

TECHONOMY 2017

Advancing Global Health With Tech

Speakers:

Dr. Agnes Binagwaho, Vice Chancellor, University of Global Health Equity

Oliver Hsiang, Global Head of Health Technology Partnerships & Corporate Development,
Johnson & Johnson

Vyomesh Joshi, CEO, 3D Systems

Dr. Roy Smythe, Chief Medical Officer – Healthcare Informatics, Philips

Moderator:

David Kirkpatrick, Chief Technologist, Technomy

(Transcription by [RA Fisher Ink](#))

Kirkpatrick: I'll start with introductions. Roy is Chief Medical Officer for the Global Connected Care and Healthcare Informatics Group at Philips. He's a doctor who has only joined industry in the last years after a career running hospitals and doing an awful lot of innovative things in the healthcare industry about which he has impressively strong opinions, which I hope will be displayed on this panel.

You've met VJ who I introduced before. Really one of the great business leaders in American business, who's turned to his new job turning around 3D Systems, and basically made it into a healthcare company, which is really exciting.

Next, Oliver Hsiang leads the Health Technology Partnerships and Corporate Development Team at Johnson & Johnson. So he's a Silicon Valley guy, who has moved into healthcare.

And finally, Agnes Binagwaho is Rwandan; she was formerly Minister of Health in Rwanda. Some of you have seen her at our program before. She was at our New York conference earlier this year. And she's currently Vice Chancellor of the University of Global Health Equity in Rwanda, which she may talk about a little bit. It's a university that really aims to help grow knowledge about how to transform medical systems and to build more practitioners who can use modern tools across the world, even in the poorest parts of the world, to really make the health changes that are absolutely necessary.

Just to reiterate the theme of this discussion, it really is about how technology can advance global health. And at Techonomy we consider that an absolutely urgent priority. In the description we refer to the UN Sustainable Development Goals, which as you'll hear, are very important to us. They are goals for 2030 and one of them, several of them pertain to health, but they are not easy to achieve, because they're very ambitious. But we need ambitious goals to change the world.

So maybe ladies first, start with Agnes.

Binagwaho: It's not difficult in this panel, no? There is no competition. Okay, ladies first.

[LAUGHTER]

Kirkpatrick: Why don't we let you quickly talk just a little bit about what you're doing exactly and how to think, from your perspective, about what the challenge is with global health and what the opportunity is with technology?

Binagwaho: Let's remember first that global starts where you have your feet. Every person on earth is the center of global health. So we have learned, by how we implement for success, what are the principles behind that? And they are very few. The first one is: leave nobody out. Whatever you do, whatever technology you try to introduce, always think what it will bring to the most vulnerable member of that community. And if you manage it, everybody will cope with it and will use it. So all the others take a couple of years to learn it. But the objective is to create systems that are human-centered, using innovation and technology around this. And since yesterday we discussed is it for the best or for the worst? Technology has no soul. The soul is with the humans who are using it. And I can give the same question that was asked at the beginning. Guttenberg, when he was doing books, everybody was saying, "Oh my God, what is this going to bring?" And of course, it has changed the balance of power. Of course it has increased the possibility of education. So this is what we want to do. It's in rural Rwanda, and the principles that we teach are applicable all across the world, because the need of the people is the same and the way we can leverage all innovation and technology. That's what we teach, and I advise all of you to come and see.

Kirkpatrick: Good. We're going to try and do that by the way. And it is deliberately located in a rural part of Rwanda because you wanted people to learn in a context that is similar to where the work needs to be done, right?

Binagwaho: Yes, because the majority of the world lives in a rural area. The majority of clinicians are educated in cities. And after that you ask them, "Can you go and work where the people are?" They don't know how to do that. So we start educating where the needs are.

Kirkpatrick: It's a good idea. Let me just ask you one last basic question: given that you are interacting, in your former position as a minister and in your work now talking to people from around the world—with government leaders and health experts from so many countries—how would you characterize the state of awareness and readiness to take advantage of what

technology makes possible in the countries around the world, particularly the poor ones that you know so much about?

Binagwaho: So first of all, we have to say that we have made it so complicated for people. They believe that it's impossible to achieve, and that's not true. Just think about the phone that has [such] huge penetration in Africa and that can be used for everything, for so many things. So technology we need to simplify it, but we need to simplify the way we talk about it. It's not complicated; you don't need a masters to do this. You just have to some more education that is simple and you can have on-site or during your basic education. Could we start talking about technology in kindergarten? In primary school, secondary school? So it accompanies your life? So it is not complicated. People are aware but just opposed because they believe it's too much for them. They don't want to look dumb and not capable to use it. And there are many people, unfortunately, who are afraid to use their power with the old way to do business. So they believe that young, very active people will come and take over their position.

Kirkpatrick: Okay, it's always the job security that it comes down to in the end.

So Oliver, I know one of the things about Johnson & Johnson that we've learned at Techonomy that we're really excited about is the way you really are taking a global view. You're really thinking how can the innovations that we come up with and the capabilities that we have, really apply to improved health in literally every place? So talk a little bit about the thinking at the company. And also how you, as a technologist coming into Johnson & Johnson, are trying to use tech more and help the company embrace technology as a tool, and what's happening there.

Hsiang: Yeah, so technology's exciting because it can be distributed globally at relatively low cost, depending on how you do it. So the ultimate goal, of course, is improving outcomes. And we think a lot about democratizing access to that care and technology is the driving force behind that.

One example I can come up with is, especially when you think about things like income inequality and the lack or divergence of access to care in developing versus developed areas, how can we do better to reduce that and eliminate that? And one program that we came up with was really around improving maternal health and baby health. If you think about the efforts that Facebook has made with Internet.org to make connectivity available to all, to every corner of the Earth, we think about that in a health-specific context. So how can we deliver, in this case, important and critical content and information around pregnancy to pregnant moms. And we've reached, through various programs, over 4 million women, ranging from low-income urban areas in India to parts of Bangladesh and Africa and [others]. And so this is exciting, because sometimes we take for granted in the developed world this access to information. Through these programs we can push, through mobile messaging, important information that ranges from preventative care to important milestone information about where you might be during your pregnancy. Things that might not otherwise be available. And you were mentioning

now, the phones, they don't need to be smartphones. They're accessible everywhere. And so how can we think of simple, but yet powerful applications of that to help people?

Kirkpatrick: That must be challenging, though, in all the languages and all the different ways of expression that are needed. How do you localize that?

Hsiang: By prioritizing localization. I spent a number of years at Google in the early days, and a big thing was when you were ready to launch a product, it needed to be ready in 15–20 languages off the bat to be able to reach the 90-plus percent of the world. And in this case, it's developing custom programs in the areas that we want to go into.

Kirkpatrick: I hope you two can talk more. I bet you guys can think of some interesting things to do. And there's a bunch of stuff we want to come back to.

Roy, as a doctor, you're thinking, again, very globally. When you think about the situation we're in with what we have available in technology and the health of the world, as it stands now, what do you see as our biggest opportunity and our biggest challenge?

Smythe: There are a lot of opportunities and a lot of challenges. I would like to start out by saying that in the little preamble that was written for this session, which was very well-written. I'm assuming you did that. But it does say that the world is the healthiest it's ever been. And I actually take a little issue with that, because despite the fact that a couple of vectors are going off in different directions. One, obviously, is in the medically developed world, a rapidly aging population and in the medically developing world, the world in general, growing population, period. Both of which are outstripping traditional healthcare delivery. And if you look at that first vector of an aging population, what we now know is that 20 percent of individuals around the world have five or more chronic conditions. And the increase in lifespan, which has been significant since 1900—actually significant since the 1990s, about six years added to lifespan globally—that adding to the lifespan has actually created a lot of people that are living with chronic disease. And it was already mentioned previously about the outbreak of preventable and chronic disease around the world. Seventy percent of the world's disease now, is preventable and chronic.

Kirkpatrick: Seventy percent is preventable?

Smythe: So while mortality has improved and lifespan has improved, we're creating a situation where quality of life based on health actually is declining slightly, globally. And so it's a question of which of those things you think is more important: living longer or living with quality health. I would like to say they both are, and so both things need to be tackled.

Kirkpatrick: Pull tech and what we can do with tech into the thought.

Smythe: First of all, while I agree that there is a surfeit of technologies we could use in the medically developing world now, we're not using most of them in the medically developed world. We have a number of technologies that we're developing at Philips that have places to

land and some frankly, that don't have places to land yet because the incentives to use them aren't in place. And most of the world's healthcare spend is in the medically developed world. And we're wasting about a fourth of what we spend, so about \$8 trillion dollars, by my calculations. It's about \$1 trillion dollars in the U.S. wasted, about \$1 trillion dollars in the rest of the medically developed world. You know that \$2 trillion dollars can buy a lot of technology for the medically developing world. But the conundrum is, or sort of the irony here, is that in order for us to free up those funds, to transfer them to medically developing world, we have to better use technology more effectively here. And you know, eliminate redundant care, eliminate unnecessary processes, democratize care so that individuals can do what they can do themselves without the need for a clinician or a big shiny hospital facility.

Kirkpatrick: Compliance.

Smythe: Yeah, all those things that, you know, could easily put a huge dent in that expenditure.

Kirkpatrick: The reason I say that, we had a discussion recently where the statistic came up that 40 percent of Americans don't do what their doctors say. They don't take the drugs they're prescribed. So therefore all the medical intervention in the world isn't going to make any difference if the patient doesn't do what they're told.

Smythe: But that's where the technology loses its luster a little bit, and that's where philosophical shifts have to happen in order to sort of unleash that surfeit of technology. And we talked some about this previously. There's not much pressure on healthcare providers—so I was in a meeting about a year ago with a couple of very senior health system leaders, one of whom ran the medical practice, and I was talking about leveraging technology to lower costs and transfer funds to the medically developing world, and all this. I thought it sounded like a great theory. And at the end he goes, "I guess I could write a book on the things I've heard that won't ever work in healthcare." It was a little deflating. And I said, "Well what do you mean?" And he said, "Well, I can't get 50 percent of my patients to take their medication." At which time I said, "Do you know why?" And there was a silence, just like you heard then. Obviously he didn't know why.

And so if we had this philosophical shift around—and at least in the medically developed world—that healthcare is a human right, a fundamental human right, got to be delivered. If we also held the medically developed world to incentives based on outcomes, if you did those two things, you would create an incentive for different behaviors. And worrying about why 50 percent don't take their medications. If I'm going to be paid on how this population looks a year from now, I'm going to find that out.

Kirkpatrick: Okay, but just quickly, if we're talking globally, why are you focusing on the developed world? What do you think would happen then, globally, if we did that in the richer countries?

Smythe: Most of the money is being spent here. And there's not much left over for the rest. So if you took those sustainable development goals for the UN. Number three: improve the health and well-being for all individuals of all ages everywhere, and the statistics I've seen are that we need to move from about \$171 billion dollars of expenditure to about \$357 billion dollars of expenditure. We need to go from about \$20 dollars being spent to \$58 dollars per individual. Right now we're spending like \$80 or \$90 in the medically developed world and \$5 everywhere else. And so we need to redistribute some of that. And I think, again, technology is a way for us to actually improve care in the medical care in the medically developed world, lower the cost at the same time, as long as those philosophical incentives are aligned with the use of those technologies. And then transfer some of those funds to the medically developed world.

Binagwaho: I would have another approach. First of all, technology is needed. You cannot bypass it. But behind the technology there is a human talking to another human, in between the technology. What you have lost here is the trust, the social capital, and that's what we teach in the university. Because if you come with your pills and your great treatment, there is no trust, there is no compliance. You know that we have double outcome of our HIV treatment than this country, and we don't have \$800 dollar per GDP. Here, \$70,000.

Smythe: I know.

Binagwaho: And you have half of the outcome for the program with the best drugs. We use generic. We don't have enough infectious disease. So there is something behind the man or the woman that handles this technology for service.

Smythe: Always, always. You know, and I took care of thousands of patients in my career.

Binagwaho: Absolutely.

Smythe: I was a surgical oncologist. But I can tell you, there were a lot of things that I did and the delivery system did that technology could have done, and patients would have been fine with it.

Binagwaho: I agree.

Smythe: There's always going to be a need for human intervention, but there's a lot of things we do now that technology can actually take off the human plate and give us more time to be more human.

Kirkpatrick: Right. I want to ask VJ, you know, one of your slides, was that 10 percent of people in the developing world will have some 3-D printed, you know, medical device.

Joshi: Right.

Kirkpatrick: That's a pretty stunning statistic. And I wonder how we get from here to there and why it would be good. But is part of it the affordability of this particular technology and the ability to localize it? Talk a little bit about how we get there.

Joshi: So yeah, I think there are three things. One is digitization. So I mean why are cellphones very successful? Digitizing is key. The second thing is accessibility to the technology. Can we make it affordable so that we can make that happen? And the third thing is better outcomes. Once you have a patient who is happy at what they got, then this whole penetration is going to go fast.

Let me give you an example of the dental business. So if you think about it, there are around 7 billion people, 32 teeth, that's 210 billion custom parts, right? So when you think that way, then say, "Okay, right now, if you try to buy a denture, it doesn't fit." You try it and try it and it never happens. But if you digitize your mouth and create a perfect denture, people are going to be very happy. The other important part is right now, most of processes are subtractive. That means you start with a big block and then cut it to create it the denture. In 3-D printing, you only use the material you need to create what you want. Let's take crowns. Crowns, right now, when you go to a dentist, they will charge you \$1,500 dollars. To make that crown, you start with a \$25 dollar pack and then create a two-gram crown and sell it for \$150 dollars to the dentist and they will charge you to get to the \$1,000 dollar price. If you want to print two grams of material, it is only like a few dollars. So the whole cost structure right now and the way that things are done, is completely reversed.

Kirkpatrick: But VJ, is it because we've made some recent advances in what we can do with 3-D printing that you can even talk that way?

Joshi: Yeah, well I think it starts with materials. The whole thing is biocompatible material that you will be able to customize. Mass customization, at an affordable price, is going to change the world. And that's the only reason the focus that we have is on materials. You start with the material, start with the technology—the other important part is this technology: mass customization. It means I can go to Africa and in the dental labs we could put this particular device, for a way lower price than building a big factory of creating crowns—

Kirkpatrick: And put it right there, either in the dentist's office or in the clinic or whatever. Yeah.

Joshi: So I think this whole digitization, access to the technology, and the cost structure, is what it will take. Think about hearing aids, right? Everybody wants the shell that is going to fit. Ninety-five percent of hearing aids are done with 3-D printing. And the reason for that is it can do mass customization at an affordable price, which you could globalize.

Kirkpatrick: All right. That's great.

So Oliver, I know one of the things that's sort of not entirely intuitive for non-medically educated people, that you guys are putting a high priority on, is reducing mistakes. Talk about that and how you're thinking of that, and what the opportunity is to scale that.

Hsiang: Yeah, so if you've ever read or are familiar with a book called *The Checklist Manifesto*, it's based on a very simple but powerful premise that by following checklists for certain types of

procedures you can reduce mistakes. So we all do this in everyday life, to-do lists, grocery shopping, whatever. But imagine that applied to a higher-stakes environment like the operating room. So when we think about where technology can really play a big impact, I think this notion of a more connected operating room is really exciting. And there are many ways in which you can think about this idea of better efficiency through things like reduced mistakes. So I think on one end, there is software out there—and in fact, we recently announced an acquisition of a software startup company called the Surgical Process Institute, which creates this hardware/software solution in the OR that takes most of the surgeries which can be standardized—not the types that you demonstrated, of course—but many surgeries where you can create a standard checklist of steps to make. And by following that, you can help surgeons focus more on value-added areas like where they can intervene or when things might go wrong. You can reduce the possibility of forgetting a critical step. You can, importantly, measure this and provide education and training back to the hospitals themselves. And you can even eliminate process waste by making it easier for people from the surgery team to swap in and out, because they know seamlessly what they need to do.

And so this really powerful stuff and it turns out, it also has the benefit of reducing a lot of costs for hospital systems. Reduce the variation in the steps and you reduce the variation in the outcomes, that's better outcomes for the patient, of course. You eliminate all this waste from the process, that's great for the systems themselves too. And so it's a very powerful but simple application of technology.

Joshi: But you can apply the same principles in terms of digitization, simulation, and figuring out to train the surgeons. And you know, you could take a lot of waste out and you could get a much better outcome. This is just starting, all this technology is available at a high end, and then it comes down, you know, and then I think that could be a very powerful way to really focus on the outcomes.

Hsiang: Yeah, and it doesn't have to be this super high-tech implementation and it doesn't have to be really expensive. So you can have your high-end OR with your monitors everywhere, with the speakers and everything's controlled by the foot pedals. Here's your next step. But you can also have them implemented at the local level through just having a—

Joshi: But virtual reality is going to change the way you train the surgeons, and the way you get the right kind of outcomes. That's what I believe is going to happen.

Kirkpatrick: But did you mention your partnership with Alphabet? Because that's an interesting aspect of what you're talking about.

Hsiang: That's another part of what I would call digital surgery. So we have a joint venture with Alphabet's Verily division, where we're co-creating a robotic surgical tool. And so, again, the idea behind this is to make more precise movements, to utilize the technology where it really makes sense. And you can call that reducing errors if you want, but just like we're moving

to a world of autonomous vehicles which, in theory, will reduce accidents and that sort of thing, having robotic-assisted surgical tools can help.

Joshi: We should talk.

Kirkpatrick: So Roy, I don't know, any thoughts that you've been prompted by other stuff you've heard here? And I do want to go to the audience.

Smythe: Yeah, sure. So we also believe at Philips that we sort of back up into the types of tools that can be used by clinicians that can make them more efficient and save costs. We have platforms for radiology, pathology, oncology, genomics. All of which are intuitive and are using AI to learn how clinicians work and make them 30–60 percent more efficient, more throughput and so forth, to save costs. And those are some very real-world applications of AI. There's a lot of hype around AI, but there's just some place where we're actually using it. Not really directly touching patients, but just making clinicians more efficient and lowering the cost.

I do think it's interesting, though, some of the things we're talking about here. You know, because the traditional medical-industrial complex is based interventions and acute care. A lot of things we're talking about have their origins there. And the question is: Those advances, of course, are easy for healthcare providers to latch onto, because those are already revenue-producing areas of healthcare delivery, and, you know, you can lower the cost to make even more revenue. Where I'm really interested in seeing us pay more attention is the 65-year-old obese, Hispanic, diabetic living in the rural United States or in Central America that doesn't necessarily have access to technology, didn't need to have a major surgical procedure or have a robot. Just needs to better manage diabetes. As it turns out, that's driving most of the healthcare costs around the world.

And when I talk about realigning the incentives and having philosophical shifts to leverage technology to really lower the cost, not just to make us more efficient and better outcomes—which we all want. I mean, I would have loved to have had some of the 3-D printed models when I was operating. It would have been great. But, you know, there's a huge vista of more opportunity outside of the context of traditional, acute, high-revenue care that the incentives just aren't aligned to use technology. That's where I'm hoping we focus more of our attention over the next decade.

Kirkpatrick: Agnes mentioned [the] mobile phone as—it's really a fundamental social transformation, that everyone has this—increasingly everyone. Three billion people or something close to it, and growing toward everyone, have these little things with them at all times. That really is a key tool in this process, is it not?

Binagwaho: I just want to say that it's not only for clinicians. Like in Rwanda, 45,000 community aid workers have a simple phone. It's a \$5 dollar phone. And with that the alert in case of outbreaks, in case of somebody needing an ambulance. And all this information is centralized, analyzed, and in the end, for the first time, we know what happened at the

community level. But also software helped the Ministry of Health to manage the health sector. That means it makes it more affordable for the people in remote areas, more equitable, and also better management. It's part of affordability.

Kirkpatrick: It's also interesting to note regarding Rwanda that one of the things that makes Rwanda so different—and correct me if I'm not explaining this right—is that the way the government has worked is it has really driven a lot of resources to the local level. So the village, the region, has a lot more resource and decision-making capability. That is not the way most other countries in that part of the world have structured themselves. And that gives you tools that other countries lack. Would you agree?

Binagwaho: That should be the way to go. Because where the people are living? In their home.

Kirkpatrick: Right.

Binagwaho: They don't live in the ministry. So don't put the resource in the ministry. Put that where the people are.

Kirkpatrick: This is not just in healthcare. I think the whole point, [Paul] Kagame has directed a lot of resources to the village level, right?

Binagwaho: Absolutely, because that's the place where people live. And also, health is an integrated thing. You cannot manage health without having a multisectoral approach, central to people. But it's so logical that this needs a panel per se.

Joshi: So one more point I want to make is education. I just think that educating nurses and doctors with this digital technology is very important. Because I really think that our current curriculum is not really adapted. And you could actually train, you know, doctors and nurses to do gallbladder surgery—

Binagwaho: Absolutely!

Joshi: Somehow, we are still using the old ways and I think we need to transform that.

Kirkpatrick: VR and AR are part of what you're talking about—

Joshi: That's what I'm just saying. Because the more you do that, the more the help will be there. Because as you look at the ratio of doctors and nurses to the patients—

Binagwaho: But it's not only in developing countries. Here there are a lot of regions without hospitals because they have closed. So you need a community approach but you don't need a specialized approach at the community. You need access to tools that they can give and link the people together.

Joshi: Exactly.

Kirkpatrick: Okay, let's get the lights up and who has a question or a comment?

Van Niekerk: Hi, Drew Van Niekerk, veterinarian from Canada. I'm curious as to where we are with listening technology, artificial intelligence, and the ability to medically chart. I don't know about the human world, but in the veterinary world it is incredibly inefficient and onerous to chart your visits and your care and your plans and everything else. It requires a lot of manual input and it seems to me the technological opportunity is to have systems that might be able to record as you go and be smart enough to use key phrases to construct a medical record for us and take a low-hanging fruit of efficiency in the doctor world. What do you think?

Kirkpatrick: Any thoughts from anybody?

Smythe: Yeah, so I would fully agree. You know so there was a study done a couple of years ago that suggested that in North America, including in Canada, the average primary care visit is 13 minutes long. And then since that time, what we've ferreted out is that 39 percent of that 13 minutes is documenting. And usually not—documenting exclusive of any interaction with the patient. So now you've got it down to 8 minutes, right? And the average North American sees a physician four times a year. So that's 32 minutes a year of face-to-face health care. So we're actively working—and a number of other companies are as well—on, you know, using natural language processing and auditory processing to improve documentation. It's not far away. All you have to do is come to my house and have breakfast with me and sit with my 12-year-old and my 7-year-old and Alexa and myself, and I can demonstrate to you how it's not far away. So it's a great question.

The key here is, both for clinicians doing things, documenting things, and for patients, being monitored and evaluated and followed exclusive of their interactions with clinicians, the more passive the better. If you ask people to do things outside of the context of their normal lives—put a watch on, type something into it, type on a screen—it always quenches. And so we talk a lot about passive monitoring of patients, but we need to be a little bit better with clinicians as well, making their jobs easier. So they can be more humane.

Binagwaho: Yeah. Never forget that. And also when they took 30 minutes to record that, nobody can read it, because it's a doctor or nurse's handwriting.

[LAUGHTER]

Smythe: Or it's embedded in electronic health record charts. I was on the Texas Medical Board for a number of years doing disciplinary work, and we would get the charts on physicians that would make mistakes. And we would get a printout from the EHR that was 120 pages long. And we could never find the medical record.

Kirkpatrick: Yeah, because it was designed for payment.

Smythe: Yeah that's—exactly.

Kirkpatrick: The EHR is designed for payment not for clinical progress. Okay, back there, please.

Cheney: Thanks, I'm Catherine Cheney and I work with Devex. We're a media outlet focused on the global development community, and of all the stakeholders that have come up; we've talked about governments and technology companies. I wonder if you can point to the role of donors and NGOs and in this space and any advice for them or hopes—what you hope to see for them in navigating this?

Kirkpatrick: Interesting question. Good question. Anybody have any thoughts?

Binagwaho: So donors and NGOs, when they want to work, should sit with government and civil society and ask what should you do in your level of development? And go directly to the best. Don't believe that because you are poor, we are going to start with paperwork. No, let's go [SNAPPING FINGERS] to technique and make it fly. So there is space for everybody.

Kirkpatrick: Anybody else have any thoughts on NGOs? Because certainly, they're a critical part, if we're going to make global health go fast—

Binagwaho: And never forget that government are not implementers. They are regulators. Who implements? Civil society, workers, etcetera. So there is space for everybody.

Kirkpatrick: Okay?

Abadir: Essam Abadir, Aspire Ventures. We're a health and AI VC fund partnered with Penn Medicine, Capital BlueCross. These views are my own, not theirs. A lot of what you guys are talking about is precision medicine. I'm wondering about the barriers to entry in the market, when you're printing a part for each person or developing therapies for each person, what do you think the prospects are of getting through regulatory issues, and getting into market?

Joshi: I think that's a very important step. We have invested a lot in really building the right kind of infrastructure so that we can track every step because of the requirement from the FDA point of view. The other important part here is we need to do it globally. You just can't do it in the United States, because this is a global thing. And you know you need to understand all the laws in various countries and make sure that not only the infrastructure and the tracking is there, but that's fundamental, because you know, when you are asking to put a crown inside the mouth you need to have all the approvals. So my view is you need to really make sure that you considered that there is going to be a time where you need to get all these approvals done. And, you know, that can be a barrier but also a competitive advantage.

Kirkpatrick: And Oliver, how do J&J think about the regulatory challenges?

Hsiang: Yeah, I mean, for better or for worse—that's a reality. And so I think, the technology by itself is not going to be sufficient. I think you have to really marry that with not only the scientific expertise but that regulatory expertise. So in many ways it's necessary. I think one

step that we've taken is working with the FDA's new program to pre-certify digital health software initiatives, and so really exciting, obviously very early. But participating with the likes of the Googles and Apples and Fitbits of the world. And so, there are steps out there, and it's encouraging that they are trying to think innovatively like that to streamline those things. And we're looking to participate in that.

Kirkpatrick: Oliver, do you agree with what Roy was saying about the passive things making more sense, if we can find where they are effective?

Hsiang: Yeah, I mean, behavior changes are hard across the board. It's a tough nut to crack. And how do you design technology applications to help change that? I think on the consumer side there are a number of things that you can think about utilizing, apps, and those types of things. And we created a digital platform recently that we launched called "The Health Partner," where we're working closely with the systems themselves and connecting that to consumers to help them understand not just the physical elements in preparation of surgery, but the emotional and mental elements as well. So the entire sort of mind-body-spirit approach. And it was really a great breakfast this morning with Dean, thinking about, you know, it's not just motivation through fear, which doesn't really work. It's the motivation of joy. And how can we implement technology to help people understand that in ways that aren't creating these artificial behavior changes.

Binagwaho: Social capital again. And also don't believe that behavior change is so difficult. Remember how the world was 20 years ago. We have totally changed!

Joshi: Right.

Binagwaho: So behavior change is less difficult than we believe.

Kirkpatrick: Wonderful. Well we've run out of time, but thank you, all four of you. Really good conversation. This is a conversation that will continue at Techonomy and, I hope plenty of places. So thank you all for participating.

Binagwaho: Thank you.