HEALTH CARE REVOLUTION: POWER OF OMICS, BIG DATA AND AI

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Rhonda Rhyne: They said, "15 years. Let's see if we can map human genome in 15 years, and that would have been in 1990 to 2005. It's pretty amazing that they mapped it in 13 years, and it was published a number of times in *Nature*, but the final analysis came out in 2003. They found out that there are 2,500 genes, three billion bases in the human genome, so they mapped one person's genome.

How much money do you think it cost? Anyone? Okay, let's just say a billion. That's what Facebook paid for Tumblr. I think everybody on Wall Street fell off their chairs. Nope, it costs more. It was 2 billion. We could have bought a B-2 bomber. That's pretty impressive. It costs 2.7 billion dollars.

It was 90s, early 2000s for one human genome, and so at that time for people to think we could ever bring that to medical care, it's impossible. But what's been amazing is that the cost of genome sequencing has been dropping dramatically, and San Diego, so rich in technology companies.

Illumina was really a driver in helping develop the technology. It's called Next Sequence… Next Generation Sequencing, and they really helped drive the cost down. Morse Law talks about doubling the computing power by a couple of times in droppings cost. The cost associated with gene sequencing has been dropping about 5 to 10x, and right now Illumina offers it on a USB bracelet for about a $1,000, and we still have a lot more to drop, and in fact in San Diego, there's another company, EthicoGenome just announced a partnership with Intel, and they're

doing the next, next gen sequencing, and I ensure that they'll probably be bought by Illumina, but they're gonna help us get to an amount I'm going to predict at the end of this presentation.

We'll see by the year 2020 if I'm correct, but there you go. Illumina is putting it on a bracelet. Google has got to be involved, right? Google's got Google Genomics. They're allowing you to sell or to store your sequence in their cloud and be able to allow researchers to use it for research. So there's a lot going on in the storage area, so what good is genomics?

How many of you here are remotely familiar in the world of genomics and what they're doing in medical care? Keep your hands way up. Okay, so there's quite a few. Good. You knew a lot more than I did several years ago.

Anyway, what's good about it is you can use it to treat. You can use it to prevent, cure. It's really been amazing with personalizing medicine, and they're able to take a tumor now and look at the genetic mutations or look at your genetic mutations and matchup drugs to help do more effective therapies. We're all probably more familiar with the recent testing of Angelina Jolie who had the BRCA gene mutation, and she went ahead prophylactically prevent a potential cancer and had a mastectomy and her ovaries removed.

But that's powerful when you think just several years ago we weren't able to understand the genetics and what's causing the disease and to have treatments associated with them. So, there's a lot going on in that, and then just companion diagnostics.

Not sure how many people have heard about that, but basically pharma hate it to begin with because companies were developing these diagnostics that said, "Hey, your drug might not work on these patients or it might work on them." But then pharma woke up and as usual took advantage and started to use companion diagnostics to help enhance their clinical trials because now they can recruit patients based on genetic data and ensure that it's working on those patients or not working on them.

And the FDA's even requiring some pharmacogenomic information on labeling now. That's an area that's near and dear to me because my pharmacy background, it's wonderful that we can do something called snip testing and be able to look at the metabolism of patients, say, warfarin, an anti-clotting drug, and know what type of dose you need to give them. Some of them are fast metabolizers. Some of them are slow metabolizers.

And then there's something called P4. Anybody heard of P4? Well there's an amazing man in Seattle by the name of Lee Hood. He's won all kinds of awards. He actually was at Cal Tech. He was a co-founder of EmGen which we know we've all heard of. He was recruited by Bill Gates to the University of Washington and was there for a number of years and then went and started

an institute for Systems Biology which is a research institute which is?? (6:10) number of companies.

And he basically says personalized medicine's all about P4. One it is predictive with genetic information we can predict. We can then prevent. We can personalize therapies and hopefully we can participate in all of that information, and he led a project this year called the 100th project, and he took a hundred subjects and sequenced them all, gave them an activity bracelet, did a bunch of other testing, collected that information and that was pilot for his vision of doing a program with a hundred thousand patients.

So quite a bit going on in genomics, but what's next in Omics genomics. I think we all probably heard President Obama talk about the Precision Medicine Initiative in giving $215 million dollars toward it, and it was nice to see that government get people behind this because they're driving the reform in healthcare and hopefully this backing will help really spur more research in this. They'd like to make it the norm which is the exception, cheaper and faster.

And then genomics is really just the start, and I called this whole branch Omics because it took us a while to sequence human genome, but I think we learned quite a bit and the sequencing came along. Now they're in the process of sequencing the proteome, which is all the proteins in the body and hopefully that will be done in the next couple of years.

And then we've got transcript-omics, which is about the RNA part. The DNA tells RNA how to make proteins.

And then we've got, I can't even say it, metabolomics where we're looking at the metabolites in our body.

There's a lot going on, and just if we look at what was done with the genome. I think by the time they get all of these worked out, it will truly revolutionize healthcare.

So, before we can revolutionize it though, we really need the tools to aggregate and analyze all of these genomic information and all of the other information that's coming. And so the world of big data, and there's so much I'd like to talk about on big data, but the data is growing. Besides all the genomic information that's out there, we've got the EMR. We've got the wireless. We've got the wearables. Data is coming in all different directions, not only in healthcare but across in all different industries.

It's growing an enormous rate. I was shocked to find out that they say that we've generated 90% of all the data in history in the last 2 years. Pretty mind-boggling, and then when you think about all of the data that's going to be generated going forward. On the wearables, in 2014

there are about 20 million wearables and they estimate 2018 that'll exceed 100 million, so we're all be wearing wearables and generating a lot more data.

And I said it's in all kinds of industries, but tonight I mainly wanted to focus on healthcare. But investors are here too. VCs in 2013 invested not just in big data, just in wearables about a half billion dollars of 80%. Roche at the beginning of this year invested $1.3B for a majority stake in Foundation Medicine, and I wrote for the data.

Foundation Medicine is all about cancer and genomics. That they're collecting an amazing amount of data, and really the power is in the data. And there's actually growing healthcare coverage for both genomics and hopefully we'll get up in the wearables in the future.

So really what we need to do, it's one thing to get genomic information or these wearable information, but we need a way to put it altogether and start to analyze and compare ourselves against everything else that's out there, and it's going to have a profound effect on healthcare. But how can we do it better?

I think we've got all these data. We've got some capacity right now to deal with the big data and analyze it, but I truly believe it's artificial intelligence, and I'm so glad to be validated by the Wall Street Journal.

It's artificial intelligence that's really going to make a difference because there's always so much that we as humans can compute and there's always so much that regular computers could do, and artificial intelligence is really about making a computer understand human language, think like a person, make decisions and learn from those decisions, and then we can all go to sleep.

So, we just look back. I love to look back at history, that where we come from, to learn from it and where we're going. I think we've all probably seen pictures of the UNIVAC, 1951. It was 25 feet by 50 feet. It's hard to believe we're only 60 years on the road and everyone in this room has experienced the power of these dumb computers. Basically they handled mathematical modeling, but IBM which was a leader in computing. My father actually worked at IBM in the late 50s, so it was kinda fun to do some research and learn what IBM has been doing.

About 2008, 2009 when the world is falling apart, IBM committed a billion dollars and said, "You know what, we're gonna lock up a bunch of people, a bunch of smart people in a room, and we think what we ought to do is take the power of computers and take it to the next level."

That was really artificial intelligence. They wanted to take a computer that really just does mathematical modeling and have it become cognitive. Have it understand human language, and have it start to make decisions and start to learn from those decisions, and when I ask people,

“Have you heard about Watson?” A lot of people said, “No, no.” And then I mentioned Jeopardy and they’re like, “Yeah, yeah, yeah, I did hear about that.”

Once they created the supercomputer IBM, they said, “You know, we have to test it out.” So they said, “Jeopardy, give us your two champions of the world and let’s see how this computer does against them.” And IBM said, “We don’t know how it’ll do, but we’ll try it out.” I’ve never really watched Jeopardy game, but let me tell you this computer kicked their butt. It had I think $10,000 and they had I think $2,000. I should have had a picture of that.

Anyway, they kind of described it as Siri on steroids, and this computer was able to do it because it took evidence-based responses. Remember evidence-based medicine? It sounds a little familiar. “Evidence-based responses” is how they described it and it used confidence intervals. So what happened was immediately after this Jeopardy victory in 2011, doctors started to call IBM, and they said, “Wow! We think we could use that in medicine.” And they started to work with IBM.

And one of the first institutions that IBM started to work with was with Memorial Sloan-Kettering Cancer Center, which is a renowned cancer center. They also worked with Cleveland Clinic, MD Anderson and Anthem Wellpoint, and they started on Oncology and it seems that’s where everything seems to start, and as I described at the beginning of this talk, they basically took all the medical literature, practices, the textbooks, the expert opinions. Put it into Watson, and have at it, and what Watson could do. Watson did this. This was one of the first things, on a glioblastoma, a brain cancer patient. In 11 minutes, Watson came up with a treatment plan. It took a team of expert doctors four weeks to do it.

When you have brain cancer, that’s a big delta. That really just started the journey on Watson being an amazing machine and just really started to have people imagine what Watson and other artificial intelligence could become.

And just in the last two weeks, IBM announced partnerships with J & J, Apple and Medtronic in the IT side of things with Watson, so there’s a lot going on with IBM, and not just IBM. Wall Street Journal was talking about Google, Amazon, Microsoft, all getting involved in recruiting people, a lot of them out of the University of Washington, really across the country on artificial intelligence.

So, Watson’s shrinking. Watson started out the size of a bedroom, and now Watson’s down to about three-stacked pizza boxes, so I’m sure by 2020 it’ll be on our wrist, and the great thing is Watson’s available in the cloud. It can process about 500 Gigs, equivalent of a million books in a second. I’d hate to even try to compete with that. Also, cross-reference the symptoms of about

a million cancer patients in about 15 seconds and can get the treatment plan. It does like reading and summarizing, so it can take notes that doctors have put into EMR, non-mathematical things, and it can understand them.

It can basically scan a whole EMR record of a patient and give a doctor a one-page summary, and you know doctors don't have a lot of time to go to medical records or making all kinds of errors by not knowing drug interactions, not knowing previous treatments, so I really believe that in the future Watson or artificial intelligence will help drive the diagnosis and the treatment plans across all disease states and that dare to imagine what really come true, and it's really coming true on oncology.

So, Watson needs a partner, right?

Isabel and Watson are probably going to get married. Isabel is a decision-based tool. It's a company out of London, and it started as a diagnostic, decision-based tool to help physicians and now it's in an app, and basically patients, doctors are gonna love this.

We can go and put in laymen's terms or symptoms and it will come up with a series of diagnoses and allow us to look at all the tests and other information associated with those diagnoses, and it can do treatment by age, gender, your travel history. It can send it to email via information to your doctors, so I think Watson really needs Isabel.

Okay, so, to wrap up, I'm gonna make five predictions tonight, and maybe if I'm correct, Joe will have me back in 5 years. We'll see. So, remember that I told you that first human genome, three billion dollars. It's now somewhere between a thousand and five thousand dollars. I think by 2020 it's gonna be about fifty dollars or less.

Right now we've only sequenced about 228,000 treatment genomes. Illumina's saying by the year 2017, it will be 1.6 million. I think they're really underestimating. I'm gonna say 10 million by the year 2020.

Next, all of omics will be sequenced, so I told you that they're working on proteomics, maybe a couple of years away. We'll get metabolomics. We'll get the RNA transcriptomics and really be able to put those together because a lot of people believe it's not just in the genes. You gotta look at the gene expression and RNA. You gotta look at proteins.

I'm fortunate enough to be CEO of Prevencio where we're looking at multiple protein algorithmic analysis tests to help rule out obstructive coronary artery disease. I hope I'm wrong when I say it's probably a combination of everything because we're only looking at proteins now.

Next, we're going to have a fully connected cloud-based healthcare system, and last, artificial intelligence would be driving diagnosis and treatment plans and everything. It will be doctors writing it out, and that's all I have for you tonight.

Joe Hage: Do you have some questions for Rhonda because I have a half dozen. I'll go first then. Hey Rhonda.

Rhonda Rhyne: Yes?

Joe Hage: So, as a small-to-midsize medical device company, you got bought out by the pretty nice multiple. How did you do that and what can folks with small-to-midsize medical device companies learn from your experience?

Rhonda Rhyne: I have a great analysis like Jeffrey Kraws. What I really learned was so much of life is not working in who you know. That's why it's great you're all here. CardioDynamics was really small, really research stage, that because the angel investor was Alan Coulson, he knew people. He was able, even though he could have funded this all by himself, he got friends involved. He had friends. He got analysis coverage from companies that we shouldn't have had analysis coverage from. I say shouldn't have because we were so small.

We were so unknown. But again, it came back to the power of who's associated with your company, and I've looked at that even in terms of partnerships. Now, I saw many more people than I did back then and I see the importance of being connected, and I'm connected with people right now who were in line to possibly buy the company I'm with. So, it's never too early to really be out there and meeting people and looking way down the road, looking your end game, and even if you're early on, like I always felt most companies were way ahead of the curve, there are people out there who can help you get sold, get the coverage and get the exposure that you need. Think big.

Joe Hage: So, I read your book cover to cover. Even though it's…

Rhonda Rhyne: Joe wants to me to talk about myself. I really don't like to.

Joe Hage: Just a little.

I don't know. 40% of this audience is female. What advice would you give them about how you broke through the glass ceiling, became CEO. I've read a little excerpt about some of the challenges you had along the way. Perhaps a nugget or two that you could share.

Rhonda Rhyne: I think this applies to everyone, but it applies a little bit more to women. Fear not. Truly, don't have fear.

Deep down, we all have a certain amount of insecurity and a certain amount of fear, but guys, they would never tell the world that they're fearful, that they couldn't do something. They haven't done it. They just go out and do it, and I think women, they talk about their fear. They won't take jobs because of their fear because of risks. So, one, fear not.

Two, persevere. Don't give up.

At CardioDynamics, one of the stories we love to tell is early on we had an opportunity to partner on General Electric. It wasn't called GE Medical Systems. I don't know, but it was called then that.

Anyway, 1999 I was president of the company, travelling with the CEO. We had a meeting with GE, and they called that morning and said, "We're not having the meeting. It's cancelled."

We didn't get the message. We did. We got the message, but I said we didn't get the message, and we went, and we end up getting a partnership with GE because there are just times when you don't hear the wrong information, and you persevere through it. It was an interesting process, but I always say people say no until you give them enough information to say yes.

So, fear not. Persevere.

And the last piece of advice, have lots of money, lots of partners, exit as soon as you can because we all know in this world, you never know. We were held up as a model company by Medicare, and from that day forward, it was kinda like a marriage.

I heard a joke recently. A woman thinks the guy is great until she marries him, and then she spends the rest of her life transforming him or changing him. Medicare spent the rest of their life after holding us as a model company cutting away at our reimbursement, so exit as soon as you can.

Joe Hage: Quite a few folks in this room need money badly because they have a great innovation and where's the money?

I know you're gonna talk about it a bit, Jeff… and Rick, are you in the room? There he is. Rick Baron's here. Rick is a former CFO of Globus Medical and in 2012 he was one of four IPOs for the medical device category. That deserves a round of applause.

So, he'll get the question too, but what did you tell me over lunch about where do you start, how did you do, how did you make it happen?

Rhonda Rhyne: First of all, raise money more than you ever, ever think you'll need because we all know it takes probably five times as much money and five times as long to do whatever that

you're going to do, so that's easy for me to say to raise more money than you think you'll need because a lot of you are out there just saying, "Hey, I'll take my first million."

Again, I'll say it goes back to who you know. CardioDynamics and Culture Technology, the principles behind it had money and they knew people who had money, but it gets to a point of your career where you're supposed to be the one that has those contacts, and so really it's going out and meeting as many people as you can, learning from them, asking how you got the money.

A lot of times it's starting with angel investors in your earlier, your C round maybe even your A round. I always say keep the B, Cs out as long as you can. Be friends with analysts. I hadn't seen Jeffrey Kraws in… but you know what, he came out to me tonight like, "Oh my goodness." So, I should have been in touch with him. Thank goodness I've had access to money for Prevencio, and I'm very, very grateful, but there will come a time when I need to get more institutional funds in, possibly even B, C money in, and he's a great person to know.

So, I think Jeffrey is speaking to you tonight and another gentleman at the back. Maybe not tonight but over the course of this conference, but anyway, raise as much as you can and again through networking do that. There's wonderful money to be had in partnerships, and I just say that you be out at your industry conferences and meeting as many companies as you can, and what we talked about tonight, really be forward looking. These big companies have strategic initiatives that aren't advertised, but you can be fortunate to be a part of what they're looking at as a strategic initiative, and they'll do some amazing development partnerships, sales marketing opportunities and acquisitions. You know, if you're the right company at the right time it will happen.

My former CEO of CardioDynamics started a company, CRISI Medical, and in 2010 right after CardioDynamics sold, he started as CEO there. I shouldn't say he started because it was in a very embryonic stage when he took over, but less than five years, at January of this year, BD, Becton Dickinson bought them, and it all started about three years ago when BD had an initiative on patient safety. They had a product and development. BD gave them all kinds of non-diluted funding and then diluted to develop it, had the rights for distribution, but really what they wanted all along was to acquire them and it was sold.

So, kudos to San Diego. You guys got amazing companies here. You've done very well. Some had challenges, but a number had done very well. One of the things I love about Seattle is it's young, but it's a very dynamic, collaborative environment, and they've got a lot of exciting things going on especially on oncology and now some in proteomics.