From Electronic Health Records to Space Medicine: Building the Future of Space Healthcare

Peter Devault: For those of you who don't know Epic very well, and I will assume that's most of you, electronic health records probably seems a specifically earthbound an endeavor. I'd like to convey, hopefully, over the next several minutes, not only has Epic always had its eyes on the stars, but we've developed and deployed at scale a number of technologies that we think are going to be vital for building the platform for space healthcare and healthcare in space.

The girl on the screen here represents really what we've always been at Epic, which is centered on the patient or with the patient at the heart, all the petals around her head, and by the way, that's our founder's granddaughter. All the petals around her head represent the different applications and the different data types that we work with around that patient.

We are a multinational company. However, all of our development is done in Verona, Wisconsin. We have a single code base that is used throughout the world in, I think, about 20 different countries right now. We do have offices in about 16 countries, but those are for supporting the local deployments. All of our development, about 14,000 of the 15,000 people that work at Epic today live in Verona, Wisconsin. Just as a point of historical reference, when I started at Epic, there were about 100 people there. It's probably helpful to know a little bit about us. We are a private employee owned company, and we build everything that we sell. We don't acquire companies, we don't acquire technologies, and we put a lot of what we take in as revenue back into the development cycle, much more so than many of our competitors.

The fact that we have a single code base for the world, as I mentioned, means that when we do a deployment in Finland that is focused not only on healthcare but on social care, we bring those learnings back the United States and throughout the rest of the world, but we bring them back in our system, as well. Those capabilities are there for everybody, whether you're in Finland, whether you're in the United States or on the Space Station.

We've always, as I said, had the focus on the patient. In the early days, that meant focused on health systems, medical centers, and then the patient portal, which came out about 25 years ago. Those of you who do know Epic at all might know us from the patient portal MyChart, which is the most popular health app on the various stores these days. We have almost 200 million active users, meaning people that actually login. It's important to know that the MyChart portal is not just a window into a record that somebody else produces for them. This is a way for patients and their family members to interact with and navigate the health system, navigate a hospitalization or a research study that they're in, or indeed a mission or some other endeavor that they might be part of. MyChart understands not only the data that's part of a person's record, but also the unique workflows and information flows that they're part of.

Over the years, we've expanded what we call the health grid to incorporate not only traditional hospitals and medical centers, but all of the venues of care that a patient might seek care in. Hospital at home, hospice programs, schools, dentist office, post acute facilities. We've also expanded to cover not only the sites of care, but also the other entities or companies that touch a person's health care like laboratories and payers.

Part of what that has meant is developing robust interoperability capabilities. That means, for example, with our Care Everywhere platform, that we are able to exchange records between different health systems at the rate of 20 million records per day. I had to double check that with the experts back at home right before this talk. That is the number. About 20 million patient records per day are exchanged over our Care Everywhere network, and that is a little less than half epic to epic and a little bit more than half epic to non epic sites, whatever that might mean. That could mean the DOD and the VA, it could mean a physician office practice that doesn't use Epic. That robust

interoperability capability is not just being able to get a fax from one place to another. That's hundreds of structured data types that actually can go from one system where they do work to another health system where they can do the same work.

That concept of a network of different healthcare entities with a shared governance structure and a shared set of technologies and standards worked so well that we have replicated that concept several times. One of the more important ones is in our Aura network, which enables a health system to make one connection to the network and thereby enjoy connectivity to all of the different commercial labs that they might order tests from. What it means for the laboratories is that with a single connection, again, they can send structured results back to all of those different healthcare entities.

These capabilities might mean for a space health program is that astronauts who might receive care and indeed come from many countries around the world can have their records assembled and wherever they go, and indeed here or up in space, the records can follow them. When we say records, again, it's not just the paper, it's structured data. That includes genomics and pharmacogenomics data, which is where I spend most of my time. We were the first electronic health record system to introduce structured genetic results and genomic results into the patient record. It's our strong belief that that data is as vital a part of the health record as the problem list, the medications, and the allergies. We have a structured home right within the epic patient record to represent genetic variation.

We have taught the system over the years how to work with those new complex data types. In fact, it's a story that has replicated itself several times over the history of Epic, whether that's wearables, data, genomics information, or some of the new diagnostic capabilities that are coming out. What that means is that health systems, whether they're the ones who are testing the patients or receiving patients that have been tested elsewhere, can surface things like pharmacogenomic warnings when somebody's prescribing a medication that is not going to work with their biology. They can find the right treatment based on the molecular signature of the cancer that they're working with. Indeed enroll in a clinical trial that has an inclusion criteria of a specific genetic mutation.

Now, Cosmos is not just the theme of what we're talking about here today. It's also the name of our patient data aggregation platform. A little more than 10 years ago now, talking with several of our customers, we were reflecting on the fact that we've all gone through our different journeys, and we have a lot of only data to share with each other, but insights into that data. We thought that it would be great if we could share those insights in a robust way. That was the birth of what became Cosmos, much more than we anticipated at the time. Today, it's the home of about 300 million longitudinal records representing data from health systems in the United States, in Lebanon, in Saudi Arabia, and Switzerland in Canada. This is obviously a platform that is very capable for research, and many people do research on that data, but the reason we built it wasn't only for research. It was so that we could surface insights into a person's care or a population's care wherever and whenever we needed to do that.

We can suggest second line therapies. We can produce growth charts for rare disease patients based on actual observational data, and we can correlate a patient's information with what might be seen in the broader population of people that look a lot like them. Cosnome was the next logical step in that, where we introduced that genomic data that we've been working with our customers to aggregate into Cosmos itself. Obviously, that is going to help make what can be done in Cosmos more precise. It's going to enable new kinds of research at a scale that hasn't been possible before.

Perhaps the most impressive, set of features are yet to come. We have been working on AI capabilities within Epic for several years now, and many of those, if you practice in Epic, you'll be familiar with them today. Generative AI that can help you write your notes or respond to patients. Even more interesting than that is we've built a large medical model on top of the data in Cosmos, where we have tokenized the different kinds of events and observations that can be made in the healthcare setting or wherever whatever setting it might be, so that instead of generating the rest of

a sentence given a prompt, we can generate potential futures for a person based on what has happened before. So we can play out several different scenarios. In fact, in parallel, we can play out hundreds or thousands of scenarios and narrow in non specific kinds of risk that a person might have. We can expand this, of course, to new types of data, whether it's telemetry data being collected in space, genomic and proteomic and transcriptomic data collected before, during, and after emission, and bring that information back not only to predict astronaut health, astronaut resilience, but also help understand what makes people resilient in general.

Well, we already saw that. I'll end by talking, I grew up in the 80s just like our company did, and I was 10-years-old. This will date me specifically. I was 10-years-old when my dad brought home the first edition of Carl Sagan's Cosmos. We watched the television program, and this is a quote that has always stuck with me, and I'm sure you're familiar with it, "The cosmos is within us. We are made of star-stuff. We are wait for the universe to know itself". But as I reflect on our preparations for our children to one day gaze down upon what is increasingly a fractured world from space, it occurs to me that it's not enough to know the universe and to know itself. It's important that we be the way for the universe to heal itself as well. I hope we have a vital part to play in the development of space medicine. I think the capabilities that we've built are going to be necessary for that. Thanks.