on. If they tell us, "No, I want a hardcore National Early Warning Score (NEWS), multichannel watch, too", which we also have, we will use that instead.

We have very much geared the choice of devices to the clinical needs of patients. We would not diagnose patients using devices. Normally, there is a user group that will use our system, with clinicians guiding them as to what sort of devices they would find useful. Then we activate that selection of devices for them.

There is a very active movement in the UK called Hospital at Home, which is trying to put as much of the care and diagnostics as possible into the patient's hands. There is so much technology available, some of which is validated and quite accurate, by which patients can perform tests at home, including blood tests and urine tests. When you have a platform with very simple algorithms that can predict deterioration, you can avoid a lot of problems further along the line.

You ask who is going to monitor the outcomes. We are running a pilot with a very enlightened local authority (Stockport City Council) in the UK which has decided to pay for it. It is using an out-of-hours service provided to the NHS[1] which does the monitoring and triaging and funnels the patients to the appropriate pathway of intervention. It is being used with people who are, unfortunately, so far along the line that they are in care homes with mild or severe dementia, but also with people who are using the devices at home.

There was a discussion about the usefulness and usability of the devices for the end user, who may be elderly. The oldest user on our system is 97 this year and was 90 when they started. We have encountered zero problems in teaching older people to use them, including some people from restricted or unfavourable socioeconomic backgrounds. At the moment, for the elderly population, we use a single-app iPad, because they cannot do anything to it—they cannot lock it out or whatever. It does not use wireless, it uses mobile networks—4G, and we are looking at 5G. When we select our medical devices, we look at user-friendliness. People need to be able to switch it on, to use it and do nothing else with it.

The Chair: Thank you. Lord Browne has a quick question and then I shall move to Baroness Rock.

[1] Mastercall, a social enterprise providing out of hours NHS care to patients of Stockport, Trafford and Greater Manchester.

Lord Browne of Ladyton: Mine will be a quick question. Professor Blandford, when talking about barriers you mentioned compatibility with the ethical standards mandated by the HRA. Did you mean the Human Rights Act?

Professor Ann Blandford: No, I meant the Health Research Authority.

Lord Browne of Ladyton: Okay. You said it was a big barrier. Can you expand on that a little? I do not want to take up too much time, but what demands are made of you?

Professor Ann Blandford: In order to do any study, particularly one involving vulnerable users in co-design or understanding their use of technology, one needs to go through an extensive ethical clearance process that was designed, quite rightly, for drugs and the development of invasive health innovations. That is often disproportionate when all one is proposing is to engage people in interviews, in a focus group or a co-design session. It can be a disincentive towards doing small pilot studies. Once one has a large study, it is worth the investment in getting that ethical clearance and it is doable, but it inhibits some of the earlier pilot work.

Lord Browne of Ladyton: Is this a standard that is imposed externally and which the HRA has to adopt, or is it one that it has just adapted from another use to apply to what you are doing?

Professor Ann Blandford: My understanding is that the HRA has adapted it from a pharmaceutical model and is applying essentially the same model to the development of digital healthcare technologies.

The Chair: But it is possible for you to have a conversation with the HRA and to explain, to get it to understand, the ethical issues. The HRA, on the whole, tends to work to be helpful towards ethical principles. Am I wrong?

Professor Ann Blandford: No, you are not wrong. It can just take a long time to go through those processes.

Dr Ewa Truchanowicz: May I make one comment that may shed some light on this? Basically, the MHRA, which regulates pharmaceutical research into drugs, decided a few years ago, because of extended delays in processing research projects, to adopt a proportionate approach. If a product is reviewed initially and deemed to be of a low risk to the participants, the review process is much less burdensome. If it is high-risk, it increases proportionately to the danger to the participants.

We recently applied for ethical approval for some research projects, and my impression is that even though we are only collecting data and not necessarily from vulnerable individuals, the burden of evidence of safety is the same regardless of the level of the project's danger to participants.

Q98 **Baroness Rock:** Coming back to the theme of innovation, I want to focus on the technologies that are being deployed in older people's homes—in the home environment. What new technologies are being developed that you are aware of? What areas should we be prioritising

our R&D on?

Dr Ewa Truchanowicz: There is a mixture of technologies that can be used in care homes. There are environment-based technologies—sensors and alarms. The sensors can be positioned across all domains, so you can have sensors on kettles: has someone boiled a kettle? You can have sensors on beds: has someone had an accident and needs to be changed? You can have sensors on doors which show whether someone has been in or out. That is the environmental domain. Then you have the person domain: what is the individual actually up to? That is where you have all the devices on them and around them reporting patient-reported incidents, et cetera.

You have two different domains and they can both be installed. The issue is one of cost. With modern technical solutions, there is not much need for hardcore adaptations, for drilling into the walls, et cetera. You can effectively monitor the resident's well-being without necessarily having to make major structural changes to the fabric of the environment. However, some of the technologies are unproven or have not been on the market for long. There is always more on the horizon, and we are always looking for more devices, more solutions and more partner companies to add to ours to present a whole parcel, not just person-centred monitoring but the environmental side. There is a lot going on in the market at the moment.

Baroness Rock: How difficult is connecting the two solutions? Is that a challenge? What are the challenges that you face?

Dr Ewa Truchanowicz: Interoperability and Open API should be the gold standard for technology, because there are a lot of solutions out there, including some that are purchased very locally, and there is fragmentation in the purchasing models and the purchasing and choice decisions. We end up with very niche solutions which are not evolved to talk to anything else. They solve one pain and do not do anything else.

We should make interoperability the gold standard, not just for data formats but for the way data is transferred and how devices interact. If we are looking at the Gestalt, the whole solution, the problem does not reside with the person alone, with the environment alone or with service design alone; all elements need to talk to each other. That is why interoperability is a must for any technical solution.

Professor Ferdinando Rodriguez y Baena: If you look at the horizon, the technological landscape, you have to take everything with a pinch of salt, but there are technologies in the making that could offer considerable advantages to the elderly population in the home. However, it is difficult. At the moment, they are proof of concept, so fairly low TRL technologies, whether they are wearable sensors that monitor gait, for example, or mechanomyographic sensors that monitor muscle stiffness in Parkinson's disease diagnosis.

Within a very controlled setting, there is promising early evidence to suggest that these technologies could be placed in the home to monitor such things as Parkinson's disease or dementia. However, there is a

significant gap between the control proof of concept and the medical device that would enable you to produce an output of diagnostic value.

Professor Ann Blandford: There are also questions about informed consent and understanding what data is being gathered, what is being done with that data and how it informs service delivery. These are really big questions that we have not yet got very far in addressing as a society.

Q99 **Lord Borwick:** With these new technologies moving from the home to wearables, am I right in thinking that Apple and Fitbit have such a big percentage of the wearable gadgets market worldwide that their budget for R&D must dwarf anything else in the industry? In those circumstances, would your ambitions as academics be to work under contracts from Apple, or would you look to develop new technologies for their own benefit and that of your universities?

Professor Esther Rodriguez Villegas: Yes, their R&D budgets dwarf everything, you are absolutely correct. But you also need to bear in mind that they are looking to address a particular market and there is a lot of risk in developing certain medical devices. Why? First you need to solve the scientific problem, which is hard. Then, once you have proved the concept, you need to take it to the patient—you need to do the translation—and that is where you come across real-world challenges, which are even harder than the earlier ones.

For those companies, it is much easier and much more commercially reasonable to focus on a technology that will be on the market two years later. With a medical device, we are looking at that happening many years later and it is uncertain, so the risk is much higher. Therefore, their investment in medical devices is very low. They have an alternative strategy, which is that they let others develop the product and then they buy the start-ups—they take on the risk of the project. So there is a place for start-ups.

As an academic, I have done that already. I have my own medical device company precisely for that reason: because I do not want innovation to die in my drawer. I thought I was better placed than anyone to translate the technology. Am I going to take it all the way until it is used by millions of people? I do not know, but at the moment I am the best person to translate it.

The good thing about that is that I realised that when you are in academia you are very unaware of the real-world challenges, the valley of death and the problems that you have to tackle. One of the gaps at the moment is investment for translation. The little there is is targeted at clinicians, but I do not think that is right. Clinicians are facilitators. They have to identify the problem and validate the solution, but ultimately the technology has to be developed mostly by engineers. At the translation point, engineers are, in most cases, the ones who should be leading. I think the Government can do better in closing that gap.

Professor Ferdinando Rodriguez y Baena: Just to confirm, investment in wearables by large companies is a double-edged sword in

the sense that it blurs the line between the mass market for gadgets and the truly useful wearable for diagnostics and therapy. However, taking the Apple example, it has done a very good job of taking a limited risk by providing a platform and then allowing clinicians, engineers and scientists to make use of the data. So it is already inching its way into a device that will tend to become a diagnostic device, but it is offloading all the risk to the smaller companies or the public sector.

The Chair: Can you tell me about implanted devices for the tests and treatments that you have just mentioned?

Dr Ewa Truchanowicz: We do not use implantable technology. We have some wearables but not implantables. Implantable devices would potentially come under the same regimen as diagnostics, where the burden of proof that your device is safe to use and accurate is much higher. We do not do that. We use stand-alone devices and have some things that people can wear, but we do not have implantables.

Professor Ferdinando Rodriguez y Baena: With implantables, the burden of proof is significantly higher. From a technological standpoint, mini and non-invasive diagnostics are progressing in universities and hospitals. There is better imaging and smaller devices, and there are capsules with more diagnostic capability than ever before, but in terms of TRLs, those products are still very much at the laboratory stage and there is quite some way to go before they become clinical products that can be deployed broadly.

Q100 **Baroness Hilton of Eggardon:** To continue on the data collection point, there are two aspects to it. One might be to improve individual care by using the data. Alternatively, I wonder how much the data is used in much wider aspects of research—epidemiological research, for example. To what extent is it being used in those two aspects?

Professor Ferdinando Rodriguez y Baena: It is tricky, in the sense that data is probably one of the most prized possessions of companies that invest significant funds in developing technologies, especially in the wearables space. As an academic, I appreciate the data's intellectual and commercial value, which needs to be protected.

Equally, looking at the broader landscape, I imagine that having the ability to access a very large amount of data acquired in a non-biased fashion would help to accelerate progress in the direction of wearables. Of course, that is an advantage of the NHS because, as the largest healthcare provider in the nation, it is uniquely placed to harmonise how the data is acquired and shared. Obviously, I am thinking of this as an academic and a technologist and not necessarily as a company or a device manufacturer because, as I said, that would create some difficulties.

Dr Ewa Truchanowicz: Some very large datasets collected by the NHS are accessible, provided that there is evidence that they will be used for the correct purpose. You cannot just go and ask for any dataset; you need to justify why you need it.

No current technological solutions used across different settings are feeding data into a central repository. That is why I feel that interoperability and common standards would be really useful. Then, we could end up with a really large, real-world data set that could be used for real-world evidence generation and inform epidemiological-level and public health decisions.

However, we are not yet anywhere near those kinds of data streams being fed into something useful. We have standard medically collected data in a repository that can be accessed for research purposes, or for commercial purposes if sufficiently justified for the well-being of patients, but in an ideal-world scenario we would have wearable medical devices or systems that would feed data into AI algorithms. That would give us better modelling and better community care, as we would be able to see gaps in provision where certain diseases occurred in postcode pockets and could then avoid the postcode lottery in care provision. However, that is just a vision.

Professor Ann Blandford: At the heart of that is also the question of who owns the data. Interoperability is essential, but so is a more open approach, particularly where data is owned by commercial organisations—the Fitbits and Apples of this world.

Baroness Hilton of Eggardon: That is the wider aspect, but what about individual tailoring?

Professor Ann Blandford: In principle, having individuals own their own data sounds ideal, yet the commercial pushes do not always work in that direction. There also need to be appropriate algorithms so that individuals can interpret the data in ways that are meaningful to them, and that is also a challenge.

Dr Ewa Truchanowicz: Just to clarify, it is not only commercial companies that provide feedback. We have feedback from some NHS trusts that run research projects and they tell us that they own the data. Philosophically, from the viewpoint of our company, we feel that the participants own the data because ultimately the data is derived from them, but we understand that different people have different viewpoints about what belongs to whom.

With the way our system works, we feel that it is essential to give users access to the data. The information is formulated so that they can easily see how the care plan works and they can then actively manage and adjust what happens to them and the tasks assigned to them. However, we feel that they should be able to see the data, because ultimately data is power. You can see trends and values. When you see that when you walked up the staircase your blood pressure shot up, or when you walked up the staircase your blood sugar went down really nicely, you can alter your behaviour.

However, if you are not given access to the data, you will not know. We had one anecdotal case where a participant went back to their doctor and demanded a review of their medication, because looking at the long-term time series record they could see that they were okay. Access

substantially changes the balance of who uses information for what purpose.

Baroness Young of Old Scone: I have a very quick question. In view of that lack of joined-up-ness, what is the risk of competing bits of your multimorbidity screwing each other up—technical term?

Dr Ewa Truchanowicz: Do you mean if different services are used for different things?

Baroness Young of Old Scone: Many patients have multiple morbidities. Is it possible that there is a lack of joined-up-ness in the applications they are using, so they make one worse because they are trying to make another one better?

Dr Ewa Truchanowicz: That is a clinical question and I would ask a clinician, but normally if you improve your diabetes you also improve your cardiovascular well-being. For some patients with diabetes, if they change their diet it has knock-on effects on their overall well-being.

However, certainly from the point of view of our solution, multimorbidity is not a problem because we are talking about a whole person; they do not come with one disorder. There is also a sea change in the perception of how those kinds of remote patient monitoring solutions and connected care solutions should be applied—that we should be looking not at one disease model but at the person. Comorbidities are a reality, and the older you get, the more accompanying complications and diseases you are likely to encounter.

We need to look at the whole person, not at just one disease uniquely, because, yes, you can give them medication that improves one disease but makes another worse. But that is a clinical question, and I am not a clinician, so I would not venture into that discussion.

Q101 **Baroness Penn:** You have touched a bit on the ethical and privacy issues relating to data, and I want to explore two more aspects of that. One is whether concerns about how data is used and privacy impacts on individuals' willingness to use some of this technology. The flipside is whether in the UK we have the right regulations on the ownership of that data, privacy considerations and that kind of thing.

So one question is whether we have the right regulations in place to govern this. The other, from the individual's point of view, is whether they are well informed enough or have concerns about that, and if they do have concerns whether that acts as a barrier to them taking up some of this technology.

Professor Ann Blandford: One size does not fit everybody. People have different attitudes to data privacy, and issues of trust to do with who is going to access what data and what they might do with it also come into play in that space. So unfortunately it is not a simple "Should we do it this way or should we do it that way?", because what is right for one person may be different from what is right for somebody else.

Also, what is right for one individual may change over their life course, for example as their needs grow, their relationship with their family changes, they change GPs, or whatever. All sorts of things happen to each of us, and they may affect our attitudes to data privacy and data security.

Professor Ferdinando Rodriguez y Baena: Over the past 15 years or so, our understanding of personal data versus non-personal data and the way we handle it and perform informed consent and so on has actually improved rather a lot. As scientists or as patients or healthy volunteers, our understanding of how this data can be used and the limits for each bit of data that you give for whatever purpose is quite good. It is possibly too conservative in that it can sometimes get in the way of progressing with technology, but having been in the operating theatre and having been involved with trials for many years I would certainly say that our understanding is now an order of magnitude better, and better enforced, than it was 15, 20 years ago.

Dr Ewa Truchanowicz: There are much stronger data protection regimes, and legal instruments, and you will be very sorry if you breach any of the regulations that are in force at the moment.

In terms of patient-level, individual-level, perception of what happens to data, it is really important to be transparent. Certainly there are very good guidelines out there and experts in the area who can advise on how to inform patients, participants, volunteers in such a way that they are guaranteed, or at least can be helped as much as possible, at different levels of educational understanding of the scientific background of whatever it is they are agreeing to take part in, to understand what happens to their data. They feel in control of it, and they know they can withdraw their consent. You can also, again, explain to them what happens to the data that has already been gathered.

The biggest public concern is, I think, the various data-handling scandals involving commercial companies. One of the most frequent questions we get is whether the data is going anywhere outside the EU. Is it going to the States? Is it going to China? Who is going to analyse it? The destination of data is a concern, so we need to be extremely transparent about what happens to it, who is going to be touching it, in what format it is anonymised, and whether it has any identifiable personal information with it—because, again, that makes it different.

Health data, however benign or subtle, should always be perceived as really vulnerable data. This is something that can really make a difference to a person's life. Luckily, we do not have the private insurance model in the UK, but it is really important to make sure that we follow the Caldicott principles and are proper guardians of the data. Trust is a major issue.

Baroness Penn: You have talked before about the difference between wearables as gadgets and as medical devices. Does the strength of the regulation that governs what happens to data and the best practice in transparency for the users get used only in a medical-device setting, does it also apply to the kind of wearable-gadget setting as well, or could there

be gaps?

Dr Ewa Truchanowicz: Normally, wearables are a much less regulated market, so again there is the issue of the legal underpinnings and what you can and cannot do with the data, because it is a business-to-consumer model. The assumption is that as an individual—as a consumer of the device—feeding data through it, you consent to whatever. We are all guilty of scrolling down to the terms and conditions and ticking—right? Then you discover the hidden caveats which you did not bother to process, and you suddenly find out that your data is feeding some algorithm somewhere which you had no idea about. It tells your location, it has your habits, it has all sorts of things about you, which, if someone is not benign, they can do a lot of unpleasant things with.

When it comes to medical devices and how you process data originating from them, in deciding whether to use a medical device as opposed to a well-being wearable you need a cause—you need someone who wants to look at the data. Again, those pathways from a medical device, by whatever platform, to the clinician or whoever looks at it at the other end are very closely regulated.

Q102 **Lord Hollick:** The Government have adopted their target of improving healthy longer life. To what extent were the medical academic sector and the medical healthcare companies involved in setting that target?

I will move on to the second part of my question. Is there now an agreed transition plan to move from where we are to where the Government wish to get to? It is a very laudable ambition. In all the work that you are involved in—particularly the healthcare company that one of you runs—do you have a clear sense of the steps that you need to take to achieve that? Is there a clear sense of the medical devices that need to be developed to achieve that? In other words, having set this goal, is there a sense of urgency and direction about how we will actually get there?

Professor Ann Blandford: It has provoked a conversation—

Lord Hollick: After the adoption of the target.

Professor Ann Blandford: Arguably, yes. Bringing all the different stakeholders together and moving in the right direction will involve engineers, social scientists, clinicians, members of the public and regulators of many different authorities working together to a degree that I think it is fair to say we have not worked together in the past.

Professor Ferdinando Rodriguez y Baena: My answer is a little along the lines of Professor Rodriguez Villegas's "We could do better", in the sense that you have my posse—the technologists who are enamoured with technology and tend to develop it, and then necessarily look for a solution to a problem that has not quite materialised—and then government targets for where we should be.

A bit more hand holding in between would probably help to channel some of that effort, many of the resources, and the very capable people working on these problems to try to get us to the target more quickly. I

am not sure that we are doing exactly the right thing in making everyone paddle in the same direction.

Dr Ewa Truchanowicz: From our point of view, there are ambitions and targets, but it is not entirely clear what pathways will be put in place and when in order to facilitate going towards those targets. There are a lot of initiatives. I have just heard about the minimum spending that is going to be set for NHS trusts to spend on digitalisation, but at the same time the picture is much wider and includes multiple stakeholders.

We heard earlier about fragmentation. Fragmented approaches do not work and will not solve the problem. We need to look holistically in this whole debate and look at what happens in a person's home, what happens in the residential home, what happens to the individual, what happens to the service design of the health service. We also need to look at the broader environment and things like smart cities. If we are looking ahead five years plus, we need to look beyond that and start putting in interventions that look holistically at our pathway through life. Healthy ageing should be a target for all of us and should be facilitated by those broader solutions.

Q103 **Lord Hollick:** It is clear that co-ordination, co-operation and agreement on steps are important, but from your own points of view, which are the key areas and key innovations that need to be deployed in order to have a chance of making progress towards that target?

Professor Esther Rodriguez Villegas: Thinking about 2035, the people who will be old in 2035 are not those who are old now. We should not be trying to create technologies that improve what is happening now; that would be suboptimal and unrealistic. You can do it to certain extent, but you need to be more visionary. One thing we should do is improve the diagnosis and management of conditions that, if you diagnose them now, will not have a long-term effect later.

I will give you an example I know very well, because I work on it. Sleep apnoea is a condition that affects between 3% and 12% of the population. If you have sleep apnoea, you are not going to die today. You will be tired, there will be consequences in the workplace, your productivity will be less, but that does not actually affect the NHS budget today, so why should a CCG that is quite constrained in its budget invest in that?

However, sleep apnoea causes traffic accidents: 25% of the road accidents in Europe are caused by the condition. If you do not treat it, 20 years later you will have cardiovascular disease, stroke, glaucoma, diabetes. What is the problem with diagnosing sleep apnoea? It is that it costs the NHS between £600 and £1,500, depending on whether you send the person home with a very bulky system or you leave the person in hospital. You need two hours of a sleep consultant's time, which is very expensive.

What are we doing with that, for example? We have created a device that is small enough that you can post it to people at home and it gives an automatic diagnosis with the same accuracy as the doctor. Patients have

proved that they can use it by themselves, alone, with no instruction. There is no cost. However, does that mean that the NHS is going to adopt it tomorrow? I do not know. It might. We are just regulating it at the moment, but I presume it will not be that easy. Why? Because sleep apnoea is not a priority today. This was just an illustration, but you understand where I am going here.

Dr Ewa Truchanowicz: The important thing here is quality of life. We are looking not just at extending life as such but extending good-quality, good years, of life; not just existing and surviving on painkillers—being there but not being there—but actually being interactive, experiencing things and being active. I completely agree that prevention is key. We need to start our interventions now, at the population level and the individual level, to actually make a difference that will have an outcome in decades.

Q104 **Lord Hollick:** You made the point at the beginning that the use of digital devices is not quite as challenging for old people as some would think. In that context, to what extent do you think that voice-addressable computers, and their sister devices such as Alexa, can help address healthy living or medical conditions in the home and therefore prevent people having to go into care homes?

Dr Ewa Truchanowicz: There are several solutions out there which use Alexa or similar solutions. Ours does not. We operate by providing a channel for communication between the healthcare professional and the patient. A concern that patients often have when you ask whether they would like to be put on to a technical solution, a platform with remote monitoring, is that they will be abandoned: "I will be pushed home, because you have technical solutions for giving me my pills on time, you know if I have taken them or not, you have technical solutions to monitor my vital signs, if I need to do a urine test I will do it at home, and I am not talking to anyone".

Our platform is designed around two-way communication. The assumption is that there has to be two-way communication, because without support, people's gains drop off very quickly. Initially, when you are diagnosed, there is the fear response and people are very compliant. Then, as the fear wears off, the compliance drops off. That is where two-way communication is absolutely necessary.

Alexa can provide a degree of interaction and connectivity, but one anecdotal comment is that people access resources that are not necessarily verified: they seek information about their disease that is not accurate. There are plenty of Dr Googles, and much lower grade than that, which will provide you with ad-hoc information about medical conditions.

We provide the education part, but that is created in collaboration with the patient, so if they want to know something more, they know it comes from their clinician and they do not access random sources via a device that allows them access to those. So it is a slightly different model, but they are certainly useful, and we have had feedback from families who

have used them as an intervention for a family member that it made them feel better.

The Chair: Currently, Alexa gives different answers to the same question, so it will have to be refined quite considerably before it could act as an adviser.

Lord Browne of Ladyton: This is a quick question. The pathway is described in the long title of the healthy ageing challenge: "Industrial Strategy Challenge Fund (ISCF) Healthy Ageing Challenge Framework". The Government, as far as we understand—they are quite specific about this—are focusing on delivering this through technologies and related services. So we know what the motorway is, but we do not really know what is going to travel on it to get us to the destination, as it were.

Helpfully, Professor Blandford, I do not think you did this exhaustively, but you gave us a description of some of the people who need to be brought together, or convened, to discuss how we get there. My question is simple, and it is to all of you—a yes/no answer will probably do. Do any of you know of any convening of the people with the skillsets to answer this challenge? If you do, who is doing it?

Dr Ewa Truchanowicz: Yes. We are fortunate enough to be residing within Birmingham, where we have something called Birmingham Health Partners, which brings together the NHS, academia and industry. For those kinds of conversations, where there needs to be multi-stakeholder engagement, they will convene those discussions.

Lord Browne of Ladyton: Are they happening?

Dr Ewa Truchanowicz: Yes, and where there is an opportunity to apply for grants, groups of people will be brought together to apply for them.

The Chair: Is this driven by a government department, by individuals or—

Dr Ewa Truchanowicz: It is an organisation that has been set up between the University of Birmingham and local NHS Trusts. It is a local initiative driven by practitioners and academics, rather than by a central government initiative.

Lord Browne of Ladyton: So all roads lead to Birmingham, and HS2 will too, if we get it. Are there others?

Professor Ann Blandford: There are parallel conversations.

Lord Browne of Ladyton: Maybe you would drop us a line if you know about them, rather than take up any more time.

The Chair: This is a very important question, because we are trying to explore how the Government are going to deliver this grand challenge. By itself it is a good challenge, but it needs a clear strategy for delivering it if we are to get the UK to be an innovator for the commercial marketplace and for what that requires. We are pleased to hear that there are initiatives in pockets, but that does not mean it is a government strategy. All of you, please feel free to write in; we are very interested to hear about this.

Professor Ferdinando Rodriguez y Baena: Wearing my recent hat, the Hamlyn Centre is part of the Institute of Global Health Innovation, which is headed by Lord Darzi. The purpose of that overarching centre or institute is exactly that: to bring the clinical side, the clinical pool, and stakeholder engagement much more closely together with technologies and technology. But, again, it is not quite a government-led initiative; rather, it is somewhere in between.

The Chair: You might, in writing to us, address the question of what the Government need to do to drive this nationally.

Q105 **Baroness Walmsley:** I was very interested in the sleep apnoea example of early diagnosis preventing worse illness, a shorter life and more ill health down the track. It occurs to me that if the Government are to fulfil their objective we will have to pick some of the low-hanging fruit. In this country, we have quite a lot of very good screening programmes. However, do you believe there is potential for rolling out more widely some of the very quick and accurate diagnostic tests, such as those for diabetes, atrial fibrillation and probably other conditions? Are there major barriers to doing that, or would it be relatively easy? Do we already have the infrastructure, and it is just the will and the funding that we need?

Professor Esther Rodriguez Villegas: I think that is where we should be going. That is why I think that new wearables technologies should be one of the targets. You ask how we can achieve that. The problem is that the challenge is too broadly worded. It needs to be broken down. What do we want to achieve? There need to be proper specifications. When it comes to wearable technologies and medical devices, the attitude should be that creating technologies that facilitate screening and diagnosis costs little money and a lot of people can be screened and illnesses can be prevented.

Professor Ferdinando Rodriguez y Baena: Again, the way the NHS is structured lends itself to this country being a world leader, probably much more so than any other country I can think of. I am originally from Italy and am thinking of the United States. We are uniquely placed to do that.

Baroness Walmsley: Some people do not attend their screening appointments, which is why the cervical screening numbers have gone down. So I can see the potential, not necessarily for that condition but perhaps for others, if screening can be done reliably at home and the data fed to clinicians.

Dr Ewa Truchanowicz: There is definitely the infrastructure, because everybody has a GP or GP provision of various types, including, now, video consultations. I used to work in the area of clinical trials in atrial fibrillation. One of the scariest statistics is that most people are diagnosed when they present at A&E with a stroke, when it is too late and they have been walking around with the condition completely unknowingly.

The old-fashioned way of diagnosing AF detects one type but not the other. It involves wearing a harness at home for 24 hours, which is

cumbersome and a burden on the patient, and there is a cost to the NHS of lending out the harness. There are much better technical solutions nowadays. We have the infrastructure to roll it out, but the difficulties have been identified—the will to use it and the funding that allows the use of such technologies. The barrier that we encounter as a company is inappropriate funding pathways that do not allow Trusts for example to purchase our solution, because they do not have the correct budget code and they find it very hard to find the correct one.

Professor Esther Rodriguez Villegas: There need to be incentives, basically, so that the interests of the different stakeholders are aligned. If screening for a certain condition costs money, a different stakeholder will say, "Well, it's not my problem". That is the issue. In this room, we might be trying to crack a social problem, but you need to think about how to make all the stakeholders happy. As long as they are all happy, they will align the interests and we will crack the problem.

Baroness Young of Old Scone: Before I ask the question that I wanted to ask, I have a question to which I would like each of you to answer yes or no. You have just made the point that we could become world-beating in this technology if the NHS played its role in harmonising, bringing together, setting protocols, getting people to talk to each other and operationalising it. Do you think that within the next five years the NHS will do that? Yes or no.

Professor Ferdinando Rodriguez y Baena: I am an optimist, so I do not want to say no. It is a tall order, but it could be possible.

Professor Esther Rodriguez Villegas: I am a realist, so I am going to say no.

Professor Ann Blandford: I am a different kind of realist, so I am going to say that the NHS is not a single organisation but a lot of clinical commissioning groups that all make independent decisions. So the answer is: half and half.

Dr Ewa Truchanowicz: I am going to be a pessimist and say no, purely because, even if one organisation decides to buy something and it is proven and so on, there is no guarantee that someone else will buy it, and there is no centralised enforcement mechanism to make them do so.

Q106 **Baroness Young of Old Scone:** So the idea that there is a National Health Service in this country is a mythology.

The question that I wanted to ask was about inequalities in healthy ageing. We have heard about some of the risks of tech-savvy people getting a better system, but are there things that could happen in the healthy ageing challenge that specifically need to happen to help reduce inequalities in health status?

Professor Ferdinando Rodriguez y Baena: One way of looking at it is that if this wearable technology played the role that it could play, it could be either a source of great inequality or a technology that levelled the playing field. It depends very much on whether it is the sort of

technology that is available to all through the public health system rather than a premium technology that is available only to those who have private insurance or the money to pay for it. Therefore, I guess that we have a very big say in whether this technology aids inequality or flattens the playing field.

Professor Ann Blandford: I think it is about how the technology, the services around it and the funding mechanisms are used. It is not just about the technology; it is the surrounding factors that determine whether it increases or decreases inequalities.

Dr Ewa Truchanowicz: The technology is the easy part. It is advancing so rapidly as we speak that the technical solutions are there, but it is the pathways and the support that are required. From my experience, it is often the ones who need the support the most who do not access it. It is a case of making sure that people do not get left behind just because they feel somehow disenfranchised or do not engage with the healthcare system to the same degree as someone who is perhaps better educated or better off. We would look to roll out our technology in such a way that it is accessible to all.

The Chair: Thank you all for coming today. Those were both most interesting sessions. If you have any ideas that you suddenly think of and that you forgot to mention, please write in with them, together with the things that you have already said you will write to us about. You will get a transcript of this session. If you have any corrections to make, please let us know. Thank you again.