Cafe Connect - Episode 7

Voice over [00:00:02] This podcast is brought to you by the University of Aberdeen.

Dr Barbara Gorgoni [00:00:07] Hello and welcome to this new episode of Cafe Connect, where we bring you the latest research from the University of Aberdeen.
My name is Barbara Gorgoni, and I'm part of the public engagement with Research Unit at the university. In this series, we meet different researchers who will talk about their work and their relevance to our everyday life. If you have any questions, we would love to hear from you. Please email peru@abdn.ac.uk. And we will put your questions and comments to our speakers. Keep in mind, however, that they won't be able to answer any personal or medical questions today. I'm delighted to welcome quite a line-up of experts from both the University of Aberdeen and NHS Grampian who have worked together in the last few months. First of all, we have Professor Corri Black, Director of the Centre for Health Data Science. Dr Nick Fluck, medical director for NHS Grampian. Dr Graham Osler, Health Intelligence Analyst and Dr Dimitra Blana, Lecturer in Health Data Science. They will discuss how modelling is used to support the NHS in the response to Covid-19 locally. So welcome, everybody.

Everyone [00:01:40] Hi, Barbara. Good to see everyone. Hello.

Dr Barbara Gorgoni [00:01:42] I will hand over now to Professor Corri Black, who will get started with a few definitions. So, first of all, Corri, what do we mean by locally?

Professor Corri Black [00:01:54] Thanks for inviting us to join this podcast. So as the Centre for Health Data Science, local for us during the current pandemic has meant working really closely with our partners in NHS. Grampian and I'm going to invite Nick. Would you tell us a little bit about NHS Grampian as a whole?

Dr Nick Fluck [00:02:14] Yeah, certainly, Corri. And welcome, everyone. At NHS Grampian, we're one of the larger mainland health boards in Scotland up in the northeast of Scotland. The population coverage is just over half a million and it's a very diverse area spread from city region with about a quarter of a million people in Aberdeen through to rural Aberdeenshire and up to Murray. Now we sit in the context of the north of Scotland, which has got six health boards in it, and we have very close relationships with the island boards of Shetland and Orkney where we provide the majority of the care and also some of the regional care across to Highland and for Tayside as well. So it's quite a big patch, certainly geographically, but relatively speaking, I guess in a national context, still quite a small population.

Professor Corri Black [00:03:06] Thanks, Nick, for giving us that insight into Grampian. And I guess it's worth saying that it's part of a picture across Scotland, isn't it? As we've been planning into Covid, we've been looking both at the UK information, the Scottish information and globally in terms of trying to understand how we might need to react and respond as a system. The focus today is thinking about how we've used modelling and I guess we've heard a lot in the media about following the science and following the model that the UK government is describing. But it might be helpful just to think about what does a model mean to us. So, Nick, for you, as somebody having to design a response from the health service? And I guess you coming up and asking us for help with using data to plan that? What does a model mean to you?

Dr Nick Fluck [00:04:08] Thanks, Corri. I mean, right at the beginning, I think we all recognise that a lot of our information was coming really from the news and from friends around the world and across the UK. And I guess in its simplest terms, for me, a model was a very clear picture of a situation both now and for the future. So fundamentally a communication tool. And certainly right at the beginning, there was a major deficit in not having that to hand.

Professor Corri Black [00:04:39] That's great. So I'm going to turn for something a little bit more technical. Dimitra, you're a biomedical engineer. So what's your shorthand definition for a model for you as a scientist?

Dr Dimitra Blana [00:04:53] Thank you, Corri. So for me, a model is a mathematical description of a system or a process. So, as you said, my background is in biomedical engineering. And I regularly use mathematical models of their musculoskeletal systems. So models that describe how muscles enable us to move. So in epidemiology, a model would mathematically describe how an infectious disease spreads.

Professor Corri Black [00:05:17] OK, that's great. That hopefully sets a bit of a picture of what we're going to be talking about.

Professor Corri Black [00:05:24] Nick, I remember when we started this back in probably February, even before the first cases of known Covid in Scotland had emerged and we were watching the situation in Italy. And I guess, well, at that time, it was a conversation about, well, what could we learn at that highest level? What could we learn in terms of how we might begin to apply in a system change? Just reflecting back on that, as somebody who was having to look at that. Well, what was starting to go through your mind, but what sort of information did you think you were going to need at that point?

Dr Nick Fluck [00:06:03] Yeah, I completely agree, Corri. So, again, early on, it was a situation where we felt we had lots of information. So there was a huge amount on the news. We had lots of communications with individual clinicians, but we really didn't have that clear picture for what would it mean for us. And I think one of the critical aspects that we hadn't been able to communicate right at the beginning, and this is what we were really looking for, is understanding the exponential nature of a pandemic event. Just about everyone in health care is used to the idea that demand has variation. But really, in terms of a growth of demand, it tends to be very linear or in a surge manner. But that notion of exponential growth. So understanding if things came to Aberdeen and we thought of a word, what would that actually mean locally for us? And how do we convey that message to our clinicians that what you may be needing to plan for is something that you have not faced before?

Professor Corri Black [00:07:10] Yeah, I think at that time, my memory's feeling really struck by the images that were emerging and the stories actually on Twitter and other places from Frontline A&E consultants and senior managers and some of the hospitals in Italy. And that sense of how quickly it seemed to go from one or two cases into queues of ambulances at the front door. And yes, that difference between what a doubling time looks like. So going from two cases to four, you know, and increasing but as you go up from what still feels like quite small numbers to suddenly turning the corner as we hear them describing it now into these really massive increases every day. And I suppose for the first time, really seeing what that might look like on the ground as you watched the news each day, it was pretty daunting. I think, in all honesty, it felt pretty daunting at that moment in time.

Dr Nick Fluck [00:08:11] Completely agree, Corri. I mean, certainly in those early few weeks, you know, we all had really pretty bad sleepless nights, sort of trying to really get a grip on what it would actually mean for us. And, again, you know, quite a lot of us were used to what I guess you could call individual major incidents, where something comes, it's very bad. One has a very short lived but immediate response to it. But this was a situation where we were trying to imagine a future that wasn't in front of us yet. That would probably span for a much longer period of time. And really trying to visualise and get a grip on that was very, very difficult. And certainly, yes, we used to come several times a day and sit around these sort of whiteboard and try to get a real picture of how we understood it. When we went down to meet the clinical teams in the hospital, there was a real sense that we were needed to bring them closer to that understanding rather than the one of this was a disaster happening in Italy rather than something that we would have to plan for and face.

Professor Corri Black [00:09:23] Yes, I think that was really striking that sense that as it almost came across the country through, you know, through Italy and Europe, and then into London and even though by that time we had cases in Grampian it still felt very manageable and still something that perhaps was quite a long way off. Graham, I remember at that point in time, you and I spent a lot of time reading and trying to think about how we could interpret and use the information that was then, into March, beginning to emerge from Imperial College and the "Imperial paper", the "imperial model" as it was talked about and talked about widely in the media as well. Do you want to say a little bit about what those first steps were like for you within Health Intelligence in Grampian and seeing those models and thinking about, well, how can we use that to help support this planning conversation?

Dr Graham Osler [00:10:33] Yeah, thanks, Corri. Well, that was an extremely interesting period of time for us in health intelligence. I think, as Nick says, you know, in terms of a health intelligence approach to sort of planning and so on, we talk about years and looking at averages over years and so on. And nothing of this nature had sort of come our way before to start to be thinking at that sort of scale, and especially over lots of the data that we manage and deal with this stuff that we're very used to and can measure and have done so for years. Coming to this situation as a sort of epidemic situation was something that was completely new to us. And it was invaluable having the link with the University of Aberdeen, with you Corri, who were pulling out those research papers that were published, you know, rapidly. And putting those in front of us really was key to how we could respond, I think. Your ready access to a knowledge of where to find those things was key to saying, right, here's the thing that's going to help us get somewhere. So I think that Imperial paper came out on about the 23rd of March, if I remember correctly. And it was something that we then literally poured over as quickly as we could, because what we were faced with was a massive lack of information on that local level, really. And we weren't going to get that really. We weren't going to understand how many of our population were infected or anything like that, that we could, you know, obviously that we could put into models. And so having a basis to begin with, with that imperial paper, having access to your team. I remember initially as we started to pull pulled some of the information out of that and say, right, this is how we could start to do something to understand something for Grampian. I went straight back to Dr Jess Butler and said, am I doing this right? have I interpreted this paper correctly? And having that back up, having someone with that experience of the research papers that were so necessary to start to construct something, was invaluable for us at that time. And of course, that partnership with you and Jess continued with the CSO

funded project that's looking at the health care needs of people shielding from Covid-19 in Grampian.

Professor Corri Black [00:13:04] So I think that that's a really striking difference in this situation, isn't it? That normally, our normal planning models to look at what we've known, look at our lived experience and look at that either from our clinical understanding and our clinical colleagues' experience or from the data, Graham. And I'll come back to you in a minute, just ask you to say a little bit about what that means in terms of what sort of data would you be looking at routinely to plan for a winter or a health care situation. But in this situation, we had no past. We had no experience of it before. And so it was absolutely into what Nick I think described as painting a picture, you know, trying to take the evidence of what was emerging. And Imperial had taken this type of modelling that Dimitra described about taking an infectious disease model and what we understood about how infectious diseases spread and trying to use that to project into the future with very little information about what was happening in your population. And actually no information about what would happen on the ground in your population. But make some estimates of how many people did we think would need hospital care, how many of them might need intensive hospital care and support? And to use that, there was one or two concrete pieces of the puzzle that we could start to plan around and start to build. And essentially, what are a set of assumptions? I don't know what to say. Well, we think this amount might happen. So it's if we assume that and in this case, four percent of people infected might need hospital care, then what would that mean? How many beds will we have to make available if the infection spreads, the kind of rates that we might be talking about? Graham, could you say a little bit about the kind of data that you normally work with? And in terms of planning, helping support planning for the health system?

Dr Graham Osler [00:15:21] Yeah, Corri. So we use some of the things that we ultimately did use for the planning of this, but perhaps with a different basis. So a lot of the things that we were concerned about here were to do with bed occupancy, how many people would be coming into our hospital. And so for that, we get our data from what is called the patient management system, which is pulling in data on who's coming into particular specialities, working out how long they might be in for, and then taking that forward to perhaps estimate the number of beds that might be required. So that's the sort of thing that we might do. Usually fairly coarsely, really. You know, we're talking about a year, you know, in a year's time or so on what we might do and not do on a day to day sort of basis of what might be happening in that case.

Professor Corri Black [00:16:19] So and these data, Graham, are the kinds of data that accumulate as part of our normal administrative process around health care, aren't they? So as a patient comes in the hospital and they're logged and clerked in at that front desk at timestamps, a set of activities, and we gather that information up as part of our NHS processes routinely. So it was those kinds of data about the sort of service flood that we're talking about here is out. Right?

Dr Graham Osler [00:16:47] Yeah, that's right. That's what we draw on. So much of is what's recorded as patients come into the system. And I guess I should say principally within an acute setting is the data that we deal with. I don't know whether we'll touch on at any point, but obviously in this sort of epidemic pandemic, lots was going on beyond the sort of hospital walls that was important to lots of people as well. Rather than just within the hospital. So we had a set of data that is all about people coming into our care. So how we see them, how long they're with us, and not necessarily much information about how

they got here and the journey that it might have taken, which was quite important to the whole of Grampian's response.

Dr Nick Fluck [00:17:34] Corri, I don't know whether I could come in there. I think Graham has hit on a couple of things that were really critical at the beginning. So having done some of that initial work, essentially taking some of the assumptions from the imperial model and saying, well, what would it mean locally? And then I took that information down to the senior clinical leaders in our main hospital, which has got about 800 beds or so. And I guess the language Graham talks about is known to all of them, you know. Conversion rates into ICU, length of stay, delayed discharges, bed complements, all of those sorts of things. That's their everyday language. All of the people around that table had read the imperial paper. But that transition of turning that into real life take them through it, well, we've taken the assumptions out of the imperial paper. We've taken an assumption about what might be a realistic worst-case scenario. And then I'm going to now tell you what that means in our hospital here. And when we showed the first sort of figures where, you know, it looked as though at the peak, if things hit that sort of realistic worst case scenario, we would take our ITU, which normally has 15 or 16 beds, to 80 beds. We would use five to six hundred beds of our hospital just for people with Covid, and we would have over 100 people arriving to the hospital every day. Now, that sort of power of that message, I mean, there was stunned silence when we put that through. All of those people had read the imperial paper. But until you'd worked them through, these are the assumptions we take from it, and this is what it would be like sitting in this hospital if those come true, it was colossal! It was a watershed moment for me and changed the engagement, the buy-in to planning and thinking.

Professor Corri Black [00:19:29] I've worked with data for the best part of twenty-odd years now. And for me that experience of sitting down twice a day with yourself in that senior leadership team and with Graham and the raw data and grappling evidence from other sources, the hard numbers that we were used to seeing and trying to translate messages that you needed to be able to communicate and take that picture of what it was we might have to plan for was a really powerful experience. It's possibly one of the most powerful impact experiences from an academic research. You know, in terms of the time from a conversation to change was so intense. So it certainly was a real lesson for me in terms of how you might use data in a really valuable way, that was really important for me to see. And the sorts of information that you needed in order to be able to communicate, it was interesting insights into how that process can work. It struck me the thing that then was that tipping point, I suppose, was we had those conversations, we had the emerging understanding of just how big this task might be if nothing else changed. And of course, that wasn't what happened then, because that was not a tolerable situation. And the interventions, non-pharmaceutical public health interventions, as they described them, which are the lockdown, as we now all know, it was brought in quite early for Grampian in terms of our number of cases that we were experiencing and seeing through the hospital doors. But it felt like that journey into actually beginning to see cases beginning to stack up and plot that real data against the lines that were drawn in terms of the model. The simplified extraction of that imperial model into some spreadsheets to say we think this is a change you can see every day and then starting to track those occupancies, that bed occupancy that Graham described and tracking that line felt like that was quite an important step in terms of understanding that yes, in fact, this trajectory does look as though it might be real for us. We might be experiencing something that we have asked the system to because these were really hard times for everybody doing this. And it was hard times to have to make a decision. I've been with the data team telling you that you're going to need to make a decision about whether you can keep the normal services of the

NHS running or whether this is something that's going to have to be more radical. We didn't make those decisions because that was a policy decision across Scotland. But it was a daunting sensation, I guess, in terms of being the people doing the maths behind it. Graham, I don't know if you want to reflect on that on the spreadsheet aligned and then watching the data coming in terms of how that was influencing?

Dr Graham Osler [00:22:55] I think it was daunting. Obviously, that was the sole focus of our organisation, really was around our response to Covid. And yes, we've taken the imperial model and drawn some lines of our sort of worst-case scenario that we could deal with, or slightly less than worst case scenario we didn't. So that draws nice lines on a graph. We didn't actually know where our start point was on that graph. And we spent quite a bit of time gathering some data and saying, well, I think we might be in week five, but maybe we're in week seven, in which case we're on a different line. And that was all really quite difficult. Understanding the data as it came in as well was quite difficult to get a shared understanding of that variability or around that. So we drew some very nice lines and they all look very neat. But when you have five more people coming in than the line says. To know whether that's a really big issue or not was a stressful thing for people to make decisions on and say, well, let's hold on till tomorrow and see whether it goes down slightly below the line tomorrow. So it was daunting. I think that's where the team working, the team understanding came in and the amount that we were all working together. So Nick and his control team having those regular discussions with us so they knew where we were coming from in terms of what we were trying to do. I think probably my mixed messages out to the services here gave me a sense of, yes, Nick knew where we were coming from with what we were doing and what we were able to do. And I think that's really important. I never felt you could feel that you were hung out to dry. You know, you've said it's going to go like this and it's not or whatever. And there was never any of that sense. Probably not in many organisations, because it was so, so new to everyone. But, yeah, it was daunting to not know where that was going and not be able to do anything more about that, to say, no, no, it's okay, we'll go over that peak tomorrow.

Professor Corri Black [00:25:11] So that for me is the world of public health and the uncertainty that we're normally used to dealing with in long term interventions. Will this intervention have an impact on obesity in 10, 15 years time? And so I suppose to see it coming into that database, you say you were watching data and having to decide whether it increased. And I remember the weekend when the numbers started to increase rapidly. And that kind of watching it all weekend. Not really being able to disconnect from seeing the real time data comment by that time. We're tracking every day. Anyone who's coming into the hospital and has a covid test, because back then we were only testing people who were being admitted to hospital. We're tracking them, seeing them coming into the ward, seeing where they are, whether they're in the covid-dedicated wards or whether they're in intensive care. And seeing those numbers build up and I remember that we were not being able to really leave the screen because we knew it was busy on the Friday. And we could see those covid test results coming in. And wondering if this was going to be the start of it.

Dr Nick Fluck [00:26:34] Yeah. Corri, really interesting because I remember that weekend well, and I also remember the calm before the storm, if you like. So I think an additional thing I'd add to getting that model into a local context, it's also bringing it to people with sufficient trust around it. Because what we asked people to do in those two or three weeks before that weekend when it started heating up was to plan to reconfigure and reorganise the best parts of five or six thousand staff in an 800 bedded hospital to potentially do a completely different job. And the planning around that, we got some fantastic help from the military liaison officers who came and joined us and joined our team. But that work, which

was only possible because they trusted in what we were presenting them and they trusted the people presenting it. So people like yourself, Corri and Graham, and other members of the team had built that, if you like, currency of reputation and trust in our local health community, such that they could take that and plan for something that on paper looked extraordinary. So it's always very interesting when people say to me, well, it didn't really come to much, did it? Now, that's been said to me quite a bit. And I guess there's two reflections I have on that. The first is, well, it didn't come to much, but we had 100 people in our hospital with a single disease and an ITU twice the size of normal with half a dozen people on ECMO. So did it not come too much? Well, we'd never seen anything like that in our careers. But I think the other reflection is that it didn't feel like that because we built the trust to generate the planning. So as those numbers changed and we had to change wards and move staff around and all those sorts of things, we followed the script, the script that had been written by the information intelligence that you guys had built to generate that trust in our clinical staff to make those moves.

Professor Corri Black [00:28:54] So I think that it's really nice to move into a bit, I guess, where the research search starts to really come into this moving forward, because what we learnt was relationships really matter. And I think that's come out really strongly listening to the conversation and the reflections of that first wave and then taking that real world data and putting it inside a model with somebody who can understand the inner workings of that model who would help us move into this next phase of doing this for the long term. Now, doing this again, as we will see, the second wave, of course, are coming then really with quite a different scenario. So what we understood for the first wave was about this hospitalised infections. And that was the only insight that we had in terms of the real world, was the testing in hospitals. We're testing now, but we're testing a far wider range in the community and that changes the information that we have and changes our ability to interpret. So, Dimitra, I'm going to come to you now because you led us into that next step of putting together a research proposal about how we might combine and build on the learning and take some of those methodologies forward. Could you tell us a little bit about that work?

Dr Dimitra Blana [00:30:09] Thank you, Corri. So one thing I want to say is that the last few months for me have been very fascinating. This is obviously not my area of research as a biomedical engineer, but because I'm a member of the Centre for Health Data Science, I was exposed daily to all these asks from the NHS. I knew about the modelling that was going on and I was quite keen to contribute. So one thing that was obvious was that it was great to use the outputs of the imperial model and adjust them for our local situation. But what would be really good was if we could develop a model locally with data collected here from the start. And so by talking to people in the Centre for Health Data Science, I realised that mathematically, from a mathematical point of view, when you look at these epidemiological models, they are very similar to the models that I'm used to dealing with in biomedical engineering. And so quite a few of those engineering approaches that I use could be used in the epidemiological models to fit their models to local data. So this is what we did, and we applied for a grant from the NHS Grampian Endowments Fund, and it was successful. So we're very grateful for their support. And the aim of this grant is to use engineering methods to develop a model that's specific to the Grampian region so that with a local model we can then make local predictions and assist a local response to the epidemic. So I'm just going to mention quickly that this engineering approach is just a different way of estimating the parameters of the model. One of the advantages is it can estimate parameters that themselves change over time. So it's not you know, it's not different. It's complementary to all the statistical approaches. So, for example, Public Health Scotland are also developing models using statistical approaches.

So we're working together on this and we're exchanging ideas. So the important thing is that the model is being developed specifically for Grampian. So we're focussing on how the infection is really spreading here. Who is more affected by it? What are the characteristics of people here who end up in hospital? And if they go into hospital, what exactly is their pathway through the hospital? So we're fitting the model with this sort of data that we have collected from the epidemic so far. And so as cases in the community are rising, then we can make predictions about what we expect to see in our hospitals here in Grampian.

Professor Corri Black [00:32:33] So it's really important that we look after data carefully and there's a process around that. And I guess it starts right back at your research proposal, doesn't it? So we take that and we get a set of permissions. We have it scrutinised by the Caldicott Guardian, who's the person who has to make a decision about whether the benefits from looking at the data outweigh the potential risks to individual privacy. And that we have a plan around how we're going to look after those data and who's going to access and who is going to store any information. And so for these studies, when we're working, we work as if we were one, as if you and I are part of the NHS Grampian team and we minimise the amount of data that we share. We remove identifiers wherever that's possible to do so, it's not about the names of people. And that we then hold that data in a secure way that is not accessible to everybody. And I guess that's the kind of core parts of answering only the question we need to answer with a minimum amount of data that we need in order to answer it. Absolutely with that local angle about using that local data to have benefits for the care of patients in that local set.

Dr Nick Fluck [00:33:52] Corri, I'll come in a little bit on that because I completely agree. The fundamental principle is, what's your purpose? And do you have public trust? And one of the really interesting things early on is that I talked a lot about communicating with professionals. But very shortly after we'd spent time with the professionals, we went public with our information. And we were probably one of the first groups in Scotland to take that approach of actually showing what our prediction model data was and what our plan was to the public. And we made a very amateurish, short video and put that together. It still holds the Grampian record for the number of views in terms of the population. You know, the feedback was tremendous. And I think that provides a foundation that what your local population wants is they want to trust you. They want to see that you're understanding the local situation. And they want to see you planning for the future. And all of those things generate the platform to be able to run projects where people effectively are saying that I'm comfortable with the use of my data in this way.

Professor Corri Black [00:35:09] And it's maybe worth saying it again, Nick, as well. It builds on years of work. doesn't it? Where the university and NHS Grampian have worked in partnership, around building systems and structures to help. So we have a thing called the Grampian Data Safe haven, which is a secure facility with an experienced team, who help us mobilise data for approved research questions and keep it in a secure way with a tight record and control over who has access to the data. And we've used those principles to help us move at pace now where this time round, Dimitra and I will remain on the coalface with you in a sense that this is this is a pandemic situation and we needed to work at pace. So we're working in a slightly different way from that. We're working to those same principles and that same experience in how to do this well and securely with the safe haven.

Dr Nick Fluck [00:36:05] Yeah, I would agree, Corri. And even more than that, I guess we have a local population that want us to pursue that work. If we think about the fantastic

work the university has done with the children of the 50s and, you know, the Aberdeen maternity database, you know, real heritage of using data to plan for populations and understand need. So it is really interesting you describe how the gap between research and active operational business has got closer and closer. And it's not only close in terms of how we work together, it's now become paper thin in terms of the time between the research modelling and the application into practice. And that's something new for all of us. You know, we're very used to a cycle where academic research produces a publication that people read next year and potentially change practice. This is stuff where, you know, on the Monday you're doing something and we're stitching it together on the Thursday to talk to people about it.

Professor Corri Black [00:37:15] It's a real transformation in terms of pace at many levels around academia. And I guess health service redesign as well. I wonder if we could maybe just finish off Barbara, just before we stop, in reflecting a little bit. So here we are, it's coming up for the October school holidays now. And we're moving into winter and winter is always a challenging time to the health system because of additional pressures both in primary and secondary care. And we're watching a rise in positive cases at the moment in Grampian, largely in our community setting and in younger people associated obviously with the well publicised university student outbreaks across the UK. But we know that this disease follows a really standard pattern, time and time again as it moves out of that younger group who largely are fairly resilient to the illness. We see it moving into an older generation and people with other underlying health problems and the risks of those people having a more complicated time with covid begin to increase potentially. So I guess for all of us who are beginning to brace now again and begin to plan again, it's, I suppose, hearing a little bit about Dimitra's model, knowing what we do from the first grounds, I suppose, and wondering how you see some of these tools being able to help you plan and in what actually is a much more complicated ask of you this time, which is to keep a health system going and functioning for as long as you can while also having to be really agile in reacting to any change in that pattern that we're seeing from the community who are experiencing Covid and people now requiring more and more hospitals.

Dr Nick Fluck [00:39:18] Again, I would completely agree. I think the appetite and the need for this is greater than ever before. I mean, as you describe, Corri, it's definitely more complicated because as time has gone on, the critical functions of the health service that can't be paused any longer need to be provided. And at the same time, as we go into winter, where there are obviously a number of drivers that drive unscheduled care and changes in an illness throughout that period of time, and then the uncertainties of Covid. So to stitch all of those together is very complicated. It's absolutely critical. And the appetite is enormous. So, you know, there is a whole legion of our teams saying, where's the model? Where's the model for winter? We need the model for winter so we can have a plan because people want a plan. And that's all of us that are involved in that. And, you know, it will be complex, but I think we shouldn't be anxious. Models for me are not about being right about the future. Models are powerful tools to communicate and plan and to support us and hold our hand as we go through these really difficult times. We shouldn't be anxious about whether a model was right or wrong. It's always right if it helps us get through.

Professor Corri Black [00:40:47] That seems like a really good place to hand back to you, Barbara.

Dr Barbara Gorgoni [00:40:51] Yes, absolutely. On that note, I really would like to thank all four of you: Corri, Nick, Graham and Dimitra, for such a fascinating insight into how

modelling works, its importance in helping us to meet the current challenges. But also, I think this has been a really valuable reminder of how important it is to bring together different perspectives and different expertise, going from the clinicians to the biomedical engineer to face the current challenges. So thank you very much for this really fascinating conversation. And to our listeners, I would like to remind you that if you have any questions or comments at all, please email us at peru@abdn.ac.uk. And keep your ears open for our next episode of Cafe Connect. Thank you so much for listening and goodbye.

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