

Why Do the Emergency Departments Need AI? SickKids VS Wait Times

Imagine a child you care for is sick or in pain. You don't know why, and you don't know where to go. For many caregivers, it often leads them to the same place: the waiting room at a hospital emergency department.

At SickKids, around 300 families come through our Emergency Department every day. Devin Singh is one of the doctors who works here: as an emergency physician and a computer scientist. He's harnessing new technologies to address wait-time anxiety in the emergency department. And while this tech wouldn't be the only solution, he's already using artificial intelligence to solve real clinical problems.

You're listening to SickKids VS, where we take you to the frontlines of child health. I'm Hannah Bank and this is SickKids VS Wait Times.

Hannah Bank: Devin, thank you for spending this time with us today. We really appreciate it.

Dr. Devin Singh: Oh, it's my absolute pleasure. Thanks for having me, Hannah.

Hannah: Well, I see we're both wearing white button downs. You're not in your lucky scrubs. Which I've heard all about. Maybe you can tell me a little bit about those.

Devin: When I was a wee resident and going through my training, I had a particular scrub top that I loved to wear. It was the most comfortable, breathed the best. And it just became my lucky scrub top. And so, over the years, it's definitely started to fall apart. I've had to sew it up a couple of times. But, still a shirt that I wear to all of my acute care shifts to this day.

Hannah: It is interesting that many people have that one special thing that takes them through situations that might be difficult. Just hoping you could give us just a little bit of a background on what led you to become an emergency medicine physician.

Devin: Well, specifically paediatrics: I had always loved working with children. One of my first jobs was actually a camp counselor for the YMCA out in Oshawa there, where I was born and raised. Ended up running camps across the GTA, and I knew that I wanted to do medicine. And so, I knew that paediatrics was definitely my focus in medicine. And then throughout my med school training, I just discovered just the type of medicine, like emergency. There's a lot of uncertainty.

It's really incredible and a privileged position to be in to know that my words can reassure a family. And take away that anxiety and that fear that they have about their kiddo, with just simply an interaction with me in the ED. And so, I find that incredibly rewarding. And it's what keeps me in emergency medicine.

Hannah: When you bring your kid to the emergency department, you can be waiting for a while. How have wait times affected you in your career?

Devin: A lot of the work I do is really based on a particular case that sort of launched me into this. It was a case of a kiddo who I think might have died a potentially preventable death if our health system was designed in a bit of a different way. And so, this is a patient who had a deterioration both at home and then in our emergency department. I just kept thinking, if we could have been able to both educate that family in a bit of a different way, but also when these patients arrive, if we could get them through the pipeline of sitting and waiting and really tackle wait times. If we could tackle the way we deliver care in a much more targeted way, could that kiddo have been alive today. And, even to this day, I get a little emotional thinking about it because this is our north star.

Hannah: Was it simply that that the child was waiting too long and could have been seen earlier?

Devin: Health care actually has so many layers of safety in place that usually we catch cases, and usually we don't see these outcomes. But there's something called the Swiss cheese model, and you think of, like a slice of Swiss cheese. There's different patterns of holes, but usually the patterns aren't aligned that a problem can get right through the piece of cheese. It applies to this case because it wasn't just that there was one issue, I think that there are so many facets of where there could have been improvement.

When that case had happened, it had stuck with me, like I said, and I was actually trying to find ways to solve for it. And so initially, I was thinking I would go down the route of, like, patient and family education and maybe like, health literacy. And then I was thinking through maybe I'll be a QI or quality improvement expert. And so, I was wrestling with like, where was I going to focus? And I was quite literally at one of my best friend's weddings. And his brother was the CEO of an AI company in the US. And he was hearing me talk about my research and trying to figure out what to do and how to solve these problems. And quite literally, Hannah, he goes to me and he says, "Dude, AI." And then walks away. And then this light bulb went off and I realized, this is it. This is how I'm going to dedicate my career to undoing that case. And that's why I did my master's in computer science. I really wanted to understand the technology. And now we're here.

Hannah: I was hoping you could maybe take me through what it's like currently in the Emergency Department at SickKids. What a child and their family would experience from when they come in the front doors.

Devin: Really the process starts at home when a patient is becoming a bit unwell. Right? And let's imagine there's a kiddo, who should be at school, should be playing with his friends at recess and he's got tummy pain for a few days now. There is a family there that has to figure out what do I do about this? Like when do I become concerned about my kid's abdominal pain? And when do I go to see my primary care physician versus come into an emergency department? And so really the dilemma, the problem, the anxiety, the concern can sometimes start days before arriving to our emerg.

Let's say parent decides, yeah, let's bring our kiddo into the ED. They would arrive to the Emergency Department. They would go through a check in process called triage. So triage is one of the most important processes we do in the emerg. It's where we capture a bit of information: your age, your weight, your vital signs. And in this moment, we're going to get some data that says that this patient has a bit of tummy pain, has had it for a few days, is maybe having a bit of fever and the pain is getting worse. And we capture that data into our electronic health record system. And then that family has to wait to see one of our emergency doctors or trainees, residents or fellows.

After a period of waiting, you would see the physician team and let's just say, spoiler alert, this kiddo has appendicitis. And so, the physician team would then do an assessment to say that there's a concern for appendicitis and order an ultrasound. But then there's another period of waiting. Right? You've got to wait for that ultrasound to be made available. You have to actually get the ultrasound done and then wait for the results of the ultrasound. And then at that point, we would make a diagnosis of appendicitis and then liaise with our general surgeons, get an O.R. booked.

I paint it with that granularity to say that two days ago, there was a concern for maybe appendicitis, but it might take a period of multiple waits to actually get to that end diagnosis. But one way that we could help to further expand capacity in health care, tackle wait times and tackle improving aspects of care would be to augment with artificial intelligence that has a capability of mimicking decisions that we would make as humans. And that's where I think there's a really incredible promise with this technology.

Hannah: I wanted to just take a step back for a moment and talk a little bit about AI and what it means in health care.

Devin: Yeah, so, artificial intelligence is a giant field of computer science. And really what it's looking to do is to mimic the decision-making that a human might make. And so hence it's artificial and it's intelligent.

Now, within this giant field of artificial intelligence, there is machine learning. And so, a machine learning algorithm can look at some information and then learn on its own patterns and trends and how to achieve a task.

Let's say that me as a clinician in that story that I just painted around this kiddo with appendicitis, I went and I saw that patient and seeing that there's a pattern of appendicitis, I'm then going to use that data as a clinician to make a decision that, oh, this kiddo might have appendicitis and so we need to do the ultrasound. So what AI would look to do in that same story would be to actually take that data and that information about the patient and mimic my decision-making. And so one of the questions that we might ask is: Can artificial intelligence actually do that? Can artificial intelligence look at a similar type of data that we collect in the emergency department and actually mimic deciding, yes, you do need an ultrasound for appendicitis versus, no, you don't. And that's a little teaser about some research that we're doing because, turns out, yes, it can.

Hannah: So let's take the appendicitis case, for example. What would AI look like integrated into that?

Devin: So we spoke about when you arrive to the emergency department, you go through triage, where we capture your vital signs, your symptoms, why you're coming. And it turns out we can actually use artificial intelligence on that data that we collect right when you arrive to predict what your downstream diagnosis might be eight to 10 hours later, and then potentially what we propose is if we know it's going to be appendicitis with a high likelihood, what if the machine learning model or the artificial intelligence system ordered that test before you saw the doctor so that while you're waiting, we could get the testing done, we can get you to a diagnosis faster. And we can get your results faster and your treatment provided faster.

Maybe we don't just order the ultrasound. But maybe we tell the general surgeons, "Hey, in a couple hours, we've got a case coming for you." And then maybe the general surgeons could tell the O.R. to make sure that an O.R. nurse and the team is going to be ready. And maybe we can then inform the inpatient bed staff that, "Hey, there's going to be an appendicitis post-op surgery case, we're going to need that bed."

The power of a single prediction, done at the time of triage, can not only ripple to improving patient safety and getting to treatment faster, but could help with the downstream logistical facets that all go into providing streamlined care. And it's these different complexities that I've learned from this previous case, that north star that I was talking about.

Hannah: That's a great explanation. Thank you for that. That decision-making process and automating it and saying based on this information, I think this patient might have appendicitis: What are the chances that would be incorrect? Is that something that you think about when you're putting these into place?

Devin: Absolutely. Like all machine learning algorithms and AI systems will make errors. So they will be incorrect at times. This is why there needs to be quite a rigorous validation process and an ethical process woven into this right from the beginning.

And so what we've done for this particular model, if we use it as an example. We've looked at a whole bunch of historical data and have demonstrated that the model performs very well. But it does make some mistakes — they're minor, but it makes some mistakes. And so from those learnings, we've then thought, how are we going to design a workflow that mitigates the risk against those mistakes? The way that we embed an AI system or a machine learning model into the clinical workflow is how we then mitigate against the risk and the concerns around when a model makes a mistake. And that takes a lot of thoughtfulness. It takes a lot of robust engagement with patients and families as well to make sure that we design that, and I actually think at SickKids, we're probably world leading on doing that.

Hannah: I'd love to expand on that a little bit and talk about what makes SickKids unique.

Devin: The first thing that comes to mind is our patient population. We are so blessed to live in the city of Toronto and to see the most diverse patient population in the world. I think SickKids has the best chance at making sure that our algorithms are truly fair and equitable, because we have the patient population to work with directly. We're able to understand cultural nuances, the care delivery as it intersects with AI, but also we have that data to make sure that we are having good representation across these different patient populations.

The second thing that comes to mind is our people. We have some of the best people in the world working on machine learning and AI here at SickKids that help us ensure that we're shepherding in technology in a safe, robust and ethical way also gives us a huge advantage in getting our technologies deployed.

Hannah: It's incredible. And the role of patients and caregivers and how they inform your approach to ethical AI is very interesting to me. Can you speak a bit more about that?

Devin: Yeah. Well, we've got our patient advisory groups, both within the emergency department, but on the hospital level. But we also have this AI Youth Council, and this is where you start to get these fascinating opinions from our youth who are very savvy, super impressive group of youth. We assume that, like, everyone would love to get their order done faster, right? Like of course. And parents love it. It makes sense. Parents don't want to sit waiting with their kiddo for a long time in the emerg. But do you know who has a bit of a skeptical issue with this potential workflow? Are the kids. Because the kids perk up and, like, wait a minute, wait a minute. You're going to do what testing on me? Tell me about privacy, tell me about security. What happens when things get hacked? Very critical in a good way around how are you going to deploy these tools and how are they going to impact me? And so we work with them, to make sure that the technology is truly in line with what is congruent to them and sort of what they think is acceptable as well. And that's why I think SickKids is a world leader on that front, not only building these algorithms, but truly deploying them in a way that is co-designed and that is safe. And it also makes sure that we're solving the problems that our patients and our families actually want us to solve, which I think is really helpful.

Hannah: I want to expand a little bit on the AI tools and machine learning tools that you're currently working on at SickKids.

Devin: We've got some AI tools that can predict and forecast patient volumes so we can make sure we've got the right staffing at the right time. As we see patient surges occurring, we want to then use real time machine learning and AI technology to make sure that we don't accidentally have the wrong patient waiting too long. I mean, for most of us, waiting in an emergency department is a huge inconvenience. But for some patients waiting too long in an emergency department could be life or death, potentially. One of the ways that SickKids is being proactive at tackling this is starting to deploy technologies that help us to make sure that we don't accidentally leave the wrong patient waiting too long. To flag when higher risk patients are waiting, to flag when maybe there's a patient who needs an ultrasound that's waiting a bit long, to make sure they get the ultrasound in a timely fashion.

It's all about getting to the right diagnosis faster and knowing who should stay in hospital vs who could possibly go home. This is starting to step into a bit of the work that I do on the industry side in partnership with SickKids. Our company called Hero AI, it's an entity co-owned by SickKids, and it's spun out from the hospital.

Hannah: Devin, can you explain what Hero AI is?

Devin: A platform technology that allows us to take our machine learning algorithms and apply them to patient data in near real time, which just means as the data is being generated, we can look at that data, apply AI algorithms to them and then push insights out to both patients through our patient app called Beacon and to health care providers. And really, what that's allowing us to do is to improve patient safety, improve the patient experience in the emergency department and to help provide faster care in the ED.

Hannah: You're taking into account a lot of the things that we as families are experiencing, so I wanted to ask you a little bit about ethical AI. If you could explain to us what that is and how that is incorporated into your work as a physician.

Devin: Yeah. So, the ethics starts right from day one. We've actually — the AI and medicine team here — have crafted something called GET-AI. The GET-AI framework really walks through the different phases and steps as you build a machine learning model from a technical perspective, but then weaves in here are the different phases of ethics and regulatory and privacy to make sure that as you progress forward in building the technology, we're staying really ethical. We're staying safe. And one of the things that I'm really proud of at SickKids is we, I think, exceed what the bar is, even from a national perspective when it comes to, like, regulatory approval of machine learning models and even when it comes to like, patient privacy, data security, we really hit an incredibly high bar.

Hannah: What are patients and families saying about it? What's the feedback that you've gotten?

Devin: From a Hero AI side, we're getting really great feedback around some of the patient facing tools that we've deployed. And so something from one of the interviews that I did with a family that shocked me was we had a dad say, "I would be afraid to actually even get up and go to the bathroom". So imagine you're sitting there with your kiddo. You really have to use the bathroom, but you're worried that going to the bathroom might mean that you get skipped over and you lose your spot in queue. We're not going to skip over you, but people are concerned about that.

And so, just having an application that says, hey, you've got five more people ahead of you. Having people just gain that awareness so that they can think through, like, okay, I can cope better with my state because I kind of anticipate what's happening, is surprisingly powerful.

Hannah: Hero AI is already in use at SickKids and a health care center in Halifax. What might it look like on our phone if we were to open up this app.

Devin: So if you're a patient or a family, you come into the emergency department. You go through your triage, but now you're going to be prompted to scan a QR code and gain access to an application. That application allows you to link your patient data that's coming in through a health record system to your app so you can start to get a better idea of what's going on with your care. You actually can see a bit of a forest fire gauge, if you will, around how busy the emergency department is. And so what we wanted to do with this app is give you that awareness now so that you could see progression even though you're sitting there. Nothing's changing around you. In the app, you'll see progression that you are getting closer and closer to getting ready to be seen. And that in and of itself can really help give people a sense of calm that like stuff is happening. I am getting closer to being seen.

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Hannah: Take us back to that example, that scene of a patient with appendicitis. And if they were to use these AI capabilities, what would that look like for that patient and that patient family?

Devin: One of the things that we in the near future would like to do is to be able to give that family — yes, they now have already this situational awareness of where they're at in the queue, but to actually layer one level on top of that to say, you know, yes, here's where you're at in the queue and this is what we're

concerned about potentially. Like wouldn't that be powerful to have the family know we share their concern. And here's what's happening behind the scenes to get you through to your diagnosis as fast as possible.

Hannah: As I'm listening to you, and I think about your experience as a researcher and a clinician, can you talk a little bit about how one drives the other in your work?

Devin: Yeah, absolutely. I mean, and it sort of speaks to why I then went to do my master's in computer science, which was — I mean, imagine I've done med school, I've done residency training, I've done an emerg fellowship. Like you're getting a little tired of school. And I went and did the master's in computer science. And, it was really important that I did that because to your point, like they informed each other. My understanding of machine learning and the AI technologies and how to build them then started to inform the opportunities on the clinical side. But then on the clinical side, my understanding of like the workflows and the patient experience and the physician experience actually then circles back in to informing the technical build side of things, and they truly work hand in hand. And not only that we're building them to solve problems at SickKids, but in my lab in particular, we build these solutions in a way that we think could scale across the country and beyond. And that perspective really only comes from understanding both the technical but also the clinical side.

Hannah: What is your hope and dreams for AI and health care at SickKids?

Devin: I'm really excited about the opportunity for us to be able to automate aspects of care, automate test ordering and really help us diagnose faster, treat smarter and predict better. We've got incredible work that's fairly mature on that front. And I think that there's an opportunity to deploy those technologies, so that patients can really feel the impact, that positive impact, on how AI is able to help augment their care.

Hannah: So want to give you an opportunity to talk to our listeners about the power of philanthropy and what it means to you.

Devin: I actually almost get a little bit emotional when I think about it, because it's so inspiring to me to think through a community of people coming together, to take their own personal resources, to support a cause and a mission. And when we think back to that north star case and how we're building machine learning and AI technologies to really make sure that never happens again.

When you're on this path of doing something for the first time, it can feel a little daunting. But you know that you have to get to the other end, because it's really about saving that kiddo and making sure this doesn't happen again. And when I see philanthropy come into play, it really does help to clear that path forward for us, and it inspires us to work that much harder to do so.

Hannah: From SickKids Foundation, I'm Hannah Bank. Thanks for listening. To support breakthrough research and care at SickKids, please visit SickKidsFoundation.com/podcast. And if you liked this episode, subscribe and rate us wherever you listen to podcasts.

SickKids VS is produced by me, Jasmine Budak, Liz Surani, Emily Holland, Deanna Cheng, and our showrunner Neil Parmar. This episode was written by Deanna Cheng. Sound Design and Editing by Quill. Check out our show notes for helpful links and resources. Until next time.