



Airing Pain 155

This episode was produced in partnership with the British Pain Society

Paul Evans: This is *Airing Pain*, a programme brought to you by Pain Concern, the UK charity providing information and support for those of us living with pain, our family and supporters, and the health professionals who care for us. I'm Paul Evans. In September, the British Pain Society, who provide logistical support and encouragement to make these *Airing Pain* podcasts, launched the first of what's hoped will become an annual themed year. The inaugural theme is AI — artificial intelligence — Technology and Innovation in Pain Management.

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Karen Davis: The technology is not going to be as much of a barrier. The barrier is our own imagination of what we think is possible and how we should use that technology.

Joshua Pate: In my head, there was just all these risks and questions, and I'm like, guys, we need to do some studies on how this is going to roll out in healthcare.

Evans: 'If I have seen further, it's by standing on the shoulders of giants.' So wrote Isaac Newton to fellow scientist Robert Hooke back in 1675. The two didn't always agree, but the sentiment, that for the most part research and discovery is built on the work of those who came before, is as true today as it was in the seventeenth century and beyond.

In September 2026, the British Pain Society launched its Year of Innovation. So, in this edition of *Airing Pain*, I want to look at some of the challenges of innovation, from the gate control theory of pain to the emerging challenges of artificial intelligence, or AI.

In terms of modern pain discovery and research, British neurophysiologist and pioneer in the world of pain Patrick Wall is one of those giants on whose shoulders today's researchers and innovators stand. The British Pain Society honours his

achievements by inviting a person of current standing in the world of pain to give the Pat Wall Lecture at its annual scientific meetings. In 2026 that honour went to Professor of Neuroscience at the University of Toronto in Canada, Karen Davis.

Karen Davis: Pat Wall is most famous for introducing what he called the gate control theory of pain, together with Ron Melzack. Ron Melzack was a neuropsychologist at McGill University in Montreal, Canada. He brought the patient and the psychological perspective to the theory, so, together with Pat Wall, the theory was well grounded in not just basic electrophysiology and neurophysiology, but what was actually happening and experienced by people.

Evans: Put simply, what is the gate control theory?

Davis: The basic concept was that there is, metaphorically, a gate in the circuitry of neurons in the spinal cord, in what's known as the dorsal horn of the spinal cord, which is where all the signals from the body come in to the spinal cord and then send messages up to the brainstem and the brain for processing, as well as triggering an output from the other part of the spinal cord, which is the motor output, so you can have a reflex, so you touch something and then you can remove your hand.

The key element of that theory and of the circuitry is that the input to the dorsal horn comes from two types of nerve cells that receive information from the skin and different parts of the body. One set of input comes from what's called nociceptors, from neurons that are activated by stimuli that are potentially or actually damaging the skin. People call them pain fibres, but they're nociceptors. The other system that brings information into the skin has to do more with what we call just touch, right? They're activated by stimuli like brushing or touching the skin, or temperatures warm and cool, the idea being that, for some reason, if you have a lot of activity from these non-pain primary afferents from touching the skin, rubbing the skin, that that could close the gate, that that could actually reduce your pain experience.

We know that when you're feeling pain, sometimes you rub your skin, right. Does it make it, the pain, better. Maybe, maybe not. But physiotherapists and other healthcare professionals have long known that they can manipulate the body in a certain way, or the skin a certain way, that might be advantageous to help people with pain. So that did set up a lot of thinking about potential therapeutic approaches to pain.

Evans: You were talking this morning. Your subject was neuromodulation. Explain what that is.

Davis: It's a term which is becoming used more and more today because of technological developments that are allowing different ways to change how neurons or nerve cells in the brain are active or suppressed. It's not a new concept in terms of our ability to change the brain. We've had methods for decades and decades that, through either electrical stimulation or other means, sometimes very natural means, can change how your brain is active or focused on one thing versus the other. But now we have tremendous technological advances that allow us to do a much more focused modulation, or change, in how your brain is operating.

Evans: So basically, you're looking at electrical impulses within the brain itself?

Davis: Right. The brain operates based on electrical signals. Nerve cells, neurons, their way of transmitting information and processing information is all based on electrical activity, which then can result in the release of chemicals, neurotransmitters in the brain. It can affect hormones. Brain chemistry is impacted and controlled by the electrical activity of the brain.

Evans: You used the term nociception this morning. Explain that. Is that the mechanic— well, when I say is that the mechanical aspect of pain, is that the electrical side of pain?

Davis: The definition of pain is really one that centres on how somebody feels and what they experience. It's a behavioural response, whereas the term nociception is a term that refers to what's happening to the actual nerve cells in the periphery, in your body or in your brain. The activity in the nervous system is what comprises nociception.

You can separate pain from nociception. For instance, if you're having surgery and you're under a general anaesthesia, you're not feeling pain because pain is a subjective response by definition, subjective experience. If you have no consciousness, if you're under anaesthesia, there cannot be pain, but there can be nociception. If a surgeon cuts your skin, the nociceptors that arise from your skin and from those nerves are still active because the general anaesthesia is not eliminating that activity. You're not experiencing pain. So you can have input to the brain from nociceptors under general anaesthesia, but you have no pain experience because the anaesthetic is dampening brain activity.

Evans: What is going on, then, to make that nociception react with other parts of the brain to make it pain?

Davis: That's the million-dollar question. That is something that is an active area of research, to try to understand how activity in different areas of the brain becomes pain. And for some people it doesn't. Or the experience is different. Or even if that activity is ongoing, if some people are able to direct their attention to a task at hand, some people might say, well, if I'm focused on doing something, playing sports, writing, doing your activities of daily living, if you're focused on doing something and not on your pain, then maybe there's no nociception.

It's an interesting question. You can still have activity in those neurons. But the way that that activity comes together to shape a final output that we call pain might be different for one person or another, depending on what they're doing.

Evans: Professor Karen Davis of the University of Toronto in Canada.

In evolutionary terms, pain protects us, it's a good thing. If there's nothing to protect, but we still experience pain, it's quite obviously not a good thing. If we can understand what pain is good for, it'll help scientists understand how and why the pain system goes wrong. Indeed, is pain a system, or is there a specific part of the brain which can be identified as a pain centre?

Professor Ben Seymour is a clinical neuroscientist at the University of Oxford.

Seymour: When you look at pain and when you look at how what we know about how pain is processed in the brain, you realise that it shares lots of aspects and lots of features with lots of other things. It shares similarities with other aspects of sensory processing. Attention, cognition, emotion, movement.

If I was to put you in a brain scanner and give you some pain, all sorts of brain areas light up. In each of those brain areas, you think, oh, that's, we see those in our movement studies, or we see those in our emotion studies. That's interesting, but it's a challenge because you think, well, what is pain in the brain? It's just all over the place. It's, you know, this is an idea that's spawned concepts like the pain matrix or the pain network. And they're good concepts, but they don't actually tell you very much. It just tells you that it's everywhere.

But it must be more than that. Pain is an extremely specific thing. You know when you're in pain, you know when you're not in pain, you can tell when someone else is in pain and when they're not very well. It's a highly specific thing. So even though it looks like a bit of everything in the brain, it clearly isn't a bit of everything.

It's clearly something highly specific. And to try to understand what that highly specific thing is, you need to understand what it's doing. If you understand what pain is doing, you can understand, you begin to map those functions to individual bits of the brain, then start to put them together and kind of construct an insight into what pain actually is in the brain.

Evans: If I'm right here, if you were to look at my brain or look at the functions of my brain through technology, you would see certain areas of my brain lit up. If I were smiling and somebody had just said, oh, you've won the lottery, Paul. Different areas would light up. If somebody stamped on my foot and said, by the way, Paul, your wife has left you, it would look completely different, but you would experience more or less pain?

Seymour: I think there's an important point there, which is the context in which you experience pain makes pain feel very different. That has led to, I think, a misconception about what pain is. I think it's made people think that pain is inherently kind of vague or unreliable or variable or almost fluffy, because these things have nothing to do with your actual pain. Stimuli seem to be changing pain.

But what I argue for is that, in fact, it's wrong to think about pain, really, in the context of a pure sensory system. What pain is doing is telling you what you should do. It's not telling you what's happened or what's going on. It's telling you what you should do and what you should do is highly dependent on the situation.

If you have just run the lottery, it makes complete sense to ignore the pain and go ahead and get your winnings. You know, don't lose your lottery card, all those sorts of things, phone your boss and hand in your notice, all the really important things that matter. It makes sense not to take any notice of the pain. That doesn't mean the

pain's variable. Your brain is telling your pain when it needs to be strong and when it needs to be weak, and that's completely embedded in the context in which it occurs.

The key thing is when you look at pain like that, you realise, no, actually, pain is very, very precise. It's just not behaving like a sense. We inherently think about it as a sense, we can't stop thinking about it as a sense. But if you think about it more as a kind of control signal or a motivational signal, a lot of the ways in which it's modulated by contextual factors turn out to be very, very important. It ends up being much, much more precise.

Evans: If pain is the call for a signal, if you like, that something is wrong, I need you to do something about this. How do you alter what is done, what your body or your mind does about it?

Seymour: It's important then to think about good pain and bad pain. Because of the size of the clinical problem, we often leap straight into thinking about chronic pain, the clinical problem, the suffering that goes with that.

You know, most people recognise fairly easily that if you touch an extremely hot cup of coffee, it hurts. That's a good thing because you just stop burning yourself. The idea of pain being a good alert signal, a damage signal, a kind of out signal, lots of different words for it, and a teaching signal, you know, to help you improve the way you interact with your crockery in the future.

Evans: Yeah. This happened last time, therefore we won't do it again.

Seymour: Exactly. That's, you know, that's a very powerful system. But it's also important to recognise that ongoing pain, we call it tonic pain. So the pain that's there at rest when you're not doing anything, it's just constantly there in the background.

That also can be very good, so if you break your leg, you will get two types of pain. If you bash it against the sofa, of course you'll get that phasic pain that teaches you not to bash it against a sofa again. But even sitting down, you get that background pain. What that background pain is doing is saying, don't forget you've got an injury, don't forget. I would advise, your brain is saying, I would advise not going to see your friend, not going shopping, I'd advise you not getting up and moving around. What I would advise you to do is to stay exactly where you are and rest and recover, and that allows you the time and space for natural tissue healing to occur. That tonic pain signal is doing you a great, great favour.

So then you think, okay, how do we then start to think about chronic pain? You can use this understanding of pain as an injury signal, if you like, or part of an injury signal, because there's a lot more, when you think about things like injury, there's a lot more than just the pain.

You've got things like the fatigue, again a key driver of recuperation and rest. You've got the anxiety, again a key thing which helps you minimise any chance of additional threats or damage or danger in the environment. You've got modulation of mood. Again, mood is not just like normal mood and depression. Mood is something which is under flexible control. You know, that's when your mood is high. When your mood

is low, your brain is saying, you know, don't bother. Don't go looking for other stuff. Just stay here. Nothing else is interesting out there, your brain is convincing you of this.

All those things that we often think about as co-morbidities are really part of the same fundamental driving process, which is the brain thinking, how am I going to look after you? You've injured yourself. I'm going to try to modulate many aspects of your behaviour at the same time. One of those is pain. One of those is fatigue, anxiety, mood, sleep fragmentation. All part of a normal physiological response to an injury. It's all there for a reason.

Then you say, okay, well, how might that system go wrong? You can use understanding of how that's processed in the brain to think about ways in which that might go wrong. That might be different lesions causing neuropathic pain. It might be various ways in which the brain is acquiring information. We call this information restriction, but it really means the brain doesn't find out that you can get better. This is aligned to something called the fear-avoidance model in psychology, the idea that you need to drive yourself to find out information, which indicates that your injury might be actually recovering. You can start to get up and get out again.

When you do that, you see that a lot of the concepts that have been around for a long time with chronic pain, not just comorbidities, but concepts like fear avoidance or catastrophising, negative thinking and a value of information, approaches to treating pain like physiotherapy and cognitive therapy, they all make a lot of sense. Essentially, what you're trying to do is convince your brain that things aren't as bad as it thinks it is. You've got to provide it with that information to help it do that.

If you were to ask me what's the solution, what's the answer? I don't have that. But I think what we are getting closer to is having a framework for understanding how we might build those. We're really trying to map a research pathway. We think about treatments as being pharmacology, behavioural therapies and psychology.

I do a lot of research into technological therapy, thinking how we might modulate different bits of the brain or modulate the information that comes in different bits of the brain to do that. We could do that with brain stimulation. And there are many different ways of doing that now, invasive and non-invasive. We can do that with technology plus behavioural therapies. Things like virtual reality, sensory training, rehabilitation platforms and so on.

Of course, in reality, you probably want to combine that with good drug therapy. I think the direction we're moving in is integrated therapies, holistic therapies, which combine what we know works, good physiotherapy, good CBT, utilise drugs which are effective and then utilise interventions, neuromodulation, which is also effective, and try to work out a way to combine that into a good working multidisciplinary pain management system.

Evans: How close are we to solving the problem?

Seymour: I say with a bit of self-scepticism, but I do think we're close to getting to a rapid rise in our ability to change pain. I think we are on the cusp of a disruptive innovation in pain technologies that could fundamentally do it.

It just seems amazing that something as intense and specific as pain, we haven't yet figured out exactly what we need to do in the brain to change it. You might think, okay, that's because fundamentally there isn't an easy solution. Now, there may not be a straightforward solution. You've tried, people have tried zapping different individual bits of the brain, that hasn't worked that well. Okay, if you understand what different regions of the brain are doing and what we need to do to those, then we must be close to something which could actually fundamentally modulate pain.

I am quite optimistic that within my academic lifetime, someone somewhere will really figure this out. I am optimistic that great change is coming.

Evans: Professor Ben Seymour of the University of Oxford.

The biopsychosocial model for pain recognises what we've heard so far, that our experience of pain is driven by biological, psychological and social influences. Now, one of the challenges faced by researchers studying the social component is how to measure what a person does and feels throughout their day without them being influenced by the research project itself.

Diego Vitali is a data scientist at University College London. He's also a research fellow for CRIISP. That's the Consortium to Research Individual, Interpersonal and Social Influences in Pain. His expertise focuses on senses and the use of technology to collect data from individuals as they go about their day.

Vitali: The challenge we posed to ourselves was to get out of the lab. Because we have done this in the lab, we've tried to look at these behavioural responses in the lab, isolating them in a specific experimental setting and studying them and then identifying how much they matter. But then in the real world, when people go home, they've got their own house, they've got maybe one floor or two floors or a ground floor or a lower-ground floor, or, whatever it is, the configuration of their lives. Everyone's different, they go about their different behavioural patterns.

The challenge was to employ technology that could be used by participants themselves, that didn't require specialist tools or specialist skills to install. We thought, okay, maybe we can use consumer technology and see what it can tell us about these aspects. We started using a software that works through our phones, our handheld device. It's an EMA software, so ecological momentary assessment, which is a way of asking you questions throughout the day. Some set times, some random times.

Some questions are in the morning. You get up and you get a ping on your phone, this ping is customised to you, and it says, oh, how did you sleep? How's the pain right now? What are you up to today? What are you going to do? That's some quick questions. It takes about one minute, two minutes, the morning one. And there's some very specific categorical questions, asking for categorical answers, where you type in things like how you feel, mood, pain, interference at night. During the day you

get more questions like that, shorter surveys targeted in the moment. So, right now you get a ping on your phone. Is this a message? No, it's a ping. How's your pain right now? How's your mood right now?

We monitor this every day for a month. This allows us to circumvent asking a person, what was your pain in the last three days on average? In comparison, it's rubbish, because we ask people to do an average and average is never representative of what the pain was. But if I ask you in the moment and you're free to tell me that now actually pain is low, now actually pain is really bad. You can just tell me now, it's easy, it's right now. And so is the question about mood. And so is the question about interference. How much is pain interfering with my thinking, with my doing?

We do this four times a day for a month. So we can detect the differences, you can identify a period of time where there is definitely an acceleration of pain symptoms. We call that a flare-up phase. We can see what was your behaviour before and during this acute phase and then after, when the peak ends and there's a plateau, usually that corresponds to the person maybe resting or seeking repairing behaviours, or helping behaviours.

Evans: Because you are, or the system is, checking up on you at random times, I know I'm going to be asked at eleven o'clock, so I'm going to sit down and have a cup of coffee and answer it, no, you cannot prepare for it.

Vitali: No, it's about now. What are you up to? Are you outside or inside? Are you by yourself? Are you with someone else? Who's this? My wife. My children? No one. A friend. An acquaintance. You can tick boxes of whoever you're with.

For the people that we've monitored, we can see patterns of social interactions that tell us a story about that particular person. At the same time, we collect information with sensors, which allow us to monitor the activity level.

For instance, steps is a good indicator of physical activity because we walk on legs. Brain activity we do sitting down, most of the time, but physical activity most likely involves moving, and step counters are a good indicator of movement. When there is a flare-up, when pain changes, this is an impact of this activity, we can see that pattern changes.

We can see, for instance, the avoidance of physical activity, of a regular routine pattern. By comparing what that routine was maybe forty-eight hours before we started a flare-up phase, to the period after the peak has ended, when it's stopped increasing and started plateauing and decreasing. What happened to the activity there?

At this moment in technology development, with artificial intelligence and the availability of vast computing power, we can use information to build personalised prediction models. We've started to analyse voice diaries, which is another aspect of this research.

We ask people to talk into a recorder. We have an anthropologist that works with us, and it's helped us build a scaffolding, which is a way of interviewing by which you

slowly build the confidence in the interviewee to talk about things that are more personal. Over a thirty-day monitoring period, every day they talk to a recorder. In these recordings, we use artificial intelligence to decode the transcript and then we decode the voice tone to detect emotions fluctuating during the speech.

The aim of this is to build a personalised model so that we have information about the emotional state of the person. We build a vocabulary of what the person talked about, how similar it is to concepts that we think are important. Like, we often talk about pain worry. We can empirically see how many of the things that are talked about are to do with pain worry and what is the emotional tone of the person talking. This augments our capacity to see the emotional state of the person, the living context of the person.

Evans: That was Diego Vitali of University College London. And finally, somebody has brought up those dreaded words: AI, artificial intelligence. You will have an opinion on it, ranging from destroyer to saviour of humanity. Hopefully something in between. But whatever you think of it, the AI genie is out of the bottle and can't be put back.

Joshua Pate is Associate Professor in Physiotherapy at the University of Technology in Sydney, Australia. He's leader of an AI research group building global partnerships to answer clinical questions about AI in healthcare research.

Pate: Just from the get-go, let's just say I'm not pro-AI or anti-AI. I'm kind of in both camps. It's potentially very, very, very good. But also there's potentially lots and lots of risks. For me, thinking as a researcher, when this technology started getting used a lot, there's a lot of questions embedded in that. But one of them was, if it's not going to slow down, if the rollout is just going to happen, researchers should be part of this conversation and we should at least be testing what's happening.

So I lead a team. There's thirty-nine researchers at the moment, and we've all come together to go, what's some studies we can all do together that are, we can keep up with the pace, but do them in a way that they'll last. Because the challenge in all these AI studies, and you see this in the media, they go, oh, the AI chatbots are still hallucinating a lot, or whatever. That hasn't really been a problem since — when are we in, 2026? — since March this year. It's not completely solved, but like it's 99-point-something-percent solved. You're not seeing dodgy citations and all of that stuff. If you're using the paid leading models, it's capable of a lot more than that.

There's this really big challenge in AI where there's a time lag between the technology just getting released without any sort of government regulations or anything, and then people are using it. It's not like Doctor Google, but they are using it for healthcare. So if we call it Doctor AI just for this conversation, it's different to Doctor Google because they're not just accessing information, it's changing the meaning of the information.

So if you're an electrician accessing information about your nerves, the chatbot looks at its memory. And last time we spoke, we were talking about electrical wiring. Oh, I'll use that as a metaphor. And it seems to reach for relatable ways. And sycophancy

was a big issue last year, where the chatbots were trying to please you all the time. Again, that's getting better and better.

But yeah, there's, in my head there was just all these risks and questions and I'm like, guys, we need to do some studies on how this is going to roll out in healthcare.

But I'm particularly interested in the human side of the equation, like what does it actually change for someone if they upload a picture of their scar on their knee or whatever it is, or their X-ray results or their blood test or whatever, is it changing how they access care? Is it changing how they think about their body part? Is it changing the way they move their body? Is it instilling more fear, less fear? Could it be good? Could it be bad? Do they become less social about their pain? There's all these things in that space. I am a child with chronic pain. Is it all in my head?

And we're seeing if the chatbot would be stigmatising, and it was initially and now it's not. And it's like, wow, that's amazing that that got solved. We didn't really contribute much, but we got to see that that was an issue. Now we're testing it in voice mode, where it can't give long answers. Who does it side with in terms of the guidelines, the doctor, the physio, or whoever it is, the parent, the child? If everyone's disagreeing, what does it say and how does it respond? They were building benchmarks, or scorecards, for these systems, and at least considering what are the potential implications is really important.

I have kids at primary school age and the way that they talk about, oh, my friend talks to Alexa about blah, blah, blah, or Siri says this in my friend's car when I went to soccer training, and they talk to Claude about this, ChatGPT gave my friend his speech... the journey that social media has been on where it's like, oh, hang on, there's all these harms. I wish we had dealt with it differently. I feel a bit similar of like, how do we navigate this for the next generation? What are the developmental implications? All of that stuff. But at the same time, the research work I'm doing, we need to keep thinking about, well, okay, if that's happening now...

I'll just share one really quick example. We're having to build policies at a university level for students wearing glasses with cameras. There's two sides to this. Do we stop allowing that to happen? Or do we prepare people for a world where people will wear those all the time? If your doctor's going to wear them in ten years time, if it would be crazy for your doctor to not wear those glasses because they can do all sorts of amazing calculations for the doctor or whatever it is, I don't know, they could read body language in better ways than a human can or something like that, maybe we universities need to be helping people to navigate that future world. But on the other hand, in terms of academic integrity, it's an absolute nightmare because how do you know if you're assessing what the actual person knows and can do and their skillset?

That's just like a tiny sliver of some of the questions that we face in the academic world at the moment. How do you marry these two ideas of measuring learning, or assessing learning check marks, and getting qualified and becoming a trusted registered health professional when the assessment process is kind of being convoluted by these technologies? There's just so many factors at play.

I just want to be part of the effort that, if we look back, it's like, I think we're gonna wish we did more research, so I want to at least be doing some work in that space to contribute to some of that. I don't know, if everyone just put aside 10% of their research time and maybe contributed to it. We could kind of make a concerted effort to make some good decisions.

Evans: If you were to reach out to the listeners of *Airing Pain* for the answer to just one question, what would that question be?

Pate: I'd love to hear the priority. If they were like, Josh, don't do that research, that's a waste of time, that'd be helpful feedback. I think I'm open to that. I'd be interested to observe myself receiving those emails. So yeah, if people are hearing this and they're working on it, or they've got ideas and they want to test them, love to talk more about the technology side.

I think if we can harness the good bits and then be testing out the risk parts, is the work I'm doing making a meaningful difference for people hearing this, or is it still very upstream and some of the work we're doing, like you look at clinical data and for a research finding to actually change the patient experience, there's some studies showing it's seventeen years and I just don't want that. I want it to be zero. I'd love, yeah, I suppose that's my question, is some feedback on is this the highest-priority research and how could researchers do better?

Evans: Joshua Pate, Associate Professor in Physiotherapy at the University of Technology in Sydney, Australia.

To all you researchers out there, take him up on his challenge. What direction should research about AI in healthcare take? Email him direct or through the contact page on Pain Concern's website, which is painconcern.org.uk, and we'll pass on the messages. As always, I'll remind you that whilst we in Pain Concern believe the information and opinions on *Airing Pain* are accurate and sound, based on the best judgements available, you should always consult your health professionals on any matter relating to your health and wellbeing. They are the only people who know you and your circumstances, and therefore the appropriate action to take on your behalf.

Now, it's important for us at Pain Concern to have your feedback on these podcasts so that we know that what we're doing is relevant and useful, and to know what we're doing well, or maybe not so well. So do please leave your comments or ratings on whichever platform you're listening to this on, or the Pain Concern website, of course. Once again, it's painconcern.org.uk. And do check out the British Pain Society's Year of AI, Technology and Innovation in Pain Management at their website, which is britishpainsociety.org.

I'll end this edition of *Airing Pain* with messages to those who would stand on the shoulders of giants like Pat Wall, the delegates of the British Pain Society's 2026 Annual Scientific Meeting, from Professor Karen Davis of the University of Toronto in Canada.

Davis: Britain has a long history of outstanding research in the field of pain, and I think the message is one of hope, because we can see that the ideas that we're

building on over these decades are now able to get closer to being used to develop individual or personalised therapeutic approaches for pain because of technological advances.

But you can have technological advances that still doesn't necessarily help individuals. You have to merge together your theories and your ideas and the evidence and your research with those technological advances. That's a wonderful place, where we are today, that we're not necessarily restrained by the idea that, well, we will never have the technology to deliver certain kinds of therapy. It's like, no, we do now. Or we could see the possibility in the very near future.

Now, we have to understand what to do with that technology. The technology is not going to be as much of a barrier. The barrier is our own imagination of what we think is possible and how we should use that technology.