“How AI Is Shifting the Dynamics of Your Next Doctor Visit” (Ezra Cohen, MD) [#121]

Brad Power
November 20, 2024

“Most people will begin to either rapidly or slowly embrace these technologies, depending on their personality, and it will change that interaction in every aspect. Patients will come into their visits a lot more prepared. This will be preparation that goes a step further than the typical Google search, because it will be relevant to their specific case and backed up by real data, not by everything available on the internet that can sometimes be not only misleading, but even border on dangerous.” – Ezra Cohen, MD

“Fasten your seat belts because things are changing so fast. It is amazing, and, personally, it is fun to be a part of it.” – Ezra Cohen, MD

Meeting Summary

How will AI change the relationships between patients, caregivers, and doctors as each is empowered with more information and understanding?

New AI (artificial intelligence) tools are revolutionizing every aspect of your life, including your healthcare. With AI, your medical information will be easy to access and share. You will increasingly be able to ask questions and gain insights about your personal medical issues in everyday language and get answers using the best of the world's medical research in an understandable and digestible format. Physicians will also be better prepared for guiding patients with specific, up-to-date information.

Ezra Cohen, MD, the Chief Medical Officer of Oncology at Tempus AI, is uniquely qualified on the impact of AI on relationships between doctors, patients, and caregivers. He is a leading medical oncologist and cancer researcher who brings a unique combination of extensive clinical and research experience. He was most recently the Chief of the Division of Hematology-Oncology as well as the Associate Director of Clinical Science at UC San Diego (UCSD) Moores Cancer Center. Dr. Cohen also led the Precision Immunotherapy Clinic and co-directed the San Diego Center for Precision Immunotherapy at UCSD. Before UCSD, Dr. Cohen spent 15 years at the University of Chicago, where he was the co-director of the Head and Neck Cancer Program as well as Hematology/Oncology Fellowship Program Director. He joined Tempus AI, a provider of genomic testing and other services, in 2023. Dr. Cohen helped guide Kasey Altman, a young cancer patient with a rare cancer, through her pursuit of immunotherapy. He contributed to the hackathon we ran for her.

Why do you need to understand the coming disruption of the traditional relationships of doctors, patients, and caregivers by AI?

AI-enabled software agents will be used to support you in seeking better outcomes through personalized care. Cancer care often involves making complex medical decisions within a challenging environment: a balkanized medical system of many specialists, information overload

and obsolescence, limited time with doctors, and siloed data. New AI tools can enable you to more actively participate in your treatment decisions. For example, consider receiving a complex scan report in a patient portal. Today you may be confused trying to interpret it, adding to your anxiety (“scanxiety”). However, a personalized generative AI agent can translate the scan report into language you can understand, and even contextualize it within your personal health history and clinical evidence/guidelines. By providing an understandable version of the report and the clinical context of your test results, you can engage more fully in decision-making with your medical team.

How will patients and caregivers be impacted by AI?

Until now, the healthcare industrial complex has owned all medical data. But the data is the patients’ data, and patients will have access to it. A next generation of apps will allow patients to control their healthcare journey in a much more meaningful way.

Olivia, a Tempus app prototype, is an example of a vision for a patient-facing, AI-enabled app that would empower you to access and organize your medical records, manage your health, and receive personalized insights. It’s in beta testing at Tempus. Here are examples of prompts to illustrate the capabilities that could be available directly to you:

- Connect to my provider(s) to upload and consolidate all of my records in one place
- Help me prepare for my upcoming appointment
- Help me understand my treatment options
- Is there a clinical trial I should consider?
- What does a “complete response” mean?
- How can I improve my lifestyle?

Patients will come into their visits a lot more prepared. Patients will be armed with tools to report their symptoms in real time and track them over time, e.g., wearable or interactive tracking.

Armed with these insights, patients and caregivers will still face barriers of access to tests and treatments that they identify. AI may be able to help with this problem.

How will healthcare providers be impacted by AI?

- **Visit preparation**: The physician will be armed with the latest data and information, specific to that patient, e.g., test recommendations, treatment recommendations, referral recommendations, drug-drug interactions.
- **Notifications**: Continuous notifications will come from patients and caregivers, e.g., from monitoring devices, and the medical team will have to respond to them. AI can triage the notifications and route them to different members of the medical team.
- **Treatment access**: AI will help doctors in writing the letters that enable patients to access non-standard treatments.

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How will relationships between doctors, patients, and caregivers change with AI?

- **No change for many**: There will be a large segment of the patient population that will want to continue their interactions with their provider as it is now.
- **Better prepared**: Patients, caregivers, and providers will come into any meeting better prepared. Decision support will be massively upgraded.
- **Capturing interactions**: The patient-doctor visit is going to be tracked and recorded in a much more concise way. An AI-enabled tool will capture all the relevant information and create a note for the provider, patient, and caregiver.

What’s next?

- **Personalization**: We will be able to accurately predict individual patient outcomes based on real data from hundreds of millions of data points, rather than what a population will do. Payers, providers, and patients will see this predictive accuracy and embrace personalized solutions over population guidelines because these will generate the best patient outcomes.
- **Big data**: Integrating all health data, including consumer data, will provide a comprehensive view of a patient's health.
- **Tests**: The increasing number of tests and the depth of testing, e.g., whole genome sequencing, will uncover more information than current methods.
- **Breakthroughs**: Breakdowns and breakthroughs will occur as the pace of innovation from AI in healthcare explodes, while healthcare stakeholders struggle to adopt what is available.
- **Fewer specialists and fewer physicians**: AI may handle more routine tasks, reducing the need for as many specialists. In a decade, there will be a need for fewer physicians. We don't have enough physicians right now, and it will help that we won't need as many physicians in total.

How can you learn more?

- Sign up to get access to Olivia from Tempus when it becomes available around June 2025
- Engage with service providers like Tempus to provide patient and caregiver perspectives

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Meeting Notes

KEYWORDS

AI in healthcare, patient empowerment, Tempus database, clinical trial matching, patient-provider relationship, AI tools, molecular data, patient records, lifestyle management, rare cancers, whole genome sequencing, patient engagement, medical records, decision support, future of AI

SPEAKERS

Ezra Cohen (75%), Brad Power (8%), Brian McCloskey (5%), Cindy Ness (4%), Kay Coleman (3%), Alane Watkins (2%), Eric Dishman (2%), Olivia video (2%)

CHAT CONTRIBUTORS

Allen Morris, Alexander Lalov, Erin Carron, Rick Davis, Roger Royse, Brian McCloskey, Richard Anders, Robb Owen, Chad Magnussen, Eric Dishman, Chris Apfel, Kay Coleman

SUMMARY

Ezra Cohen discussed how AI is transforming the relationship between doctors and patients, emphasizing Tempus's role in leveraging multimodal data to improve patient care. Tempus's database now exceeds 200 petabytes, with 7 million de-identified records, surpassing TCGA by 50 times. Key tools like NEXUS, Pixel, and Lens aid in care pathway intelligence, clinical trial matching, and patient-specific insights. Tempus Link enhances clinical trial accrual by matching patient eligibility with trial criteria. Olivia, a patient-facing app for medical record access and personalized insights, was introduced. Future plans include whole genome sequencing and integrating consumer data.

OUTLINE

Introductions and Overview

- Ezra Cohen has expertise in immunotherapies and is the Chief Medical Officer at Tempus.
- The presentation provides an overview of Tempus's AI initiatives and aims to stimulate discussion and explore the future of AI in healthcare, focusing on how AI is shifting the dynamics of doctor visits and the potential for disruption in patient care.

Tempus's Services

- Tempus's multimodal database includes molecular, clinical, and imaging data from over 2500 institutions.
- Tempus uses these data to develop AI tools that help in drug development and provide insights for treatment selection and care pathways.

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- The company has a significant database, with over 200 petabytes of data and 7 million de-identified records.
- Tempus's tools, like NEXT and Pixel, help in identifying care gaps and tracking the size of nodules, respectively.
- Tempus Link is a tool that helps match patients to clinical trials based on their eligibility criteria.
- The tool has been successful in improving clinical trial accrual by notifying providers about eligible patients.
- The Lens database allows for sophisticated queries, such as identifying patients with specific mutations and their treatment outcomes.
- A video showcased Olivia, a patient-facing app that empowers patients to access and organize their medical records and receive personalized insights.

Workforce Readiness and AI Integration

- Eric Dishman asked about the training and integration of AI tools in oncology practices and the long-term implications for the workforce.
- Ezra explains that Tempus works closely with healthcare systems to ensure smooth implementation and addresses the need for ongoing training.
- He envisions a future where AI may handle more routine tasks, reducing the need for as many specialists.
- Brian McCloskey raises concerns about access to drugs and the role of AI in expediting this process.

Addressing Physician Concerns and Lifestyle Management

- Cindy Ness asked about the role of AI in patient engagement and the inclusion of lifestyle management data in tools like Olivia.
- Ezra acknowledged the importance of lifestyle management and said that while it is not included in the current version of Olivia, it is a future consideration.
- Alane Watkins asked about the applicability of AI tools to rare cancers and the involvement of smaller institutions in Tempus's trials.
- Ezra explained that Tempus is working with various institutions and emphasizes the importance of being comfortable with one's provider.

Patient-Centric Questions and Future Directions

- Kay Coleman asked if Olivia can be applied to non-cancer patients and expressed concern about missed medical issues.
- Ezra confirms that Olivia can be used for any patient and acknowledges the need for more comprehensive tools in the future.
- Brian McCloskey inquires about the consistency of molecular data interpretation across different providers.
- Ezra explains that while there may be differences in interpretation, the analytic perspective has improved significantly over the years.

Final Thoughts and Future Innovations

- Brad Power asked Ezra about Tempus's future plans and the inclusion of consumer data in their analysis.

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- Ezra mentioned Tempus's investment in whole genome sequencing and the potential for uncovering more information than current methods.
- Ezra emphasized the importance of integrating all health data, including consumer data, to provide a comprehensive view of a patient's health.
- He encouraged everyone to fasten their seat belts as AI in healthcare is rapidly evolving.

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TRANSCRIPT

Brad Power
This is the Cancer Patient Lab.
We're very honored to have Ezra Cohen with us today. Ezra is someone we've known for a long time. He was very helpful in the Kasey Altman hackathon some years ago. He's been an expert in immunotherapies, personalized vaccines, and things of that sort. As you may know, he's been with Tempus now for a year and a half. He's based in San Diego. He is associated with UCSD. He's the chief medical officer at Tempus.

He's got a very interesting topic for us today, which I think we'll all have fun with, which is how AI is changing the relationship between doctors and patients. At the Cancer Patient Lab we're all about empowering patients. What does that do to doctors? Does empowering patients mean disempowering doctors? I hope not, but we can see what that new relationship looks like.

This is for information purposes only. This is not medical advice. We try to arm patients with information they can take to their doctors to help them in their care.

We are a nonprofit. We are patient-led, all volunteer, and we appreciate any donations which you might make, which you can do at our website, cancerpatientlab.org.

Ezra Cohen 1:53
It's nice to be back with this group.

I've got about seven slides to give you a sense of what Tempus is doing, especially with respect to AI.

I purposefully had a provocative title to try and stimulate discussion. Hopefully, we'll have a robust discussion after the slides.

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The title is “How AI is shifting the dynamics of your next doctor visit.”

If you've been to a physician recently, you may have seen some of these differences in technologies that can listen in on the conversation and then produce a note; in technologies that are being embedded in the electronic medical record to flag certain aspects of patient care. We're just at the beginning of what is going to be a revolution and a disruption at that interaction between the provider and the patient. I use “disruption” in a good way, in a positive way, because, where we have the opportunity to make those interactions and to make management significantly better.

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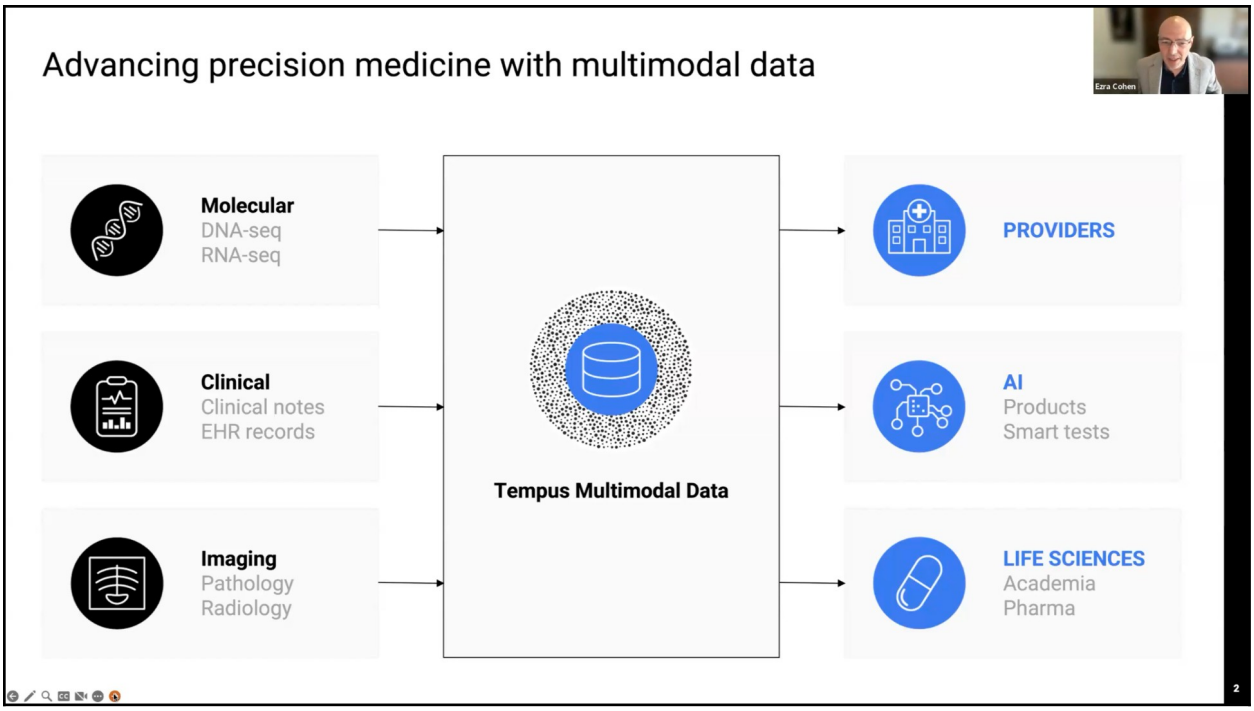

This is essentially Tempus.

We take different modes of data, whether it be molecular, clinical, or imaging. Imaging includes both pathology and radiology. We put it into the multimodal database, and we can provide that data to providers. We can build AI tools with it, and we work with many life science companies, essentially to help them develop drugs or other products more efficiently. This was really the vision from the beginning. The founders, Eric Lefkofsky and Ryan Fukushima (who joined Tempus as the first employee and is currently the Chief Operating Officer), had this sense that not only could we offer diagnostics, but if, along with those diagnostics, if we could collect the data, all of a sudden, those results become much more meaningful and impactful to help drive the best decisions possible for patients.

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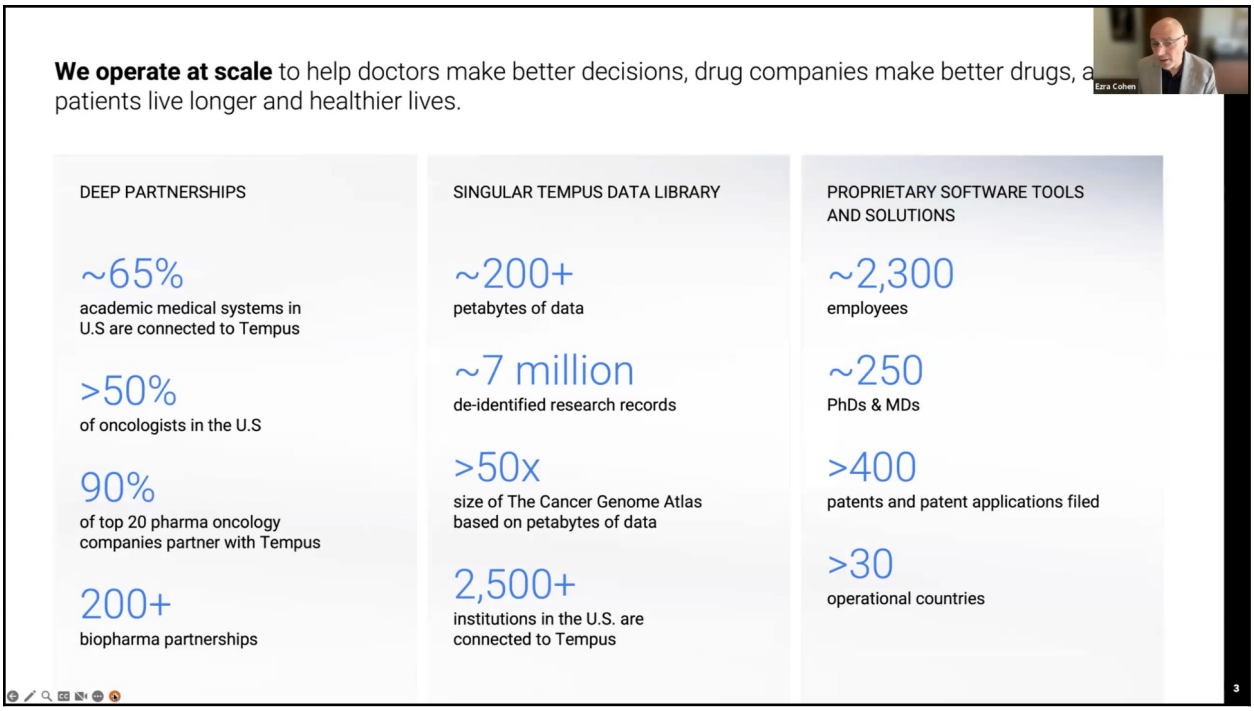

In terms of size, Tempus now is no longer a small company. I'll draw your attention to the middle column here. In terms of the data, it's now over 200 petabytes. It's 7 million de-identified records. To put it in scope, for those of you who are familiar with TCGA (the Cancer Genome Atlas), it's more than 50 times the size of TCGA. It involves over 2500 institutions in the US that are connected to Tempus and exchanging data on a regular basis. You can begin to imagine with that kind of database in oncology, what type of answers you can begin to provide and what type of questions you can begin to answer.

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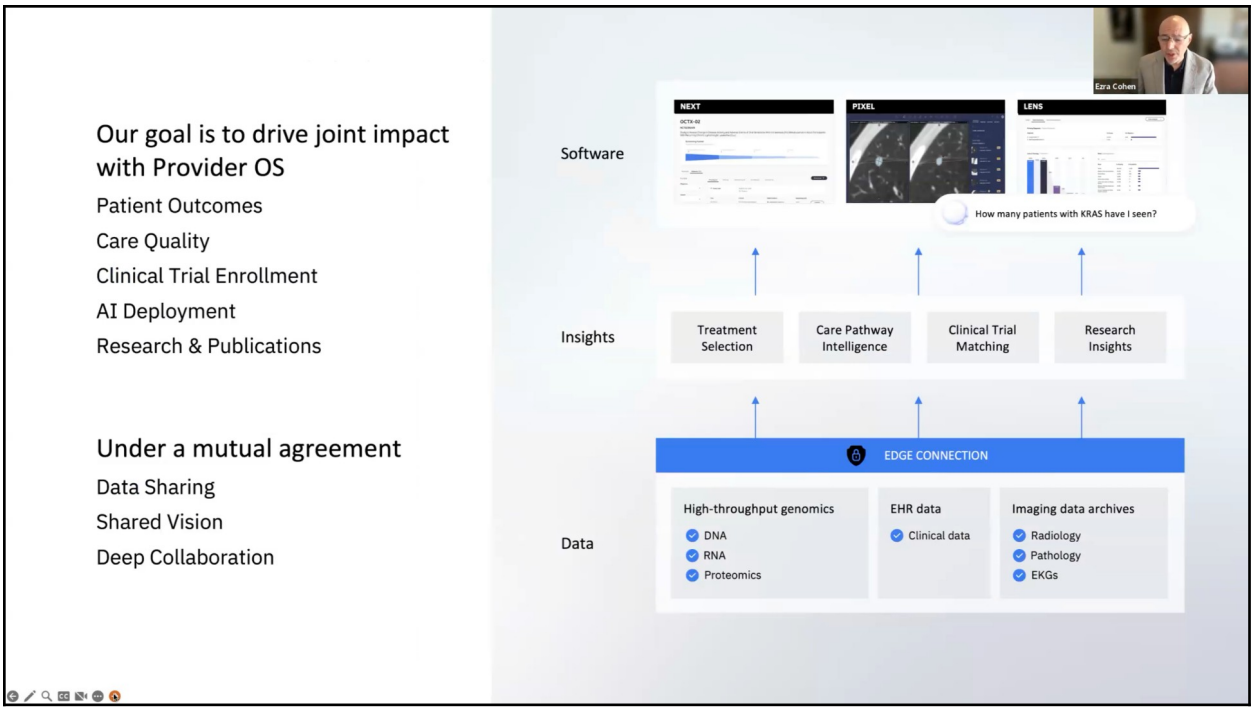
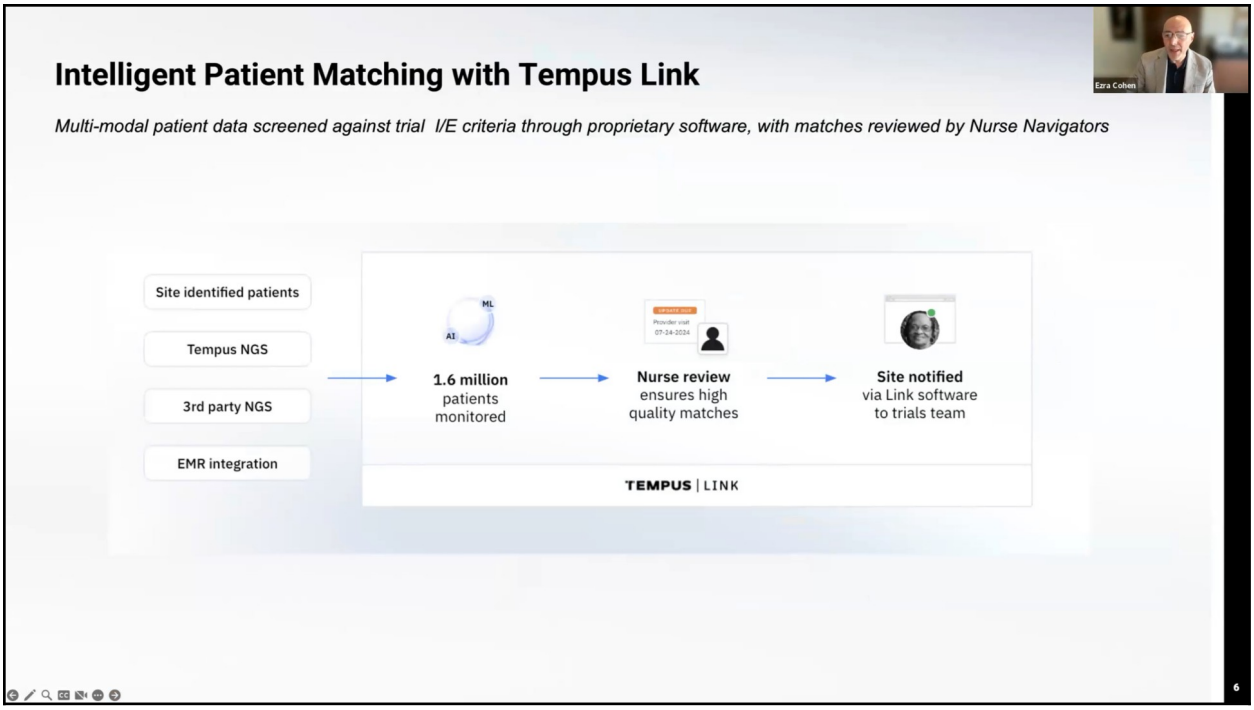


Here is how we look at what we have. At the bottom of this graphic are the data, again, be it molecular or clinical data through EHR integration or imaging data, including, now, by the way, products in cardiology, one FDA approved-looking at electrocardiograms. We turn those data sets into insights that drive treatment selection, that drive care pathways, intelligence that drives clinical trial matching and research insights, and then those get converted into usable software, hopefully very easy to use.

I've shown you four examples here.

- Next is a care pathway intelligence. Next identifies care gaps for an individual patient based on their molecular profile, their clinical data, and the available guidelines, to notify providers that a patient may be appropriate for a specific diagnostic or a specific test that has yet to be ordered. One of the real world examples is early stage non-small cell lung cancer, where an EGFR inhibitor called osimertinib has been approved and has demonstrated an 80% improvement in survival when used after curative intent therapy. We've deployed Next to notify providers that, “Here's an early stage non-small cell lung cancer. They've been treated with curative intent and the FDA and the NCCN suggest that this patient’s tumor should be tested molecularly.” We've had quite a bit of success deploying that.
- Pixel is the radiomics. It can track the size of a nodule. You can imagine that that would be quite useful for patients on therapy to see whether that lesion is getting smaller or larger. We can use that in the context of clinical trials to see whether a drug or the intervention is working.
- Lens. Lens is what we call our database here. Here are the 7 million plus patients. About a quarter million of those have DNA, RNA, and excellent clinical annotation. We can

begin to ask questions through the AI, and now it becomes very easy to interrogate this database. I have an example question there: “How many patients with KRAS have I seen?” Or you could ask, “How many patients with KRAS mutations are in the database?” Within seconds, you get an answer. But it can get much more sophisticated than that. “How many patients with KRAS mutations in this specific disease, in this line of therapy, who have received this drug, and how have they done?” “What are the other molecular features of this patient group?” For almost every query, we will have the largest collection of patients available in the world.



- Tempus Link. Intelligent patient matching. This is one of the tools that the AI is going to be especially relevant to patient management. We all know that the number of adult patients who get on clinical trials in this country is abysmal. The best estimates are about 7%. The realistic estimates are probably about 3%. We also, at the same time, realize that the only way we're going to make progress in oncology is through clinical trials. That's the only way that new interventions get approved, and that number has to get much better. We introduced Tempus Link, where we can enter the eligibility criteria for a clinical trial, match it to the patients in an institution's electronic medical record, and with a team of nurse navigators, notify the site that there is a patient at their institution that would be eligible for a trial at their institution, in an effort to try to improve clinical trial accrual. That's been quite successful in the centers where we've integrated that.

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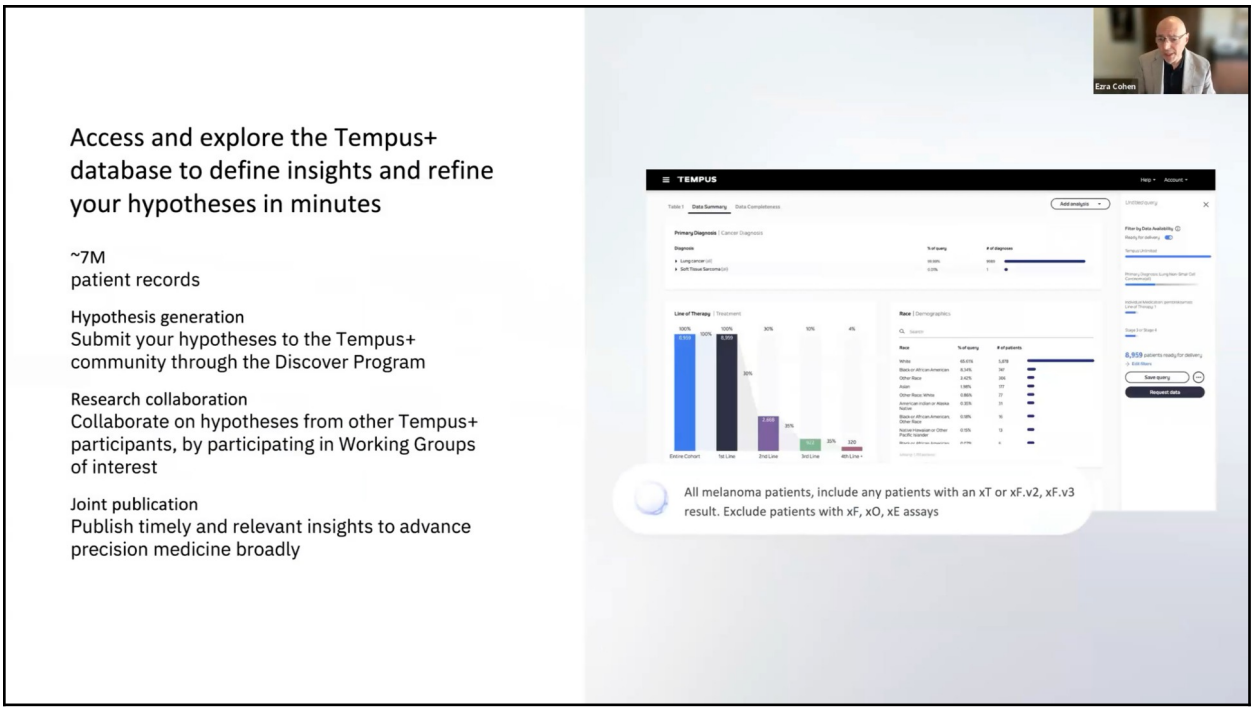

Lens. I won't belabor it, because I've already spoken about it. But here's another example of a question that one could ask of the database: “All melanoma patients, including any patients with the tests xT, xF.” (These are Tempus branded tests. Tempus xT is tissue-based assay that analyzes 648 genes in solid tumors and hematologic malignancies. Tempus xF is a cell-free DNA assay that analyzes 105 genes.) You don't even have to enter that. If you don't know the name of the test, you could enter DNA tests, RNA tests, whatever you want. You can exclude patients who have had specific tests or other conditions, and you can see that it gives you the line of therapy. It gives you certain demographics. It gives you the primary diagnosis. If I had the full demo, I could show you that it tracks survival. It shows you what other treatments they've received. It shows you the other molecular alterations that are present in that group. You can begin to understand that this would be quite useful for hypothesis generation, for research collaborations, for joint publication.

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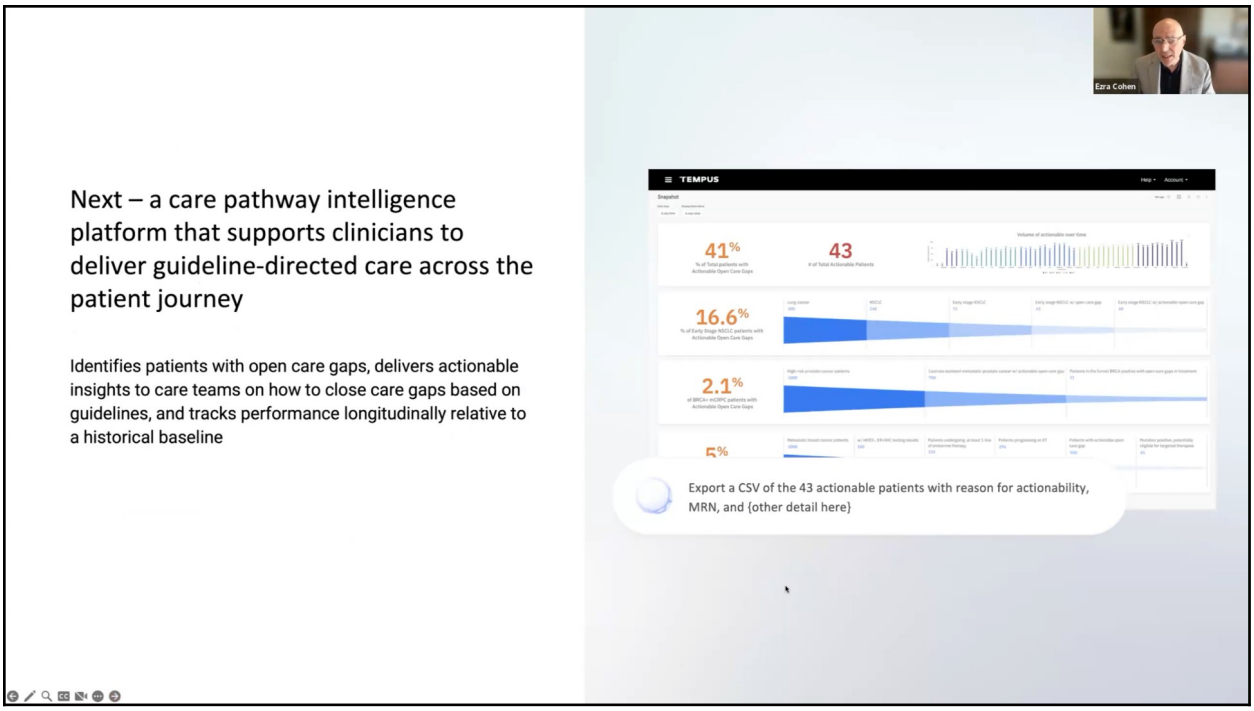

Here's Next again. Here's the non-small cell lung cancer example at the top. There's BRCA in the middle. What you don't see is a deployment in metastatic breast cancer around HER2.

We were working through multiple care gaps at a time.

All of these can be deployed at an institution at any one time.

Lastly, I just want to play this video, because this is really what I think is going to be most disruptive in the next few years, and that is a patient-facing app. It's about a minute-and-a-half to two-minute video.

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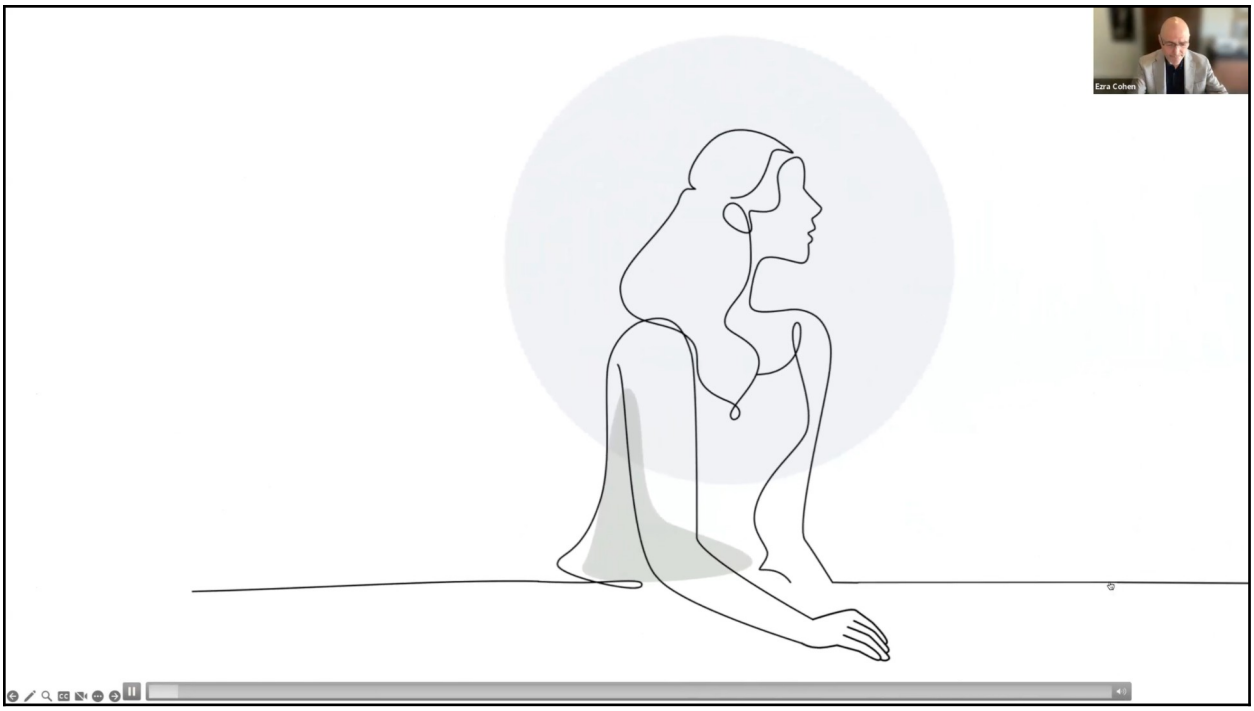

Olivia Video 13:28
The past few weeks were a whirlwind: doctor's appointments, tests, and anxious waiting. Now the doctor was saying the dreaded words, “You have cancer.” The days that followed came with a barrage of appointments and procedures, but amid the uncertainty. She wasn't alone.

“Olivia, please go to my provider for my medical records.”
[Shows review of medical records]

“Olivia, can you help me prepare for my upcoming oncology appointment?”
[Shows review of information]

“Olivia, can you help me understand my treatment options?”
[Shows treatment options]

“Olivia, is there a clinical trial I should consider?”
[Shows clinical trials]

“Olivia, what does a “complete response” mean?”
[Shows definition]

Enhanced by AI, Olivia empowers patients to access and organize their medical records, manage their health, and receive personalized insights. Imagine a world where every patient has the world of medical information tailored to their own unique journey at their fingertips, a world where no patient feels alone, a world - Olivia.

Ezra Cohen 15:48
We're very excited about it. This type of technology will be incredibly disruptive to that interaction, but again, disruptive in a good way, because until really the present time, it has been the healthcare industrial complex that has owned these records. But they really are the patients', the patients should have them, and here are now the next generation of apps that will allow patients to control their healthcare journey in a much more meaningful way.

Brad Power 16:43
Was that Olivia product you shared a mock up of something, or is that a real product?

Ezra Cohen 16:56
That's a real product. It's in beta testing right now. We've invited people to try it. It's by invitation only. If there are people interested, I'm happy to collect those names, and I can give them to the team that's developing Olivia. Right now it's by invitation only, because really, there's going to be kinks. We're not under any impression that this is the perfect app. Right now we want people to test it, to use it, and tell us what's wrong with it. We'll probably do that for the next six months, and then our plan is to launch it widely.

Brad Power 17:49
You had your very provocative title. Can you just speak to that a little bit? What do you see shifting in the relationship? Eric Topol says something like, “The patient will see you now.” What's your elaboration on how you see the relationship between patients, caregivers, and providers evolving with the advent of increasingly powerful AI?

Ezra Cohen 18:17
It'll be more patient-driven, even more than it is now. I'll tell you what I mean by that in a moment.

It also will depend on what the patient wants, and there's no doubt that there'll be a large segment of the patient population that wants to continue their interactions with their provider as it is now, and that's terrific. There will be a lot of the caregiver-patient-provider interaction that will not change.

But to get to your question, most people will begin to either rapidly or slowly embrace these technologies, depending on their personality, and I think it'll change that interaction in every aspect. Patients will come into their visits a lot more prepared. We saw some examples of what one could ask an app like Olivia. This will be preparation that goes a step further than the typical Google search, because it will be relevant to their specific case and backed up by real data, not by everything available on the internet that can sometimes be not only misleading, but even border on dangerous. We've all seen examples of that. They'll come into their visit a lot more prepared.

Then at that visit, the physician will be armed with the data and the information that is specific to that patient. There was a really nice article in the Wall Street Journal maybe two months ago,

that really speaks to this issue: there is no way that a physician can now be prepared with all the medical information that they need to know. It's just impossible. To put it into perspective, I'm still a practicing medical oncologist. I see patients half a day a week at Moores Cancer Center in San Diego. About 90% of my patients have head and neck cancer, and I have trouble keeping up with what's going on in head and neck cancer. I can't imagine what a community oncologist has to do to try and keep up with colorectal cancer, breast cancer, non-small cell lung cancer, prostate cancer, etc., let alone head and neck cancer. I have trouble keeping up with a sliver of the oncology world, what does the community oncologist do? It's impossible. Now the AI can all of a sudden produce the relevant information for the patient that that provider is about to go see. The AI can send notifications with respect to, “Hey. There's a drug-drug interaction here that you need to be aware of.” “The guidelines suggest that this patient should be tested for whatever their latest electrocardiogram showed them at risk for an MI within the next year. Consider referring them to a cardiologist, or consider this relevant testing.” That's the next part, the physician is going to be better armed with specifics to that patient.

That patient visit is going to be tracked and recorded in a much more concise way. Right now, physician notes are incomplete at best and terrible at worst. We have a hard time capturing all the relevant data, because what happens is, you interact with the patient, you ask them all of these questions, and you try to remember what to write down. So much of that interaction is lost. But now, because there are tools already in place to do this, interaction can be tracked by an AI. The AIs are getting more and more sophisticated to be able to pull down all the relevant information and create the note that the physician has to edit.

Patients can be armed with tools to report their symptoms in real time that can be tracked over time, and those patient-reported outcome tools, be they wearables – I'm not wearing mine right now – or interactive tracking, those can be conveyed right to the healthcare system or to the provider, and the providers can be notified that, “Hey. Miss Jones is moving a lot less. She is a lot less mobile than she was a week ago.” One of the healthcare team members can call Miss Jones and say, “Hey. Are you okay? Everything going all right?” “I don't feel so well.” “I'm getting more tired from my radiation or from my chemotherapy.” There are data showing that you can actually avert hospitalizations or other outcomes, other negative outcomes, by doing that. We're going to have AI across the entire spectrum of those patient visits that are going to dramatically change how we approach patients.

Brad Power 24:27
You've probably said “send notifications to doctors” at least half a dozen times, and so if they're already stressed and struggling to keep up, that community oncologist, now Tempus is giving me six notifications a day that I need to do something about. Doctors don't like notifications. They have to do something with a notification, and they're busy. So can you speak to that aspect of being overwhelmed with notifications from the AI?

Ezra Cohen 24:53
We are highly attuned to that, because you're absolutely right there. There's fatigue. I experience it now. You are going to think I'm a terrible doctor after this, but there are many

notifications that Epic gives me that I just ignore because it's just too much, and I have learned the ones that I need to pay attention to and the ones that I don't, but AI can help there as well.

There are two things. First, it doesn't have to be the physician that's notified. It can be anybody in the system that that institution designates. You can have a nurse, a PA, whatever, get those notifications and decide which ones are important to take forward and which ones they can handle themselves. You are absolutely right. The last thing we want to do is add more to the physician's plate so that they burn out even faster than they burn out now.

The second thing is that the AI can begin to prioritize those notifications, and if barriers are lifted, actually, and this is in the future, this doesn't happen now because there's regulatory issues to deal with, but the AI can begin to enact management plans, or actual management that will will not need a provider or or a human to be involved with.

The third thing I would say is, just like any technology at first, there'll be a learning curve and without a doubt, some extra work. But in the long run, as we begin to learn how to use it, it'll save a tremendous amount of work and it doesn't even have to be a medical technology. Think about your first laptop, or the first personal computer that you got. You have to learn how to use it. The first iPhone, or the smartphone. You have to learn how to use it. And that took a little bit of extra effort. But now, how much time does that save you?

Eric Dishman 27:21
I want to continue with the theme that Brad opened up and you've been addressing the last few minutes about workforce readiness for this and all the other changes that are coming in and the keeping up problem. I have a near term question, as people adopt these tools in oncology practices today, what is your training and integration service or system like? How long does it take for them to get good at it, and what changes to their workflow do they have to do? My longer term question is: 10 years out, when these things are at scale, are there still specialists, or does everybody train to be good at analytics and AI savviness and a certain amount of medical knowledge, and the AI becomes the specialist? What are the implications long term, so that we could design a workforce for where the puck is going to embrace these technologies and use them?

Ezra Cohen 28:16
We work incredibly closely with the healthcare system when we deploy these tools. We do that for several months. We had a webinar on the Next program, probably about four months ago, with the Precision Medicine person at TriHealth. That's a health system in Ohio that put it in place. Karen, who was the officer designated to do this, described very nicely the hurdles that they experienced, the problems and how they did that, but we worked incredibly closely with them. And this was still in beta testing. We've gotten a lot better at anticipating problems, but you're absolutely right. We have to work. There's a period of time where a product gets launched, where people have to learn how to use it. If it's Tempus or any other AI company, we have a responsibility to do that.

The second question is a bit more provocative. What does the future look like in terms of the workforce? I can envision a day, and that day is not tomorrow, it's not next year, it's not even in two years, where AIs get better and better and better in all aspects, and where providers do only the very high level, sophisticated interactions. Some of that interaction will be with the AI exclusively. Some of that interaction will be with the patient and caregivers, but humans will never be completely out of the process, but the level of interaction will change dramatically.

What does that mean for the workforce? We'll need fewer and fewer physicians. We don't have enough physicians right now, and so we won't need as many physicians in total. Believe it or not, I don't even think we'll need as many surgeons or specialists that are now tied to a procedure. I envision that in the future, even procedures will be done by AI and physicians will play an important role. I don't want to diminish the importance, but they'll play a much less involved role, even in surgeries, even in biopsies or what interventional radiologists and pulmonologists do now. Not tomorrow, but I could see that in a decade.

Brian McCloskey 32:01
As we talk about workflow, what I see happening here is that decision support is just being massively upgraded. The amount of time that is taken at that step in the workflow is going to be diminished.

Then you move into drug access.

What are you doing to help the patient and the providers to expedite the challenges of access to drugs?

You could have, for example, a rank order of what's the effectiveness of these five drugs, and then what's the ability to actually get access to those five drugs, and rank order them that way. That can account for clinical trials, off label, dollars available to the patient. Where do the insurance companies come into play? And the McKessons?

You are solving the first step, which was huge, massive. But, I'm going through this, and I've gone through it a jillion times: access.

Ezra Cohen 33:38
I love the question because it is something, quite frankly, that we struggle with. I don't have a great answer. But I'll tell you what we're doing and what others might be thinking about. In a nutshell, what you're saying is we can develop all these great tools to come to the best decision for that patient at that time, but if we can't implement it, then, who cares? You should be treated with this drug. It's not available, too bad. That's even a more frustrating scenario than we have. So what are we doing right now? The structure of our health system, and many health systems around the world, is that somebody has to pay for it and that payment has to be approved by some authority. In some countries, it's the National Health System. In the United States, it's the payer. We can help with that in a relatively small way by creating an AI, which we did, that helps providers. You write those letters. Those letters are time consuming. They have to pull in a lot of

information from the EMR. They have to pull in information from PubMed or guidelines or other sources to support the claim. I can tell you from doing this, those letters can take 30 to 60 minutes to write, whereas an AI can literally do it in 30 seconds. At least we can shift the burden. The provider has to edit that record, edit that letter, and make sure it's appropriate, but at least that's one thing to address the current structure of the system.

But now let's say – and we're doing this – we begin to work with insurers, we begin to work with pharmacies, with large healthcare providers, or systems like United Health, and we can begin to look at data to optimize treatment in a much better fashion than we do now. Every health insurer has, you know, some sort of flow or algorithm on, on, you know, how to treat patients. A lot of that is based on NCCN. Some of them are internally created, but they're not individual to the patient. Let's say we got to a day, and we're going to be at that day where we can take that individual patient's current state, put them in the context of millions of records, if not tens of millions of records, and say, “Hey. This is actually the next best treatment for the patient.” And we can tell the health insurer that this will save you money down the road because of this and this and this. They actually become cost effective. When we shift to a value-based system, rather than the pay as you play system that we have now, that will be incredibly attractive to everybody. But that value-based system right now, if we were to implement it, is based on pretty terrible data, and a lot of it is guesswork. Now, what if we had that based on real data from millions – potentially hundreds of millions – of data points that could be much more predictive of how that individual will do, rather than a population will do? We'll get there. That is going to be the big step to address what you're saying, because then it'll be from the insurer’s point of view. “I want to do this because it's going to save me money down the road.”

Brian McCloskey 37:57
The sooner that you can bring the payers into this and get them to see you as a trusted source, the easier that process will be to get them in on the front end. I'm sure you guys know that you are already working on it, but it seems like a lot.

Ezra Cohen 38:18
I have a call with a CMO of UnitedHealthcare next week.

Cindy Ness 38:30
Ezra, thanks for a great presentation. It was really compelling, both on a practical level and conceptually.

There are two areas that I'm wondering about. The payers are the easier group to convince. In terms of the doctors – I've done plenty of work consulting around patient engagement with physicians and ancillary staff – it's helping them to figure out what their new role is. I'm wondering if you have done any focus groups with physicians? I had an appointment with my physician today, and if I would have brought a list of the AI-generated possibilities – it was telehealth – the connection would have been cut somehow mysteriously. Because, first of all, what is he going to do if I'm coming in with options? It makes him, in his mind, potentially a monkey. What is he supposed to choose from? I'm sure you've thought about this. This can't be

the first time this has been raised and you've thought about that. Implementing this, as others have said, is going to be a really interesting thing. AI is here to stay, so the pressure of that will make it happen. But the question is, how?

Here's really what I want to ask you to respond to: what I call lifestyle management. I have a company that looks at how peer-reviewed lifestyle management research can improve patient outcomes. I'm talking about exercise, nutrition, and stress reduction. I don't see that on the Olivia system. I'm wondering if you've thought about, why not put exercise in there? Because there's really research that says that and more. There are targets from national organizations of hammer zone two, exercise, blah, blah, nutrition. Wouldn't you want to put that in there as part of best practices?

Ezra Cohen 40:59
For the first, the answer is “Yes, we definitely engage constituents when we develop any product. We probably need to do a better job doing that. There's only 24 hours in the day, and Tempus doesn't have 20,000 employees yet, but we try to do the best job we can because we understand that these technologies are different. They're going to change the flow of a practice, and we want to get that input as early as possible so that we can make any changes to the product that will allow that use and that implementation as smoothly as possible. The last thing we want to do, for sure, because it would be self-defeating, is introduce a product, and have physicians come back and tell us they hate us, and get offended by it. We try to do that as much as possible. We probably can do even a better job, but the answer is “Yes.”

For the second, I would say crawl, walk, run. Right now, we're crawling with Olivia. This is our first attempt at a patient-facing app. We've thought about what you said, for sure. That's going to be in a version down the road. It's not that I disagree with you. The things that you're bringing out are incredibly important to the health of a patient with any condition, but it takes another level of technology to bring those things in, and we will eventually do that. We won't have it in version one.

Alane Watkins 42:54
If you don't want to wait on your physician to start using these AI tools, and you want to get all of your data into Tempus, do you go with the largest institution that's using Epic that has most of your records? Or do you go with a small hometown oncologist who maybe can get at it easier and more nimbly?

For the rare cancers of which I'm one, how is the research that Tempus is doing benefiting those rare cancers?

Ezra Cohen 43:31
I love that question because we literally just had a major meaning about that on Thursday at the CTOS meeting, the international meeting for sarcoma. Every sarcoma is a rare cancer by definition. I'll get to the second question in a second.

The first question is, on a personal advice level, the most important thing, more important than AI, more important than any technology, is be comfortable with your provider. If you have a provider that you're not comfortable asking questions, or you feel that they're not giving you the information or the confidence, you have to be comfortable asking any question, no matter what it is, with that person, and that's the most important part of the interaction. It doesn't matter what their practice setting is. It doesn't matter what technology they have. It doesn't matter what their group is. The most important thing is that comfort level. And I truly believe that that drives the best outcomes possible.

Every institution and every practice is going to adopt this to some degree. First of all, you have to have an EMR. That's the law. But secondly, these types of tools that are embedded in the EMR are going to be adopted in the short term, in the next few years, in one way or another. But again, it comes back to how you interact with your provider, if you think things are falling short, or you think that there are tools that could be utilized. I would encourage you to bring it up. And if you have a good provider, they'll be open to it. If they're not open to it, I'd ask them, “Why aren't you?”

The second part, rare cancers: I heard this from Razelle Kurzrock, who's a brilliant oncologist at the Medical College of Wisconsin. She used to say rare cancers are rare, until you begin to realize that 25% of oncology is rare cancers. Everybody focuses on the top four: lung, breast, prostate, colorectal, but a quarter of oncology are what we call “rare cancers”. What are we doing there? We are aligning with different groups on these rare cancers to become, at the very least, the sequencer of choice. But what that means is that we begin to amass a database. One of the biggest challenges in research for rare cancers is that there aren't data that nobody has because, by definition, they're rare. Nobody has a collection, a meaningful collection of patients, tied to molecular data, tied to outcomes, that we can begin to ask real questions about. That's what we're going to do. We've started that with a consortium of people interested in a carcinoma called NUT (a rare and aggressive cancer that starts in the lungs or sinuses). NUT is incredibly rare, but we already have the largest database in existence for NUT carcinomas, and we're making that available to researchers in this consortium to begin to ask critical questions. At the sarcoma meeting, we began talking to the two largest sarcoma research organizations to begin to develop the same database for sarcoma. With that power these databases get large in a very short period of time. With that power we can hopefully begin to impact research in a positive way.

Alane Watkins 47:45
Are there any institutions that Tempus is trialing, doing a trial of your tools that maybe patients could participate in or focus on those institutions?

Ezra Cohen 48:01
Too many to list.

Alane Watkins 48:09
How about Mayo?

Ezra Cohen 48:10
We have some interaction with Mayo. Mayo has their own internal tools that they prefer to use. So we don't embed with Mayo as much as some others. I don't want to skew the audience or make recommendations in terms of institutions. We are connected, as I said, to 2500 institutions around the country in one way or another. There are some institutions that work very closely with us. I don't want to bias people,

Alane Watkins 48:52
I get it, the bigger places probably are developing their own AI tools.

Ezra Cohen 48:59
A lot of the big places work very closely with us.

P Kay Coleman 49:20
I have a question that's pretty much self-centered, in the sense that as you were going through the Olivia example, I was thinking, “Oh. How great would it be if somebody could pull all your medical records together from all the different kinds of physicians you see and your lab work and identify a potential problem before it happens?” Is it just for cancer patients in treatment? Or can it be applied to other medical issues?

Ezra Cohen 50:10
It's available for any patient. The embedded AI tools are geared towards right now, cancer, cardiology and neuropsych. You can upload the records and search them irrespective of the diagnosis that you know the patient has, but the more sophisticated tools may not serve that individual.

P Kay Coleman 50:41
In my own example, I visited the ER. I had back pain. They noticed my blood pressure was really high. Three days later, I saw my PCP, and we had labs. I had high blood sugar, and then two days later, I had a stroke. There was no one there looking at all the different things that were happening to me to prepare me or warn me or whatever. I feel like that was a real medical miss, and being prescribed a high dose of a steroid shot me into a stroke zone. I see the value. Because no doctor can pull all that together. I'm just wondering how long before we have something like that that's useful to all patients, no matter what their underlying medical condition is.

Ezra Cohen 51:43
That's our ultimate goal. We'll get there in terms of timeline. Unfortunately, we're still at the very least many months, if not a few years, before that ideal. But we'll get there. It's just a matter of time.

Brian McCloskey 52:13

Molecular data can be interpreted many different ways in terms of different treatments. I can go to Tempus, I can go to Boston Gene, I can go to Foundation, whatever, and I can literally get three different answers where there's no overlap in them.

How are you looking at that problem?

Ezra Cohen 52:37
Thanks for pointing out some of our competitors.

Brian McCloskey 52:44
It's the world, right?

Ezra Cohen 52:46
I’m being completely facetious.

I would say from an analytic perspective that happens rarely. If you went back 10 years ago, I would say that analytic perspective was happening. But now, the sequencing, the bioinformatics, has gotten so routine that I would, and we've and we've looked at this, although not in the thousands, but certainly in the dozens, if not hundreds. If a provider orders a test from, let's say, those three companies, you're almost certainly going to get the same results. Now, the interpretation, or the second level from those results may be different. The FDA approvals are pretty standard. But we, for instance, provide a listing of clinical trials prioritized by geography. Those may be quite different, because we may be using different databases and different ways to interpret those databases. The secondary sort of alterations that don't necessarily have an FDA-approved treatment, but may have a suggested therapeutic, those may be different. The best thing I can say is, for a provider, they need to look at what they believe are the best responses. Coming from the companies, obviously, we feel very confident in what we're delivering. From a patient perspective, it's very difficult to look at that output and understand, if this is the best answer available. At Tempus, we try to do that. We try to make it readable, easy to understand, but that second and tertiary level data interpretation that's still going to be different.

Brian McCloskey 54:56
You've got a captive audience here. We're all pretty plugged in as patients. If you guys ever want to reach out to us for insights from our patients on product development roadmap, etc, I'm sure you're not going to find any shortage of opinions on how to help you with your amazing effort. Really amazing.

Ezra Cohen 55:21
That would be wonderful.

Brad Power 55:27
I've really enjoyed about Tempus that you're constantly pushing the envelope on adding new diagnostics, whereas others might be comfortable printing money with the tests that have been

approved and are successful, but you're always pushing into new areas. What are some of those new frontiers? What's next?

At the outset, you listed the kinds of data you had, and it was classic medical data. It didn't include wearables data and didn't include consumer data. IThere's a lot of signal, potentially, if you had consumer data. Please talk about the future and what you see. What's next?

Ezra Cohen 56:16
The next thing on the horizon, and we're not the only ones thinking this way, but we're making a big investment in whole genome: whole genome somatic, and whole genome germline. Some of you may have read we purchased Ambry Genetics last Monday. We feel very strongly that there's so much information that's being missed right now in the hot spot sequencing, or the limited sequencing, and that we're going to hopefully uncover with whole genome. It'll take time, without a doubt, we'll have to build those databases and begin to understand the biology. We're sequencing a small fraction of the information embedded in our DNA.

The answer to your first question is, full genome in terms of those other aspects of health data. I couldn't agree with you more. We do not do that. Right now, we abstract, using large language models and humans from the medical record. But just as you know, doing a 683 gene panel versus whole genome, getting information only from the medical record and not from all those other things that you mentioned is a small component of what's going on. We need to do that. We need to embed those. We're not there yet. That is in the near term future, but not the immediate future.

Fasten your seat belts because things are changing so fast. It's amazing, and, personally, it's fun to be a part of it.

“How AI Is Shifting the Dynamics of Your Next Doctor Visit” (Ezra Cohen, MD) [#121]

CHAT DISCUSSION

00:37:13 Allen Morris: How does one upload his/her patient data into your system? Does medicare cover for your service? How much does your service cost in general?
00:38:19 Alexander Lalov: Reacted to "How does one upload ..." with 👍
00:39:35 Erin Carron: When you sign onto the app, it allows you to easily connect to your various providers to seamlessly connect your records into the app. We will share prices once we broadly launch once beta is complete!
00:40:38 Rick Davis, AnCan Foundation: Exactly Dr. Ezra .... general med oncs frequently fail to observe SoC in our fairly extensive anecdotal experience. 3 cases this week.
00:42:57 Roger Royse: Brad - exactly my thought. My doctors don't even look at the medical records on me that they have now (I have to point things out)
00:43:12 Brian McCloskey: Reacted to "Brad - exactly my th..." with 👍
00:43:30 Rick Davis, AnCan Foundation: Re. notes... in a virtual group this past Monday https://www.youtube.com/watch?v=XwApRA6kZ90 a physician-patient reported he asked to see his notes and found that it included 3 DRE exams that never took place. Was the doc using AI for his notes and failed to edit??? Listen for yourself around the 60 minmark.
00:45:02 Richard Anders: What is the underlying AI this is built on, or if you developed it, what was the technology
00:47:09 Robb Owen: Is 'Olivia' designed only to review current and future conventional treatments, chemo, immuno, radiation, etc. Does it have capacity to analyze complementary components of diet, supplements, commonly prescribed antiemetics and such in assisting with conventional treatments for better success?
00:47:23 chad magnussen: Can AI be leveraged by the patient to find natural substances (non FDA drugs) that may be helpful? For example, if a Tempus report finds that p180 is up regulated could AI recommend natural substances the patient could take?
00:58:03 Rick Davis, AnCan Foundation: AnCan always suggests limiting the numbr of Qs to your Provider to 6-10. Patients have to edit AI too..
01:04:16 Eric Dishman: I really hope and believe that all the companies working in the precision health space could/should come together to work on these new workforce challenges, new roles, new workflows...in a pre-competitive way so we figure out and widely train/prepare the workforce collectively...as opposed to training them on a particular product at a time that may or may not be here years from now. Let's float all boats by accelerating the understanding and knowledge of where these technologies are going--how they will change the practice and economics of medicine--and then define what new skillsets and workflows are needed to integrate these new tools faster and at scale.
01:11:48 Dr. Chris Apfel: Ezra, thank you so much for your wonderful presentation. You're doing really impressive work!
01:12:18 Eric Dishman: Great, great session again. Thank you
01:13:37 P Kay Coleman: Thanks, Ezra. Hope to see you soon.
01:15:25 Allen Morris: Can most of your molecular work be done on formal fixed paraffin embedded tissue?