SCOTTISH MORTGAGE INVESTMENT TRUST

Tempus AI: Pioneering AI-Enabled Healthcare

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Eric Lefkofsky (EL): I think a company like Tempus has the ability to quite literally impact global survival rates of the species by like a decade.

Tom Slater (TS): One of the things that we always liked about Amazon was the technology that powered its storefront got more powerful and cheaper every year. And I think you have a similar dynamic at play with Tempus.

EL: I suspect one day, and I don't know if Tempus will be that company, but I suspect one day there will be a Tempus-like company that is every bit as big as Apple or Google or Amazon or Nvidia or whatever.

TS: Healthcare is the biggest industry in the world, if you can actually... if this technology is going to be impactful in the world then it has to be impactful in healthcare.

Claire Shaw (CS): Hello and welcome to season three of Invest in Progress, brought to you by the Scottish Mortgage team. I'm Claire Shaw, Portfolio Director. In this podcast we take you behind the scenes to hear the conversations that take place between the Scottish Mortgage managers and the leaders of some of the world's most exceptional growth companies.

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On today's episode, we explore the transformative journey of Tempus AI, founded by Eric Lefkofsky. In 2014, Eric's wife was diagnosed with cancer, and Eric was shocked by the lack of information from previous patients being used to inform her treatment. A successful tech entrepreneur at he time, he decided to take matters into his own hands, Eric and his team collected and analysed data and built a tool to make sense of it. He then changed his wife's treatment plan to make it more personalised to her individual case, and it worked.

The solution is now known as Tempus AI, the company revolutionising healthcare through big data and artificial intelligence. It has built one of the

largest libraries of oncology data and uses it to personalise cancer diagnosis and treatment at enormous scale. The platform also shares data with pharmaceutical companies, enabling drug discovery and speeding up the notoriously slow process of getting new treatments to market.

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Scottish Mortgage first invested in Tempus AI as a private company, back in 2018. And we continued our support when it went public on the NASDAQ in June 2024. Today we are thrilled to have Eric on the podcast to share his plans to save the global healthcare industry trillions of dollars and most importantly continue saving lives. After Eric's conversation Scottish Mortgage manager, Tom Slater, I'll delve deeper into the investment case with Tom. But for now, let's hear from Tom and Eric.

TS: Welcome Eric, thank you for joining us. So before we dive deeper into the company, can you give our listeners the Tempus AI 101? What does the company do?

EL: Yes, well first thanks for having me. So Tempus is focussed on this idea of AI-enabled diagnostics, or how do you make diagnostics intelligent? So diagnostics, for those that don't know, are essentially any kind of laboratory test result or similar result that would be ordered typically by a physician when treating a patient. So blood tests, CT scans, MRIs, molecular tests.

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And we started thinking, or I started thinking about nine years ago when I started Tempus that if you could make these diagnostic intelligent, if you could kind of wrap the benefits of artificial intelligence around them and contextualise diagnostics, specifically for the patient for whom they were ordered.

If you could connect those two you could help physicians figure out how to make data-driven decisions and how to navigate patients to the optimal therapeutic, getting the right drug at the right time. And you could then in some ways infuse the benefits of technology and artificial intelligence into the healthcare system by sneaking it in through the diagnostics that it routinely worked.

TS: And if you could take us back to the start, Eric. It's an incredibly personal and moving story behind the motivation to create the company, so could you start by outlining the circumstances which led you to establishing Tempus?

EL: Yes, so in my case I was a tech guy, I had been in technology since 1999. So I was there from the earliest, before the first internet bubble burst. And I had never thought I would get into healthcare, but about ten years ago my wife was diagnosed with breast cancer. And so, I had spent a lot of time involved in her care, as any husband would, and I was kind of amazed at how little data and

technology were part of her care and a part of really anyone that was being treated with cancer.

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And so I started to thinking, this is crazy that we're giving truck drivers that are delivering pallets of water bottles more technology than we're giving physicians who are making life and death decisions. And at the time, genomic sequencing was a fairly new thing. We had sequenced the genome about 20 years ago, so about ten years ago the cost was just starting to come down and people were doing it a bit more routinely in the United States.

And the challenge was this data was coming back and it was incredibly complicated, there was lots of data. What mutations does a patient have, what's going on at a genetic level. And physicians were having a really hard time interpreting this data and personalising it around that patient, right?

So for example, let's say a patient has a mutation, let's say they have a PIK3CA mutation, which is a gene that might be mutated. If I recommend a drug like everolimus, when you get a report back it says patient X has a PIK3CA mutation and therefore there's a, in our case let's say it's an FDA-approved drug called everolimus that you should think of taking. Well if the patient already took that two years ago or three years ago in a prior line of therapy and failed, it's a really bad recommendation, right? You're kind of sending a doctor down a wild goose chase.

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And I was amazed that he fact that these reports were coming back with all this information but they had no idea who my wife was. They didn't know if she was male or female or old or young, didn't know what drugs she had taken. Even the clinical trials they were recommending, I was thinking, like, this is crazy, they're recommending trials but let's say one of the first criteria of the trial is that you can't be a cigarette smoker. Well, what if a patient smokes two packs a day? Right? Like it's a terrible recommendation to make.

So I started thinking, why don't we know who the patient is? Why are we running all these very sophisticated, expensive laboratory tests or genomic tests and we have no idea who the patient is. And the reason is because all that healthcare data of who the patient is, what drugs they've taken, how they responded, who they are, their characteristics, it's all locked inside these typically antiquated systems and the data is siloed. It's unstructured, its siloed, it's messy.

But what had happened around the time my wife was diagnosed is that these background technologies were emerging, like natural language processing and optical character recognition and cloud computing, and most recently obviously Large Language Models. But you had all these background technologies

evolving that were making it so that you could structure all this messy, siloed data about who these patients were, and you could actually, at very low cost and very high quality, build almost a vignette of these patients in real time.

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And therefore when you ran the test, a genomic test, whatever the test was, you could marry them. We had the technology tools to allow you to marry them and generate insights. And that gave rise to Tempus.

TS: And after you'd come to this realisation how did you approach the task of scaling it into a solution that could help millions of patients requiring cancer care, or care more broadly?

EL: Yes, you know it's funny when we started Tempus I thought, I was thinking a lot about how do you personalise these diagnostic results, how do you make genomic tests in cancer intelligent and how do you bring the benefits of AI to these tests. But I wasn't thinking about opening up a lab. In fact, I'm like, you know, I don't know how to open up a lab and sequence patients.

So I went to the big sequencers at the time, the people that sequence the patients, and I said to them look, I'm a tech, I understand technology, I'm a tech guy, I've built a series of technology companies, I think I can solve this problem but I didn't know how to generate the molecular data. And so I went to people who did that and said, hey, why don't you, let's partner.

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And they all said to me, no, there's no way, you're never going to get our data, we would never give it to you. And they also said, and if you try to open up a lab and go to hospitals they'll never give you the clinical data so your nice idea, you know, rich guy but it's never going to fly. And so, we're like, okay, let's open up a lab, I mean nothing we can do, no one's going to give us the data. So we started building a lab, we started hiring people that knew how to sequence patients, hiring medical directors and pathologists and we built the lab, and it was a very small lab.

And we went to a few hospitals and said, look, we're sequencing patients, we've opened up a lab that's certified and we have expertise and we're sequencing patients. And we think this is the solution to this problem, you're going to need someone like us to make these tests intelligent and your doctor's are going to be overwhelmed if we don't do this.

And we were very fortunate that we had a few early adopters, and that's typically how tech companies tend to get off the ground is you have one or two clients that believe that you've identified a pain point, it's something that's really miserable that they're having a hard time with. And they're willing to take a shot

that this new company can solve it. And so in our case that was Northwestern Medicine, which is here in Chicago, and we knew some people there so we were at least a trusted... There was some trust.

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And we began sequencing some of their patients and building out this technology and connecting the two. And then we landed another client, another client, and it began to scale. And the business really scaled because our genomic tests were more personalised and more intelligent and had the benefits of technology embedded within them, they were more comprehensive, more intelligent, and so pretty soon more and more hospitals began ordering our tests.

And that's really how we scaled is we became the largest sequencer of cancer patients in the US and that fuelled the adoption of all our other products.

TS: So I'm going to read out some statistics to illustrate that that ambitious idea nearly a decade ago has achieved to date S you now have one of the largest libraries of clinical oncology data in the world, a database of over 7 million cancer patients' records. 50% of US oncologists, that's cancer doctors, are connected to the Tempus platform.

You work with 19 of the 20 largest public pharmaceutical companies, something like 190 petabytes of data. And if you're anything like me, you'd have used a Chat GPT to give a real-world example of what the 190 petabytes of data looks like, and that's approximately 57 billion songs in MP3 format, or 51 billion digital photos.

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So the bottom line is Tempus has a lot of data and you've integrated it from many forms and sources. But taking it a step back there's always been a lot of data in healthcare, the issue has been that doctors have been unable to use it to improve patient care, is back to the silos that you talked about, the fact that it's unstructured, it's unconnected. So can you elaborate a bit on how Tempus is fixing that problem? And what are the benefits that then materialise from you fixing those data pipes?

EL Yes, I think when we think certainly the scale is, it's been nice to watch it grow and to see the adoption and to get to this point, but underlying all of this, and I think the last word you used is the key word, are these pipes. So the way to think about it is in the United States there are roughly 5,500 hospitals, give or take. And we are connected now to something like 2,600 or 2,700, so about half of all hospitals in the United States.

And what we've done is we've built, we started in cancer, we've migrated to a few other disease areas like cardiology and neuroscience, but we started in cancer

and we began building these two-way connections, or these data pipes. Where hospitals could send us data for their cancer patients, we could generate some diagnostic result, like we could run a next generation sequencing assay or we could run a hereditary screening genetic test, or whatever the test is we're running.

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And we can marry the two together in real time, like literally in the same number of days it takes to run the test we can bring the data in, run the test, connect it to generate insights that are specific to that patient. And then return the result to the physician through those same pipes so the doctor has his or her order, what the results of that order for that patient, and it was actually contextualised around that patient.

So the way to think about it is it's a bit like, almost like Tempus is a cable company. Back in the 1980s we just ran around and started wiring up cable. And now we're connected to all these hospitals and through those connections not only can we bring that messy clinical data out, so we can structure it and make sense of it, not only can we generate a diagnostic insight and put those insights back into the hospital. But those same pipes can be used to really distribute any form of AI insights that we generate.

So if we're, let's say for example we see a patient who's a perfect fit for a clinical trial, we can use those same pipes to notify the physician. Let's say we see a patient that for some reason is falling through a care gap, it would have been the standard of care to order a particular test, someone made a mistake and never ordered it.

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Or the patient should have gotten a particular dose, someone made a mistake and they're getting a different dose. We can actually see these care aps in real time and then send automated algorithmic alerts or insights to these physicians to say, hey, you may want to consider this it looks like your patient would benefit.

And so now that we have these pipes that's really the foundation upon which we are able to bring AI to the US healthcare system and now we have to think a lot about how do we build those same pipes in Europe, in Asia and around the world.

TS: So you've talked us through the initial ambition to be a data company and this realisation that you'd have to actually generate a lot of this data yourself and do the testing. And so, genomics is your largest division today, about two-thirds of the revenue of the company. I think you've sort of talked a bit in what you've been saying just now but I guess just to make it explicit, it's probably fair to say that the accuracy of the tests that you do is relatively similar to your competitors,

the reimbursement rates are about the same, so what is it about Tempus' value proposition that enables you to win in that testing market?

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EL: Yes, I think, look, it's interesting, you know, and you guys are right, I think were large shareholders, still are in Tesla, I think. And I use the Tesla example just because I think it's really interesting. I have a Tesla.

TS: Me too.

EL: So this is firsthand, okay. So if I say if I handed you two EVs, let's say five years, and you're like, here's a Tesla and here's another, here's a Ford whatever, a Volt or something, a pickup. On their face you'd say, well, both have four wheels and both use a battery and both deliver similar results, I can get from point A to point B the exact same way. So these things are basically pretty similar. And there are lots of people who buy a Volt, and they might for whatever reason they like that car.

But for people that, if you looked at Tesla's growth you'd say well something's different about this Tesla car because it's capturing a vast amount of the EV market share. And at the end of the day, I think we could talk about all the different things that are in that car but it really comes down to a technology advantage, The technology wrapped around that Tesla was just demonstrably better than other EVs five or ten years ago, which led, I think in large part, to their growth.

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And it's the same thing with Tempus. We have a technological advantage over our competitors. It's not that you can't get a perfectly good result from somebody else that's sequencing, you can, you can order a test and if you're just looking for the top 100 genes that might be mutated you can order a foundation one test and they'll deliver you those results. You can order Caris or Guardant and whatever, they're all 100% perfectly fine.

But we have a lot of technology that is wrapped around our tests. How we're integrated with electronic healthcare record systems, how we personalise these tests by matching them to clinical data. Other insights that we can derive that other people just can't because of how much money we've invested in all these algorithmic diagnostics that sit on top. Our ability to route patients to the right clinical trial, our ability to close care gaps. There's a lot of technology.

And so, I think for physicians who choose us over other people, and clearly people doctors have chosen Tempus over others over the last, the company Tempus, is nine years old, we opened the ab about seven years ago, something like that, and we've become the largest sequencer. So we've grown much faster than our

competition, who on average has been sequencing twice as long as us. These companies have been in market for ten or 15 years.

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So more and more physicians have migrated to Tempus because of that technology and that edge. And I think it's often hard to describe because it isn't like we do one thing better. In the same way, for example, when Google launched Google there was Lycos and AltaVista and whatever, and they were all perfectly good search engines. It's just that Google was better, it rendered more accurate results and so over some period of time we all started using Google.

TS: And if you extend your analogy with Tesla, the driver of the Tesla, in your case, is the physician. And one of the ways that they interface with Tempus is with your smart reports. So I've had a look at previous smart reports, even to a non-physician I can quickly see why if you're seeing 20 to 25 patients a day that this solution would allow you to do your job faster and more easily. So can you describe to listeners what a smart report looks like and what it provides to a physician, how it differs from what a physician would have had before you?

EL: Yes, it's really hard for me because Tempus is a beneficiary of all these kind of background technologies that have been transformational. And by the way, none of which we developed, all of which we're benefitting from, all of which were like amazing strokes of luck that just befell upon us.

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None of these technologies, which are incredible, including low-cost molecular profiling and cloud computing or, none of them as transformational as a generative AI. These Large Language Models and Large Image Models and all the derivatives are so fundamentally transformative that what's funny is when someone says to me can we talk about how smart your reports are today, all I can think about is how dumb they are compared to how smart they're about to be.

And so, the reports, which are smart today in that when you order a Tempus report it comes back personalised around your patient. So as I mentioned a minute ago, doesn't recommend the wrong drug or the wrong trial. But what's also pretty awesome is we launched the first version of our AI agent, called Tempus One, which is embedded into the tools the doctors use, because you are right, they're the driers of the Telsa in this example.

And a doctor can ask Tempus One a myriad of questions. It could say what mutations were found for my patient or what's the recommended therapy for those patients, if there's a recommended therapy you can say what is the FDA warning label say for adverse events for that drug, or where's that clinical trial open, or what's the phone number for that trial or is there a known side effect if

I give these two drugs together, right? So it can ask an enormous number of questions and get answers.

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But as these models evolve, whether it's Gemini 2.0, whether it's GPT-4o or o1, whether it's the latest version of Llama, our ability to make these tests super intelligent is in the near-term horizon. Where you'll be able to order a Tempus test, get it back, and literally it's as if the totality of medical knowledge is just going to be sitting on top of that test result. Where you can basically ask it anything and if it's known today you'll have that insight in the palm of your head. I would say Tempus tests are smart today but over the next year or so are going to get incredibly smarter.

TS: And is that ease of use, that ability to interface with it, is that… We can see how that could ultimately improve outcomes for patients. And is that part of the explanation as to why you've just grown so much faster than the rest of the market? That you're making physicians' lives easier?

EL: Yes. I think the reason why our genomics business has grown is certainly because we're making physicians' lives easier, we're helping them get the right information at the right time and our technology helps them manage the complexity of that information in a way that allows them to do their job quicker and easier and more efficient. So that's why doctors order our tests.

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What happens is to do that we have to marry clinical and molecular data together. We were fortunate that I think we realised early on if you de-identify that data it's very valuable because it's at scale and it's coming from all this real-world clinical interaction, right? So it's very valuable to biotech companies and pharmaceutical companies.

And so, early on, maybe five or six years ago, we began to build technology tools to make that data useful so people could license it, they could interrogate it, they could analyse it. And that began to take off and so all of a sudden we have this fairly large data business, which also was growing rapidly and generating high margins.

And so then what happened is the combination of our genomics business, which was growing and becoming more profitable, and the data business, which was becoming more profitable, all of a sudden we were generating lots of gross profit, hundreds of millions of dollars of gross profit that we could reinvest in technology, in our AI, in some of the models we've been talking about. And so we built this kind of self-sustaining machine that's generating hundreds of millions of gross profit that we can reinvest in AI.

And that, to me, is like the biggest hurdle you have to get over. Because what ends up happening is you can have all these audacious ideas to bring AI to healthcare, but if you don't, if you can't invest in them it doesn't really scale. So we now have been able to build a machine that scales.

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TS: I'd like to explore the AI side more but before we do I just want to go back to something you mentioned there, one of the business model advantages that you have is that you can package up that data that you're generating, that you're combining with the data from physicians, and sell it to pharmaceutical companies to help facilitate drug discovery. And you have partnerships with familiar names like GSK or AstraZeneca, Eli Lilly, Recursion, which is another Scottish Mortgage holding, we had Chris Gibson on the podcast previously.

So that's obviously a huge validation point having these big established players partnering with you Could you just explain what the pain point is that you're solving for these companies? Because I guess some might assume they have huge resources, huge cash piles that they plot into their own research and development. So what is it that Tempus offers to them that they struggle to do themselves?

EL: Yes, well the very first part of it is that they, these companies up until Tempus, never, at least in cancer or oncology, were never able to get the data that you would actually need to kind of add a molecular lens to the clinical trials or the studies you are running. And the reason that they couldn't do that is up until Tempus there was some molecular data, right, not a tonne but some, but it was just molecular data. And then there was lots of clinical data, like who are these patients and what drugs are they taking, but that was kind of over here.

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And so the only time people ever tried to maybe even in small ways marry the two is when they ran a clinical trial. So let's say I have 400 patients and I'm going to run some clinical trial and maybe as part of the trial I'm going to sequence those patients, and I have 200 patients, or 40 patients, or 100 patients which matches clinical molecular data. There was no way to see if those 50 patients or 200 patients were representative of the millions that were in the market. And there was no way to understand if you were missing certain molecular trends because of your small sample size.

And so, Tempus showed up and said, look, I mean if we're sequencing all of these patients clinically and if doctors are having a hard time understanding these results. If we get the clinical data and we put the two together, now we help doctors actually figure out what to do but we also generate this matched clinical

molecular dataset that typically people would have to run a clinical trial to get. And we'll generate it at scale.

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So what's crazy is when Tempus had sequenced, our first year, which I think was like 2018 or something, we'd sequence 10,000 patients, basically, and that was enough of a dataset, that was our first year, we were tiny. But that was enough of a dataset to actually go to at the time a company called MedImmune which was bought by AstraZeneca and say, I've got 10,000 patients with matched clinical molecular data, do you find any value in that. And they were like we want 4,000, we'll take 4,000 and we'll give you $8 million, or whatever it was, $6 million, I don't remember.

And so we're like, oh, we're onto something. But fast forward, I think we, I don't know the exact number but I think last quarter we may have sequenced almost 70,000 patients in one quarter or we ran 70,000 tests in one quarter. So you can see that the scale has grown and that database keeps growing.

And so more and more people can pick these really micro targeted populations like I want triple negative breast cancer patients with a PIK3CA and RB1 mutation, they can't have taken an immunotherapy, so I don't want them to have like a high PD-L1 score, and they have to be females under the age of 65 and whatever. So you're kind of almost building a clinical trial in going to Tempus and saying do you have those patients. And we have hundreds or thousands of them. And so that's what's unique.

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TS: So let's go onto expanding some of the point that you were making about AI and actually you're using this technology, the fact that it is distinct from testing and it can be applied really broadly. And I think you've said in the past this could ultimately become Tempus' largest business. I guess the starting point with AI in healthcare is that there's currently no way to pay for it. So if we use the cardiology to bring this to life, can you explain how the Tempus platform and specific tests could help predict major cardiac trauma and stroke risk?

EL: Yes, it's a good example. So essentially, the basic challenge, by the way, then we can talk a little about how I think some of these solutions make their way to other parts of the world. But the challenge in the US is we have this notion that if we were going to pay for a laboratory test result that it had to come from a lab. In other words, where's the chemistry?

And remember, these systems are very old, these are 100-year-old, 200 year old infrastructure systems, and so in terms of payment and reimbursement and

whatever. And so people began like, where's the lab, where's the wet lab? And so as AI began to take off in the last, let's say ten years, it became apparent that you actually could generate a diagnostic result, or a laboratory test result, with no lab at all.

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And of course, in the United States our infrastructure has a hard time figuring out how to ay for that because in the United States our infrastructure starts with the American Medical Association assigning what's called the CPT code. Or like is this something that's medically worthy, like should that doctor even be able to order this thing? Then it has to go into our payment infrastructure, which is convoluted because it's half public, half private. And then someone assigns a reimbursement for that.

And so, because the starting point for this is humans that get paid to do these things they've been resistant, as you can imagine, to a world where there's no humans doing these things. It's not a great... It would be like saying pilots get to decide if autopilot ever gets to be put in a plane. There would be no autopilot.

So anyway, but these diagnostics, these algorithmic diagnostics are obviously growing at scale. We at Tempus have this very large dataset, so we have hundreds of these things in some stage. We have them in digital pathology, we have them in oncology, and we have a whole series in cardiology. In each disease area, because Tempus is focussed on how do you bring AI to diagnostics, we have to first ask ourselves what's the diagnostic we want to focus on? It's not the same for every disease area.

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So in cancer, it was clear, it's genomic tests, right? We want to focus on genetic tests. But in cardiology often the first diagnostic that gives rise to a problem is an electrocardiogram, or we refer to it as ECG here in the US, it's often referred to an EKG in Europe. But anyway, it's essentially that you sit on the table and the doctor puts little stickies on you, ten or 12 of them, and it gives this wave file of what's going on with your heart.

Well, about 3% of people in the United States, and probably around the world, are told that they had a totally normal ECG, like things look great when they had their physical exam, and yet within a year they have a heart attack or stroke. So obviously you and I would say to ourselves that's a very bad test, if it didn't pick up a heart attack or stroke in a patient.

Well it turns out that 3% is largely connected a series of let's say ten different structural heart defects. They could be things like atrial fibrillation or hypotrophy cardiomyopathy or aortic stenosis or low ejection fraction, just various tings that

are kind of indicative of some problem between your heart and how blood is pumping through your body.

And we can detect that with high fidelity. So we built a series of models to do that, we took our first, which is our atrial fibrillation model, to the FDA. It got approval, it got breakthrough designation then it got approval, which is pretty awesome. But up until recently there was no code to reimburse that.

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Now, what's amazing is CMS, which is our Medicare and Medicaid entity, issued a guidance that they were going to pay $121 for an algorithmic diagnostic that sits in top of an electrocardiogram. So all of a sudden, and we're one of the only companies in the world that has one of these things, we have one and then a company connected to Mayo Clinic has one. And Mayo actually led the charge to get this thing paid for.

So now we live in a world where all of a sudden for the first time we're like, woah, wait a minute, hospitals can now bill $121 to Medicare, which is about half the patients, and get paid for our algorithm. So we've been trying to figure out how do we start working with hospitals to get this thing deployed.

It's exciting but it's all just brand new and I think over time these kind of models, models that make electrocardiograms smarter, make genetic tests smarter, make blood tests smarter, make CT scans smarter, these will become pervasive. There will be hundreds or thousands, they will be reimbursed, and I suspect if Tempus is ever a really big company like as big as Tesla, it's because we have lots of these models and they're being routinely reimbursed. And given what I saw a few weeks ago I think that will happen, it's just a matter of time.

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TS: It's a really exciting thing that you're actually starting to see the value that you're creating being recognised. I think it's probably worth making the point that it's $121 to run this algorithm on top of the ECG, but the saving to the healthcare system from paying that will be immense because of the cost of actually the care of those 3% of patients that go on to have a heart attack.

EL: Yes, I mean you're paying $121 to run an algorithm and if the patient that gets the heart attack or stroke, at least in the US, costs the system about $100,000 a year. So how many years do they live, if you tell me they live three years that's $300,000. So the ROI is like unbelievably good.

TS: ROI, return on investment.

EL: Yes, if you're the government... By the way our government hates paying for things. So when they decide to pay for something new it typically means someone's done the math and they think it's very good, because they know

they've got a problem, they're spending $5 trillion a year. Our system is, there's nothing like it. If you look at the GDP of Europe versus the GDP of the United States, they're similar. In fact I think the GDP of Europe may be larger, at least it was a few years ago. But if you look at the healthcare spend in the United States, the US spends as much as the next 14 largest countries combined. Forget Europe, it's tiny.

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We have you, India, China, Japan, South Korea, just keep going, we literally, there's nothing like it. So it's also why at Tempus we chose to stay mostly focussed on the US. If you look at Amazon, Amazon realised relatively early that it wanted to get to Great Britain and Germany and France and Japan and whatever, but I think our attitude is if we can solve these problems in the US system, which by the way is by far the most broken system.

It may produce the most innovation but we spend as much as the next 14 largest countries and we have something like the 45th highest mortality, longevity rate. So we basically don't live longer, we're no healthier, we just spend crazy amounts of money.

So we figured if we can solve this problem in the US we also can then kind of create a roadmap for other countries to bring AI into their systems and generate a benefit as well.

TS: And if you think back from a world where these AI diagnostics, these AI algorithms are the largest part of your business, what has to happen between now and then to get there? What are the unlocks that will allow that to happen?

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EL: So in our case we have the proprietary data that others don't have to build these amazing models, these algorithms that have diagnostic value. We're connected to half the hospitals in the United States so we can distribute them rapidly. So now what has to happen is people have to agree to pay for them we just saw the first sign of that with our CPT code for the $121 AFIB algorithm. People have to agree to pay for them.

And then we have to convince doctors that they should want them, right? Because we can distribute them, if doctors want them we can distribute them pretty rapidly. And so I've always told people I think Tempus will have it's Nvidia moment, this moment where people are like, wait a minute, how big could that be?

But I think it... I don't know if it's going to come in a year or two or three or four, I don't know, but at some point it'll be when these models start to get paid for and ordered at scale. And we start generating large unforeseen amounts of revenue

that not only do people say, wow, where'd that come from, but they're like how big could that be. And the answer is so big it's inhuman. Like in other words, like a trillion dollars a year of cash flow.

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So I don't even know how big could it be? The amount of waste is unhuman so if the company that algorithmically gets rid of the waste will likely be very big. And I suspect one day, and I don't know if Tempus will be that company, but I suspect one day there will be a Tempus-like company that is every bit as big as Apple or Google or Amazon or Nvidia or whatever. Because it will be routing tens of millions of patients around the world to the right therapy and getting paid a small toll every time it does that.

TS: So ahead of the podcast I looked at the first research note that we wrote about Tempus, I think it was back in 2018. And it said, if Tempus has a competitive advantage it stems from the whole of what they do being greater than the sum of the parts. And I think when you've talked about each of the product lines, whether it's in testing, in data and in AI algorithms, you can see that they build off one another, it's very clear that there's a platform that is the backbone of this company.

So you've invested $1 billion into developing this platform over the last ten years, it's given you considerable competitive advantage, as I think has come out from this conversation. What would it require and how long would it take for another player to catch up with you?

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EL: Sorry, really quickly before we get there, I didn't do the math here because I had never done the math, I just did the math right now, I was starting to think what is the ROI on that AFIB algorithm at $121, it just got priced a few weeks ago so I've never done the math. So basically net-net. Our AFIB algorithm, in the United States the audience that should order is about call it 10 million tests a year.

So that's, if 10 million tests were ordered at $121 basically 1.2 billion. So think of it, that's the cost to the US healthcare system. If we save 3% of that population from getting a heart attack or stroke, and we can pick any number you want, but that would essentially save this system $67 billion over three years. So for 1.2 billion you've got 67 billion of financial benefits. And you might say, well, let's assume it's 1% not 3%, but the ROI of these models is pretty good. Okay, sorry, so back to your current question.

TS: No, it's a great point to make because it really brings it to life, it is hugely valuable what you're doing.

EL Yes, thank you, I did the math I was like sitting here. So I think, look, you guys were obviously a very early believer and it's nice to have really high quality large shareholders that have been part of the story for a while. Especially when you're part of a story that is a young story, right? So it's kind of easier when you're a high quality investor buys a public company when they're 15 years old, that's interesting but it's really more interesting when you get an investor like Baillie Gifford who's in this thing like when Tempus is five years old, whatever. And we're small.

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Because we have so many assumptions that we also are making and things that we're telling you we think are going to happen. But because we're so young we don't really know if they're going to happen. So you have a thesis, or you guys have your own investment thesis, and we think things are going to happen, and it's nice to be able to watch how these things unfold together and kind of learn together.

I think your thesis of Tempus' is reinforced by the network effects and the benefits of each of these businesses working together in tandem was also our thesis. It just was a thesis back then, like we thought we could build a big data business. When you guys invested it was tiny.

We thought the data business would be durable, we thought that the combination of this clinical molecular data would make our tests smarter and that would lead to more growth, more doctors order our tests, the more doctors ordered our tests the more data that would be generated. The more data that was generated the more pharma would want our data and the more they wanted our data the more money we would make and we could invest in making our tests smarter and smarter and smarter with technology.

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But all of those things were kind of unknown back then and it's been nice to see how they really do fit together. People will say to me sometimes, you guys are doing a lot, you're sequencing patients, which in and of itself you could just do that as a business. You have all these data products that you've built, you could just do that as a business. And now you're focussed on really trying to leverage your connected ecosystem to bring AI or algorithmic diagnostics to the market at scale and are you doing too much?

And let alone, you're not only doing that in cancer, but you're trying to do that in cardiology and neurology and all. And not just in the United States but also now in a few other countries. Like maybe you're doing too much. And I say to them, you're 100% right, we're doing too much, okay, that's not debateable. But we don't really have a choice, in much the same way that Tesla took on a lot in

making its product and Apple took on a lot in making its products. Tempus has taken on a lot in making its product.

The product we really want to make is how do you make all diagnostics AI-enabled or intelligent across all major disease across all major geographies? And the tools we're building are those tools. So all these things we do along the way, sequencing patients, building analytic tools, working with pharma partners, these are all means to an end.

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The end is every time a patient walks into a hospital or a clinic and a doctor orders some kind of test to figure out what to do, we're in the middle of that, Tempus is in the middle of that making sure that every decision that's made is a data-driven high-quality decision, that we reduce errors and we make good doctors great doctors and great doctors super doctors.

And that we use technology to really bring all those benefits to bear. So that's the product we're building and it's a big product, it always was from its earliest days, it was a lofty goal. And we're certainly, I think, nine years in in a really good spot but the next nine years are going to be, I think, more interesting in terms of what we can build than the last nine.

TS: So it's the breadth of the platform, it's the ability to draw on all of those things that just makes it very hard for... I don't think anybody's even trying to compete with that. Thank you very much for your kind words about the partnership that we've had with you. It's something that we've really valued, we've learnt a lot from you over that period and we know private companies get to choose their shareholders and we were very lucky that you chose us.

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So final question from me, where you are now, if you look forward, we close with the same question on all of the podcasts, what does the world look like if Tempus succeeds?

EL: Well I think, and again it's a matter of time, right? If we're looking five years, ten, 25, but let's say we go forward a decade or two and Tempus reaches its ultimate success. I think we're a major player and a major reason that people live longer and healthier lives. I think a company like Tempus has the ability to quite literally impact global survival rates of the species by a decade.

So if people kind of normally live to let's say 75 to 80, they'll live to 85 or 90. And a company like Tempus also has the ability to improve the efficiency of the global healthcare system by 2 trillion to 3 trillion. And so what's it going to keep of that, we could pontificate but it's in the hundreds of billions under any scenario.

And so I think if Tempus reaches its success and becomes a company of the scale of Apple it's because it has global reach, it's deploying these algorithms globally, it's removing errors globally, routing patients to the right therapeutic globally, being predictive and generating molecular insights globally. And that will have a big impact because the global healthcare systems are antiquated, inefficient, produce lots of pain, lots of suffering, lots of death long before a patient should die.

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And so, I think this is, for me, the most exciting space because forgetting all the other cool things, self-driving cars and going to Mars, whatever, what I'm quite certain one of the near-term benefits of all of these advancements of generative AI is going to be is we will be able to eradicate many diseases and many errors. And so I think Tempus can play a big part of that and that's how you have a huge impact.

TS: Obviously as shareholders and partnering with you absolutely buy into that vision, very excited to see what you can do over the next ten years.

EL: We're excited to have you with us.

TS: So thank you very much, Eric, for joining us today.

EL: Thank you.

CS: So Tom, I think most people after listening to that conversation will come away with a feeling that this is a company at the vanguard of applying artificial intelligence in healthcare and that they are helping to support a better, smarter, faster, and crucially a more cost-effective healthcare system. I think any company saying that they could save you $67 billion over three years is going to make anyone sit up and take notice.

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So Tom, we always use this section of the podcast to give the Scottish Mortgage perspective on the company in question and try and lift the bonnet and give shareholders the insight into how we're assessing the investment case. So maybe to kick off, has Eric mentioned, we were early believers into Tempus, we first invested in the summer of 2018. So Tom, can you tell us the back story from your perspective, how did you initially come across the company and how were we able to access it, give that it was still a private company at that point?

TS: Well we were very interested in the idea that data could really make a difference in healthcare. We'd invested in a private company called Flat Iron.

CS: Yes.

TS Which had then been sold, which was looking at, not the same thing but trying to address a similar problem around data integration. And what struck us about Tempus was that you had someone in Eric who really understood technology deeply. And then through the very difficult experience he'd been through with his family had seen the opportunity to actually deploy this technology in healthcare. And healthcare's the biggest industry in the world. If this technology is going to be impactful in the world then it has to be impactful in healthcare. And so that's what got us excited.

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CS: And as you say, many of the companies that we invest in have this kind of personal story which is the motivating factor behind their vision initially. And I guess there's probably a few stories as personal as Eric's, his frustrations in the healthcare system, he witnessed first-hand as his wife was diagnosed and being treated for cancer, has almost given rise to Tempus.

But I think what I took away and what makes him different is as he said, he's not this healthcare guy, He's someone that identified a problem and was resilient enough to withstand this scepticism of, yes, nice idea, rich guy, this isn't going to fly. And he's had that kind of tenacity and drive, almost, to create this amazing company. So I guess I'm interested what were your first impressions of Etic and what it is about him that you think has increased the odds of success for the company in the culture that he's now created around this business

TS: Well as he said, he is a serial entrepreneur, he's been there before, he's been really successful before. So he knows what it takes to build a business and I think that seasoned entrepreneurs are really interesting when you're thinking about investing in companies.

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I think that one of the other things I think will be clear from the conversation is that Eric is brilliant at articulating what he's doing, that he can cut through the jargon. And I think in healthcare, particularly, people drown in jargon. So actually being able to clearly state what the company is trying to do and get people to buy into that vision. Because he raised capital really efficiently as a private company, found shareholders who were aligned with the vision for what he wanted to do. And I think that's been a really important part of enabling the company's success to date.

CS: And that kind of ability to articulate, I thought his comparison to Tesla was really quite insightful. Comparing Tesla to another EV, saying they both have four wheels, they both use a battery and they get you from A to B, but it's that kind of technological advantage that Tesla has that makes it unique. And he sort of said Tempus is similar from that perspective.

But Tom, I'm interested in your opinion, what for you did you identify as the competitive edge, or how is it evolved, especially with the advances in AI that we've seen, particularly over the last two to three years?

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TS: Well today you would say that Tempus is a diagnostics business. And that's where the largest proportion of its revenues come, from running these diagnostic genomic testing services. But actually, I would see it as a data company. And the diagnostic testing the on ramp, it's the way of getting hold of the data but the whole premise right from the start is how do you do things more effectively with data? How do we get it to the right people, how do we find out what's important?

And if you, to steal another analogy, one of the things that we always liked about Amazon was that the technology that powered its storefront got more powerful and cheaper every year. And I think you have a similar dynamic at play with Tempus.

We weren't talking about AI back when we first invested in the way that we're talking about it today. But the tools that are available are just getting more and more powerful and so if you've got that data footprint in order, if you have that resource, then it's so much easier for then for you to run these AI algorithms to generate the insights that come from that than it is for a company who's background is in simply running tests.

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CS: And so it's clear a lot of the stars have aligned for Tempus and Eric alluded to this, the cost of genomic sequencing has been falling, you've got now low-cost and scalable cloud computing, you've seen advances in machine learning. So there are big tailwinds behind the company, but Tom, perhaps put a different hat on for a second. What do you consider as the key threats from here for Tempus? What do you think's the most significant and how do you think Tempus are placed to overcome them from here on in?

TS: Well I think probably the first one is really simple, that this is a healthcare company. And the US healthcare system, in particular, is an incredibly complex system where the incentives don't necessarily align with what you would expect in terms of patient outcomes. You can see that in the way that tests are paid for, where you get funding. So I think the outlook for the system as a whole is really important and it won't necessarily follow economically predictable rationale. So I think that's a challenge.

And then the other part that's intrinsic to working in the healthcare industry is you need the regulator to approve what you're doing. And so you can deploy AI algorithms, AI systems really quickly in other industries but here you need that seal of approval. And rightly so from a safety standpoint. But I think the question there for me is to what extent is that a constraint on how quickly Tempus can move?

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CS: And just following on from that then, Tom, we spend a lot of time thinking about the scale of the opportunity for our companies. And Eric was framing the opportunity for Tempus in terms of the potential savings to the US healthcare system and it was kind of mind-blowing when he said what the US spends on healthcare is something like the next 14 countries combined. And so, I think what became clear when you were listening to him is just how the power of this technology is delivering kind of real value to these healthcare systems.

So when you think about the opportunity available to Tempus what do you think the likelihood you put on them capitalising this opportunity and them, using his phrase, having their Nvidia moment, if you like, as it he calls it, over the next kind of five to ten years?

TS: Well I think that this comes back a little bit to what you were talking about about tailwinds. We don't know exactly what's going to happen but if the technology that you're doing your testing with is getting better and cheaper, if the data that you can collect is getting more precise, more comprehensive, if you're able to connect that in more and more places. And if what AI systems are capable of, both from an algorithm point of view but also from the hardware point of view, the progress like Nvidia, what we can say with some confidence is that all of these ingredients will become more and more powerful over the next few years.

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And that's a really good position for a business to be in. Now, how they capitalise on it, what the specifics are, which areas the algorithms turn out to be really good at saving cost in or saving lives in, we don't know exactly how that's going to play out. But we do know that, as your articulation of it suggests, that this is a system where there is huge cost and if you can make it just that little bit more efficient ten that is your revenue opportunity.

CS: Well I think that feels like a pretty good note to end on, so Tom, as always, thank you very much for your time.

TS: Thank you.

CS: So a huge thank you to Tom and Eric for that fascinating discussion. Coming up over the next few episodes, we welcome two new holdings to the Scottish

Mortgage portfolio. We sit down with a co-founder of Nubank, the Latin American digital banking giant. And we also welcome the founder of Horizon Robotics, a Chinese company developing AI and robotic solutions for autonomous driving. Subscribe now to be the first to hear when these episodes go live. You've been listening to Invest in Progress, thank you for joining us.

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Unlisted investments such as private companies in which the trust has a significant investment can increase risk. These assets may be more difficult to sell, so changes in their prices may be greater.

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