Podcast – Jo Merrifield interviewing Tom MacGillivray

Transcript

Jo Merrifield speaking with Tom MacGillivray

Time	
0:10:	*Welcome to this episode of Clinical Research Career Conversations, brought to you by Edinburgh Clinical Research Facility. My name is Jo Merrifield, and today I am speaking with Tom MacGillivray, Deputy Director of the Image Analysis Core here at Edinburgh Clinical Research Facility. He discusses the importance of image analysis in clinical research and his path into this career. Enjoy.*
0:44: (Jo)	*Hi Tom, thanks so much for joining me today. To start us off, do you mind explaining what your role as the Deputy Director of the Image Analysis core involves day to day?*
0:52: (Tom)	Yeah, day to day is about making sure people can access and use our facilities for their research. So it's about enabling people to have the skills and the equipment and the specialist backup to be able to do their research projects.
1:07: (Jo)	*OK. And I guess some of our listeners might not be aware of the importance of image analysis in clinical research. Can you describe a little bit what its role is?*
1:18: (Tom)	Yeah. It's maybe not a particularly common one at first thought that image analysis would be important in clinical research. I think it really comes down to when medical imaging started to really appear as a routine tool 20, 30, 40 years ago in medical service and then people started to see how it could be used in research. It's then how do you get information, how do you get data out of a medical image that you can use to back up what you think your research question is all about. So if you think something is changing in the human body and you want to use a medical image to show that, how do you quantify that? How do you measure it, so you have the data to investigate your research question. So we help people measure things in medical images, and that gives them the data that they need for further analysis.
2:07: (Jo)	*OK. And these images, are they X-rays, CTs, what kind of images?*
2:12: (Tom)	Yeah, they can be anything. So when we started the Image Analysis core, we tried to respond to what people wanted us to be able to help them with. So in Edinburgh, that's been lots of MRI - we've got lots of people interested in using MRI in clinical research. And over the years, there's been CT as another common technique that people in the hospital use, and they want to use for research. And ultrasound as well. A little bit of microscopy stuff, and a little bit of pathology imaging. And then more recently for my own research interests has been around retinal imaging. The type of images you might get at an eye hospital, but we use that in research.
2:48: (Jo)	*Mhm. And I can imagine over the last decades or so, it's changing with the advancement of artificial intelligence and things like that. Have you seen that?*
2:57: (Tom)	Absolutely, yeah, when I first started with image analysis, we would use what we would maybe call traditional image processing techniques, and you would interact with the pixels or the voxels that make up the image and you would do operations on them to highlight the objects you're interested in. It might be the liver, or it might be something to do with the heart or something to do with blood vessels, so you would

do some image processing, you would try and segment, so identify the objects you're interested in in an image. And you could only do such a good job because there was limitations around how well you could detect something with a technique like that.

3:33: Then artificial intelligence explodes. It starts to emerge about ten years ago and has then completely exploded over the last five or six years, and that's taken the level of accuracy, the ability to detect something correctly up to just as good as if a human was painstakingly drawing something by hand on top of an image. So yeah, artificial intelligence has really taken what you can do in terms of doing something automatically and doing it quickly beyond what we could do 15 years ago.

4:02: It's a double-edged sword though. You usually need lots of data to train an artificial intelligence model. So for that to learn what it is you're trying to detect requires lots of data, and it's usually more data than people have. So then you go searching for data from other researchers, or if someone's created a data set or you could go to the UK Biobank, which has huge amounts of imaging data. Usually the AI techniques just swallow up as much data as you can give it, it can swallow it up and it just, they will consume more and more because the more data you give the model, the better you think the accuracy is going to be. So there's always this tension between you think you could do better, but the data is never quite enough, it sometimes seems.

4:42: So in clinical research, we often work with tens or hundreds of people, but an artificial intelligence technique for analysing an image could require thousands or tens of thousands of images in order to train to do a task automatically.

4:56: (Jo) *And so you obviously have to collaborate with research teams and researchers and maybe industry. So how does that work in your role?*

5:06: (Tom) It's, first of all, working out what it is they're trying to do and what type of imaging technique they're using. And then answering the sort of question of can we do that? Do we have the facilities for that? So that might be, do we have a software package that is measuring, say, part of the heart from an MRI scan. We know we have the software to do that and the expertise to do that, so then interacting with the researcher to work out how much data have they got, have they got 10 patients, have they got 100 patients? Is that data from Edinburgh? Is it from other sites across the UK or even around the world? How do we get that data into our image analysis core lab? Does the researcher need training to do this themselves? So then working out what the researcher has skills-wise, what we can train them up to do. Or do they want us to do the job for them? So they just want their images measured, they don't want to do it themselves, they're quite happy to leave that with some technical experts to do. It doesn't always happen because quite often it's interacting with people with clinical backgrounds.

6:05: So my team and I, we are more about the imaging technology and the computational sides. So quite often the interface is with people who have the medical knowledge. So that when we are measuring something in an image, we are using their clinical input and our technical know-how to make sure we do the right job, measure the right thing. I think sometimes when people look at images, it's easy to slip into what everybody knows, which is looking at a photograph, and a photograph is fairly good representation of what we see. But when you look at an MRI scan or a CT scan, that's been constructed in a different way with some different physical techniques. So you

need to understand what the image is of and how it was constructed and bring those two things together in order to accurately measure it.

6:49: (Jo) *Yeah, I can really see how you would need both those skill sets to come together to actually analyse them appropriately. Can you give some examples of some projects or research that you've been involved in, just to give some context to what you've just said?*

7:03: (Tom) Yeah, stick with the world of MRI because that's one where we work on loads. People might be interested in, for example, the size of muscles that you see on MRI scans. Changing muscle size has been looked at in different cancer areas, where the change in muscle mass might be telling you something about the progression of cancer or how well a treatment is going. So in an MRI scan, you can identify that muscle, you can measure it on lots of different slices that build up the volume of the muscle, and then you can get a measurement of that, and then if you do that on some patients and then relate that to the clinical information, it may give you some information about how muscle size is changing as someone's cancer is changing, or someone's treatment is progressing.

7:47: Very similar in the world of hearts, cardiac health, where again, MRI is used quite extensively to look at people's hearts and heart function. If you spend some time not just looking at the volume of the heart, but how it moves at particular points in the cardiac cycle, you can make inferences about its functions of how well it's pumping blood. So if you measure how the heart changes in size over the cardiac function, then you can determine how well it's pumping blood and how well that says something about the quality or outputs of the function.

8:18: And you can again look at people who have maybe particular heart problems, or you can look at people on particular treatments and say, well, we can measure the function. How does that correlate with the treatment they're on or the condition they might have? Some people with particular diseases might have worse cardiac output than other people and it's putting numbers usually to what clinicians think might be the case. It's providing that solid evidence that particular heart condition is affecting heart function, suspect this, and they sort of see it in the clinic, and then this is putting numbers, it's putting data and evidence to make that solid claim.

8:56: (Jo) *Yeah, so giving more, so not just listening to the patient's condition and what's in front of them. It gives it...*

9:02: (Tom) Yes, it's another aspect to that. I always see it as pieces of evidence, that you're building up pieces of evidence to make a case for what you think is or is not happening in a group of patients.

9:13: (Jo) *And typically, if you're collecting that data as part of research, is that then used to support diagnosis in the future? How is that then used in clinical practice?*

9:23: (Tom) Yeah, I mean, quite often the studies that are run in Edinburgh are about not quite changing clinical practice, but it might be saying, well, it's worth using MRI as part of routine clinical practice. It might not be. It might be that measuring heart function is something that just happens for research and then the researchers think, well, actually this would be useful to do on every patient or particular groups of patients. Then you've got the data to say that yes, measuring this is a good thing to do.

9:49: Then you might be showing that doing a particular measurement on a particular imaging type might be worthwhile doing on patients routinely. So you're sort of again, collecting the evidence to show that this type of measurement is really useful for helping to diagnose a patient or for prognosis, it might be more about the outcome for that patient. And it might not be something that's done routinely, but by collecting the evidence on a group of patients in a research study, you can then make the case for why it should be included back into the hospital, routinely on larger numbers of people as a sort of standard part of care. So sometimes it's about that.

10:23: Other times it can be about just investigating the future. If someone has an idea, think this could be good thing for the future. Where we are sitting behind us is a retinal imaging device that is being used by some researchers who are interested in kidney disease. And it's a strange connection, but the small blood vessels at the back of your eye are very similar to the small blood vessels in your kidney, it turns out. So if you look at microvascular health at the back of the eye, it might be a really good marker for kidney health or outcomes for people with kidney problems. And even people who have had transplants, trying to find out post-transplant who is on a good track, who's on a bad track, who do the clinicians need to spend more time with, trying to tailor the treatments. So sort of taking that piece of equipment you would find in an eye hospital, and can we make that transition into a kidney clinic in the NHS. So it's that sort of slightly more forward thinking thing of, here's some technology that's never been used on kidney patients. How do we translate that into kind of routine care, because we think it's doing a really useful, quick, non-invasive test of microvascular health.

11:31: (Jo) *Yes. That's amazing. That seems incredible. And like you say, that surely is less invasive than a lot of the other investigations and things.*

11:38: (Tom) Yes. And then where image analysis comes into that is you can't just go and buy a software package for that. So for cardiac MRI you can - there's a couple on the market - you can go and buy them from people who have spent years making them and selling them to clinicians and hospitals. For retinal imaging, that's where Edinburgh and people in my lab have worked on how do we make our own software tools to analyse these images? How do we find the blood vessels and then measure particular properties about them, how wide they are, or how narrow they are, how many of them, or how sparse they are, because we think these are the interesting markers of microvascular health in these images.

12:17: So it's working with the clinicians again to be guided by what are they interested in, they're interested in the blood vessels, they're interested in things that tell them something about if they're normal or abnormal, and how do we translate that into things we can measure. And then generate the processes to give that data back to them.

12:35: (Jo) *Wow, that sounds really exciting stuff. I wonder, do you mind telling us how you got into this role, because it seems quite a specialist area to have got into. So what was your journey here?*

12:44: (Tom) Yeah, well, I didn't go to the guidance counsellor at school and say "how do I get a job in image analysis"? It didn't happen that way! No, it's a bit of a strange one. So I did physics at university - undergraduate and postgraduate. And through physics, you see

some strange and wonderful things in the world of physics. And some of it doesn't quite seem like you could get a job out of that. But medical physics always seemed like a kind of a really useful part of the physics world where you have scanners in the hospital, all different types of medical imaging devices, you have different ways of imaging and measuring and analysing people. So that was a little bit of an interest. So when I got to the end of doing a PhD in physics, I was then looking at the skills I had for my PhD, which was a lot of things to do with analysing signals and measuring things from signals, and I thought, well, I could take some of that and measure images. The signal is just really something changing over time and an image is changing over time in two dimensions or three dimensions or four dimensions at a time.

13:44: So taking skills I had from my PhD and thinking, well, I need a job. And I could do something with medical imaging, and there happened to be a couple of opportunities for me to go and try that out and that has led to where I am today. I didn't think it was going to be a career at the time, but it has turned out to be one. And it was enjoyable, it was fun. Interacting with images, so it's very visual. You're trying to solve problems, you're trying to find things inside an image. There's a little bit of computer programming in there, which I had some skills in. So I kind of like the challenge of doing something visual, doing something with computers, doing something in the medical world, and then interacting with lots of different people from lots of different backgrounds.

14:23: (Jo) *Mhm. And did you imagine it would evolve the way it has with AI and things? Were you aware that that was on the cards?*

14:28: (Tom) Kind of. I was sort of aware that that was on the cards. It's a funny thing because a lot of the AI techniques that are being used over the last five years were being thought about 40 or 50 years ago. And they sort of, every now and again they'd make a re-appearance, and it was just in the last ten years where it felt like maybe it was a hardware thing, maybe it was a data thing, the ability to utilise lots of data on lots of computer hardware to do the number of calculations needed just enabled it. So it felt like it was bubbling away, and then it just exploded from there.

15:01: (Jo) *Yeah, yeah. So you said earlier that you have research interest yourself in retinal imaging. But you're obviously trying to balance that with leading a facility and making sure there's a resource and the facilitation for other research. So how do you find that balance? How much of the time do you get to do your interests and how much is balancing others?*

15:21: (Tom) Yeah, well, I am probably at a point in my career now where it's other people get to do the exciting things and I get to direct that or put some input into that, give people my ideas and see if they can run with them. So, to explain further, there are PhD students working on projects and they are PhD students I help supervise in conjunction with clinical colleagues, that are projects that have arisen out of research studies. So, where I've worked with clinical colleagues to help support their research with image analysis, we've then seen opportunities for a PhD student, for example, who can work on that data, and they can take some of the ideas I've got about how you would analyse those images, and they take the ideas from the clinician about why you should analyse those images and what it would be useful for in terms of a disease to better understand. So you've got a PhD student who can cross between the technology and the clinical application, which is really interesting.

16:16: So that's probably the main way I get to have an involvement in research because I've got the job of managing the facilities, as you say, making sure that resource is available, making sure we stay up to date, making sure that it's all working properly and we are staffed appropriately and all those kind of issues. And then any ideas I have, I can filter down to students or post docs and they get the exciting job of trying to run with that.

16:42: *(Jo)* *Yeah. But I guess that makes your job really broad and varied in what you're seeing in the research and you've got your finger in… it must be quite interesting.*

16:51: *(Tom)* Yes, and you sort of forget sometimes that, when you've been doing something for long enough, you have bits of information that other people don't have, which you take for granted. You think, well, I know what to do with this image, because ten years ago, I spent four years of my life working with this type of imaging. You just take for granted that you maybe know some key piece of information about something that you can quite quickly deliver to a student or to a colleague that saves them time and energy, having to learn something or repeating the same mistakes or doing something that you can quickly pass on and convey some key details to them. So it's kind of nice to pass on those learnings and that experience, to help other people out.

17:30: *(Jo)* *Yeah. And would you say that's the most satisfying thing about the role? Are there any other things about the role that you…?*

17:35: *(Tom)* Yeah, the variety of things. I think I've been fortunate enough that the job's never really got too boring because I'm helping other people do their research, that there's always a new research project just around the corner. Sometimes you're never quite sure what that's going to be. Sometimes you do because you've been asked to help with the grant application, or asked if you can do a particular thing. But there might be a research project that comes around the corner next week that I have no idea it's going to be there, and it's going to be this huge exciting thing. Or it might be a small project. It could just be a small piece of work that we do. It's just kind of really interesting, something we've never done before. So that variety of things we work on, because we're facilitating other people's projects, we're helping them do their research. There are lots of people out there with ideas, and if they come to us, then we get to work with them on that. It's really, really interesting.

18:24: *(Jo)* *Yeah, I can imagine. So obviously this podcast is about careers in clinical research. So what advice might you give someone who is listening just now and thinks, oh actually this sounds really interesting, I've never appreciated this was a career opportunity, etc. What kind of advice would you give?*

18:41: *(Tom)* Yeah, it's a really interesting question because if I think back, I didn't know this was a career option. I sort of stumbled across it, not quite by accident because I was looking for jobs in the medical physics area. I think it would be to get out there and do your research, it's to get out there and see if you can find out what people are doing for jobs. And LinkedIn just looks like a really useful tool that if I'd had that back when I was looking for jobs, I would have used.

19:06: It's just reaching out to people and saying, what is it you do? What's your job? And you know if someone messaged me on LinkedIn and just asked me a couple of questions about my job, I'd reply to someone, because that would be more interesting than just getting bombarded with rubbish messages. I'd reply to someone's genuine enquiry

about what's it like to do image analysis, or how did you get into that job. So I think using LinkedIn as a way to see what jobs are out there, because you'd probably be surprised at the breadth of jobs and skills that are needed to deliver clinical research and just to understand what it is that people do in those roles, because there'll be many different things from image analysis. I mean, in image analysis alone or imaging alone, there's loads of different roles from running the facilities, to operating the scanners, to providing the physics support, to looking after the data, and that's just in one area of clinical research. So there's many different things out there, and I think it's thinking about the skills that you've got and how those skills could be applied to some of these roles.

20:05: (Jo) *So you don't need a PhD in physics to be…?*

20:08: (Tom) Some of the ones you might do, but not necessarily, no. I mean, it all depends on the role in terms of what you're working with. A PhD in physics is probably going to be needed for an MRI physicist, but then there's Master's courses in imaging, there's Master's courses in clinical trials. You know, there's a breadth of roles out there where you can take the skills you have, not necessarily from a PhD or a Master's, but just skills from other jobs, other roles, and bring those skills into clinical research.

20:36: (Jo) *And finally, what's one thing that you wish you knew earlier in your career, which…? I mean, you've already said about LinkedIn, if only that existed…*

20:45: (Tom) That yeah, I would say that I wish I'd known it was OK to say no. I think we are fortunate enough to work in a culture here where we want to help everybody that we can do to do their research. I think we're really positive about helping deliver research and trying to work with people. If you say yes too many times, you create too much work for yourself. You get overloaded. And I think the quality, if I think back over the years, there may be some of the projects I've worked on when I've said yes. I've not really had the time to do my best work, and maybe the quality wasn't great there. So I think nobody wants to hear a no, but sometimes that's the best answer to give because you might just have too much other stuff on the go.

21:29: (Jo) *Yeah, that's good advice - one we probably all should take note of. Well, thank you so much, Tom. That was really interesting and slightly different to all the other episodes we've spoken about. So yeah, thank you very much.*

21:40: (Tom) Yeah, no, my pleasure. I'm happy to share those experiences and yeah, image analysis is maybe a slightly left field thing, but a really fascinating area of research.

21:50: (Jo) *Yeah, great. Thank you very much.*

21:57: *Thanks, Tom, for a really insightful conversation about image analysis in clinical research, his role as Deputy Director of the Image Analysis Core, and the career opportunities in this field.*

22:09: *He clearly explained the importance of image analysis in clinical research and shared several examples of its applications. Tom also highlighted the variety of roles within imaging, each requiring a broad range of skills. He encouraged listeners to do their research to understand what roles exist, what they involve, and what skills are needed, suggesting LinkedIn as a great tool for exploring opportunities and connecting with professionals.*

22:35: *I hope you enjoyed this episode of Clinical Research Career Conversations. Please share and subscribe and until next time, bye.*