5G-2016/07/19

THE BROOKINGS INSTITUTION

FALK AUDITORIUM

THE 5G NETWORK, THE INTERNET OF THINGS, AND THE FUTURE OF HEALTH CARE

Washington, D.C.

Tuesday, July 19, 2016

Opening Remarks:

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P R O C E E D I N G S

MR. WEST: Good afternoon, I'm Darrell West, vice president of Governance Studies and director of the Center for Technology Innovation here at the Brookings Institution. And we would like to welcome you to our discussion of "5G Networks and the Internet of Medical Things." And we are webcasting this event, so we'd like to welcome our viewers from around the country and, indeed, around the world. We have set up a Twitter feed at #HealthIoT, that's #HealthIoT, so feel free to post any comments or questions that you have.

We are at an interesting point in the history of health care. We are on the verge of a technology revolution with the potential to transform a number of aspects of health care. Soon our country, as well as other countries around the world, will be rolling out a new 5G network that will bring together an estimated 50 billion devices and 212 billion sensors. There will be fast, intelligent networks that will handle the traffic flow, and there will be cloud-based services that will allow applications to process content quickly and effectively. This is going to enable many new approaches in health care in terms of imaging, diagnosis, and data analytics. It's going to be possible to get second opinions remotely, far from where people live. Sensors will help people track various symptoms and electronically transmit that information to their health provides. Data analytics will generate actionable insights in real time so that physicians can learn about what works and what does not work. So these new tools and new network will improve access to medical care, and the hope is that it will do so at an affordable price.

We actually have put out a paper summarizing some of the new developments in terms of 5G networks, and we also make a number of recommendations for using 5G networks to improve health care. And just to quickly summarize some of those ideas, we emphasize developing the digital infrastructure so that we can gain the benefits of a 5G internet of things, harmonizing the spectrum so that there is a combination of licensed, shared, and unlicensed spectrum, using technical standards to ease concerns regarding interoperability and getting all these devices to connect with one another, balancing technology innovation on the one hand with effective regulation on the other, and then finally, altering government reimbursement policies to encourage telemedicine, video conferencing, and other kinds of home health therapies. So if we do these things, we argue that we will move much closer to the world of

connected medicine and that it will help to improve health care for all of us.

So today we are bringing together a number of leading experts to discuss the future of health care and particularly the role that technology can play in that. We're very pleased to welcome our first speaker, Julius Knapp, who is the chief of the Office of Engineering and Technology at the Federal Communications Commission. And in that position he leads the commissions' activities on technology innovation. He is the commission's primary resource for engineering expertise and technical support for the chairman, the various commissioners, and the various bureaus and offices. So please join me in welcoming Mr. Knapp to Brookings.

MR. KNAPP: So good afternoon, and thanks, Darrell, for that introduction. I was invited to speak here a few weeks ago to talk about "5G and the internet of things" and what it would mean for health care. And at the time, the FCC was planning to adopt new rules for 5G on July 14th. But sometimes your best laid plan is to have something adopted on the dates slip a little bit, so there was some risk in accepting the invite that the commission would actually vote to adopt the new rules and then -- otherwise I wouldn't have much to talk about today. But thankfully that happened, and the commission delivered on its plans to provide for 5G in a big way.

So last Thursday, the FCC adopted new rules for wireless broadband services in the frequencies above 24 GHz, which made the United States the first country in the world to make this spectrum available for next generation wireless services. FCC chairman, Tom Wheeler, said at the time, it's probably the most important vote that the commission will take this year. At the commission meeting, the chairman and commissioners talked about, we don't know exactly what 5G is going to be. And here we are today, just five days later, talking about what 5G is going to mean for health.

In preparing for today's session, I had the pleasure of reading Darrell's paper that offers insights into the promise of 5G technology, and how it will enable the "internet of things" in the context of health. The paper, among other things, talks about the need for spectrum, development of industry standards, and effective regulation. So let me start with spectrum. And I beg your indulgence for those of you who aren't spectrum geeks.

We made spectrum for 4G available early. And as a result, the United States was the

first nation to deploy 4G networks at scale. Because we led in networks, we led in users. And because we led in users, developers focused on the U.S. market. Today, 91 percent of the world's mobile app downloads are from U.S. businesses. The result has been a mobile app economy that created 1.6 million new jobs. We're repeating that same formula for 5G. One, make spectrum available quickly and in sufficient amounts. Two, encourage and protect innovation driving competition. And three, stay out of the way of technological development.

5G is not going to be about one frequency band, or even two. 5G requires access to low-band, mid-band, and high-band spectrum to achieve coverage and capacity to meet the growing demand for access to wireless. And all are available in the United States now through flexible use of the existing wireless frequency bands and the addition of new bands in the last few months. The low-band spectrum at 700 MHz that first fueled 4G in the United States was reallocated from TV broadcasting. We are currently conducting the world's first incentive auction in the TV spectrum at 600 MHz to make more low-band spectrum available.

Last year we opened up large swaths of mid-band spectrum. Our AWS-3 auction in the 2 GHz region generated auction revenues in excess of $40 billion. We also opened up spectrum in the 3.5 GHz region for both licensed and unlicensed use based on cutting edge technology that enables sharing with incumbent radio services. The commission's action last week made available licensed, flexible, high band spectrum at 28 GHz, 37 GHz, and 39 GHz that totals more than four times the amount of flexible use spectrum that the Commission has licensed to date. And let me just repeat that. More than four times the spectrum that is fueling wireless today. And we didn't only make spectrum available for licensed. We also added spectrum in the 60 GHz region to open up a huge 14 GHz of spectrum for unlicensed use. And just in case all that wasn't enough we proposed additional bands totaling more than 18 GHz of spectrum. So we're not done yet. Even with all that we've done, we've proposed to make additional spectrum available.

When it comes to the development of standards, terms that might be familiar to you is GSM, CDMA, and LTE. The Commission for more than 20 years has relied on the private sector to develop those standards. We're following that same formula relative to the development of standards for

5G. Organizations such as the International Telecommunications Union, 3GPP, and the IEEE are already well-along the process of developing standards for 5G. The steps the Commission took last week will exercise our responsibility to make sure there is a competitive environment that furnishes the incentive to drive competition and bring new services to the market. We're also making sure that industry takes into account, right from the beginning, the need to build cybersecurity protections into the standards right from the start. And that's got to be very important, especially in the health care industry where you need reliability and immunity from attacks.

Our nation is also investing heavily in research and development for 5G. All of the major U.S. carriers are conducting, or plan to conduct, 5G trials. Just last Friday, only day after the Commission meeting, the Office of Science and Technology Policy, and the National Science Foundation, announced the creation of the Advanced Wireless Research Initiative with a substantial investment in fundamental research of wireless technologies that would support the development of 5G. This initiative is going to establish platforms for advanced wireless research that is enabled by a new industry consortium that's going to include both public and private partners.

Earlier I said we don't know exactly what 5G is. What we do know is that it will provide high speed, high capacity, low latency wireless networks. But what does that mean for the health sector? In the past few years at the FCC, we've been gratified to help enable a variety of new wireless medical applications, medical telemetry, microstimulator devices that restore motion for those suffering from a wide array of debilitating disorders or injuries, medical body area networks, diabetes monitors, implantable devices for weight control, hearing assistance devices, and devices that restore a level of sight to persons who have no vision. That's just to name a few. And I should mention that we do all of this work in coordination closely with the U.S. Food and Drug Administration. We actually have a Memorandum of Understanding with them. We meet three or four times a year, and we have a constant dialog in-between.

4G brought together the wireless in health sectors in ways that weren't possible before. Short range devices that operated only a few feet could suddenly be connected, over the Internet, via a smartphone to a remote location anywhere around the globe. Today's networks have the capability to

remotely monitor a variety of patient conditions for purposes such as cardiac care and diabetes management. All sorts of novel health care applications have been developed. For example, small wireless sensors and shoes can monitor the gait of an elderly person and send a signal to a relative that they may be at risk of a fall. These sorts of applications are sometimes referred to under the term the internet of things. Whether we are talking about connections between people or things, it is fundamentally about the ability to connect with anything or anyone, anywhere, at any time. And when it comes to the health center, the connectivity that 5G promises to open up a new world of possibilities. Imagine having the ability to perform surgery remotely, enabled by 5G's capability for real time interaction, coupled with virtual reality. Imagine being able to transfer high resolution MRI images to a physician wirelessly in seconds, not minutes. Imagine sensors that can collect and send far more data about a patient's condition than can be done today. Better still, imagine sensors imbedded in wearables that could serve to identify health issues in an early stage when they're more easily treated. Darrell's paper provides many more examples of potential applications, yet no matter what we imagine today, we can be sure that it will fall short of the innovations to come.

In closing, let me also recognize that where technology provides new opportunities, it can also foster the need to re-examine existing policies. For example, it was an eye opener to me to read in a Darrell's paper that today reimbursement is only provided for health care when the physician is there in person. So I look forward to the discussion this afternoon. We've made the spectrum available. The technology is being developed, and all that's left for us to do is to take advantage of the wonderful opportunities for the betterment of health care for everyone. So that sounds pretty easy.

So thanks for listening and I'd like to introduce Bob Rogers of Intel. Intel was very active in our 5G spectrum proceeding. They've been one of the leaders in this space and I know that they've been working on some very exciting products and the supporting technology that will be the engine that drives other innovations. So, Bob, thank you.

MR. WEST: So, as just mentioned, our next speaker is Bob Rogers of Intel. He is the chief data scientist for big data solutions. He's someone who's very knowledgeable both about health care in particular and the topic of data analytics. And I also want to note, we appreciate the generous

support provided by Intel for this discussion. So, Bob, we look forward to hearing your comments.

MR. ROGERS: Thanks, Darrell, for your very kind introduction. I really appreciate it, and I'm actually quite thrilled to be here to speak to you all. And thank you FCC Chief Knapp for your very insightful comments on FCC's work to really enable this technology and ensure that the U.S. has the resources and spectrum needed to continue our technology leadership as we move towards the next generation of technology innovation.

The Commission's recent decision, making so-called millimeter wave, or millimeter frequencies, available for new 5G applications demonstrates the global leadership that we need as attracting substantial 5G investments and experimentation in the U.S. In fact, those, again borne out by Mr. Knapp's comments about the amount of research that's happening. As a technology provider, Intel is really honored to have the opportunity to support the Brookings Institution in this work, and in their examination of the impact 5G will have in the years to come.

Brookings has been a leading voice in examining how technologies can impact and transform our world. It's been a privilege for me, and I think for the rest of us at Intel, working with Darrell to explore the effects that 5G and the coming internet of things will have on industry and on people's well-being.

At Intel we believe that the world is becoming increasingly smart and connected. Our vision is a world where every aspect of life is integrated into the network through a variety of connections, not just mobile broadband, but through an internet of things and applications generating huge networks of machine-to-machine communication. This smart connectedness is going to place unprecedented demands on today's wireless networks, and it will really drive the need for 5G.

So 5G and the internet of things are going to transform the ways we interact with our world. They'll infuse intelligence throughout the network and bring seamless connectivity and computing power to every person and thing across our society and our environment in which we live. At the same time, the “internet of things” promises to create new services and solutions that will affect nearly every part of our lives.

We'll move beyond the current connection form factors that we have to see everything in

our lives connected. Of course, our smartphones and our vehicles, but also our homes, the places we work, where we travel, and, in fact, even the devices that we wear on our bodies for our own well-being and health care.

More than just connecting those sources of data, we're going to see that the billions of things brought to life by 5G will create an intelligent computing environment that allows us to pursue grand aspirations such as finding more productive ways to feed the world. That intelligent computing fabric is critical to how we take advantage of 5G. The ability to connect things that were never connected before will lead to new insights that have the potential to materially and meaningful impact all this. And I believe, and I think we all believe, that this will be particularly important in health care.

Today, commercial networks and devices already allow some new forms of care delivery. However, mobile health and telemedicine are limited by current 3G and 4G mobile broadband and by application and device limitations. The connected internet of things is going to change everything. By design it will not only increase capacity, it will enable even the smallest devices to perform heavy computational tasks, connecting rapidly and opportunistically to processing power that will be diffused throughout the network. Again, a really critical point when we envision the future world of 5G and the connected internet of things.

In health care we may soon have the capability to enable things such as remote diagnostics and even remote surgery. And, I have to say, I was a little hesitant to talk about remote surgery because it seems so far off, but then when Mr. Knapp brought it up it gives me great comfort. And I think we're all aligned in our vision here. So these require high bandwidth communication, low latency, and very, very high reliability, all the way down -- and the latency down to millisecond level.

We're also going to see just in time delivery of care, powered by seamless integration of data and analytics. Imagine a world where patients receive the care they need, where they need it, and when they need it. Imagine the impact that this will have on patients suffering from chronic conditions where trouble with coordinating data and services is a huge challenge, and also patients who are in resources scarce areas where it's challenging to get access to centers of care. And smart pharmaceuticals will certainly be possible thanks to the real time capabilities of 5G. Not only can

pharmaceuticals be imbedded in connected devices, but they themselves will be the connected devices, creating the capability for a patient's condition to be assessed in real time and medications to be titrated remotely.

Intel, in partnership with Michael J. Fox Foundation, has already developed a system to monitor and interactively assess the highly variable symptoms of Parkinson's patients to improve our studies of possible therapies. In a more connected world, the scope, scale, and impact of these studies will expand dramatically, allowing us to better control the dosing and outcome of therapy.

5G is also going to bring transformation in the use of big data, which means great things for diagnosis and treatment. Data analytics, enabled through 5G, will be able to aggregate, analyze and make sense of data in new ways, making every device smarter because it's connected to the cloud. Today there's an incredible loss of valuable information in health care. In a health care system enabled by 5G, data silos and a lack of semantic interoperability will not be tolerated. In fact, this is the promise of precision medicine: Secure access to the right information about each patient so that the best care can be provided. And some of this can be done in real time, accessing comprehensive analytics that can determine treatment regimens at the point that they are needed.

As Intel's chief data scientist for big data solutions, I'm looking at all the ways that data will be used today, and I'm particularly interested in the way that data will be used in the future. So, with that in mind, I'd like to just tell one short story from my own experience that will be enabled by 5G. This is the story of the unconnected ultrasound.

So recently, my wife -- I was sitting with my wife while she had a kidney ultrasound. And, of course, me being me, I couldn't just let the technician do her work, I had to ask her about the device she was using. So, I asked her, what do you think about this device? Well, it's okay, but it's not as good as the other one that we use. And I said, oh, really? Why not? And she told me, on this one, the algorithms are wrong. Wow. I was amazed and thrilled, partly because I never get to use the word algorithms in my real life, but also because this was a challenge right here before me that's right in my wheelhouse. So I asked her what the problem was. She said, well, look at this artery right here. We automatically measure the diameter of the artery, but 40 percent of the time this one gives me the wrong

number. I have to go into the system and I have to change the record with the correct number every single time for that 40 percent. This was a huge lightbulb moment for me because, as a data scientist who uses machine learning, I saw that this unconnected ultrasound was missing the boat for advanced analytics.

They have an army of technicians entering data to correct their algorithms in real time, and because the system is not connected, that data goes nowhere. The opportunity to use machine learning to improve algorithms and to advance our ability to measure accurately in complex cases, completely missed. Obviously a connected ultrasound changes that story.

But it goes one step further. Imagine, now, if that ultrasound fits in the palm of your hand. That's potentially revolutionary. The lifesaving power of ultrasound diagnostics that can go anywhere they're needed. But it also raises a challenge, because right now, ultrasound is done by experts, and if I can take it anywhere and anyone can use it, we need some way to guide those users. 5G and an intelligent, connected system allows us to take into account context, and to, in real time, provide intelligent guidance for non-experts to provide lifesaving data acquisition at the place that it's needed. Here at home, in other developing countries, it's a very powerful image of where we're going with this connected story. So this type of capability will be pervasive across health care, and the day of the unconnected ultrasound will be no more. Everything will be connected and intelligent.

So sounds fantastic, but there's a lot to do. These billions of devices are going to have widely varying capabilities and data and power demands. We need a network that connects all of them, intelligently, and takes into consideration the use of power, data demand, and spectrum. In that regard the FCC will need to continue to make low, mid, and high spectrum bands available in a flexible and investment friendly manner. I'm not looking at you. And it sounds like we're on that path. Work is already underway to standardize solutions that will use existing footprints, enable global coverage, and allow for solutions to be secured quickly. So we're on the path.

Just to summarize, 5G and the internet of things promises to ignite opportunities across many industries and fuel innovation in nearly every part of our lives. I look forward to hearing from the panelists today, and I have to say in the green room, the conversation was already really outstanding, so

I'm really looking forward to hearing this. These panelists will provide their perspectives on what this paradigm shift will mean for health care. Thanks again to Darrell West and the Brookings Institution for recognizing that a technological revolution is underway, a revolution that will impact not only our industry, but all industries, all services, and all people. Thank you.

MR. WEST: So we've now heard the perspective of government and business, and I thought it was very insightful, both Mr. Knapp's comments, as well as Mr. Rogers' views. What we're going to do now is we have three experts who are literally on the front line. So these are people who are actually out there delivering care, working with organizations both in the United States as well as around the world. And so we want to get their perspective on what they're seeing, what lessons they're learning, obstacles they're encountering, and ways that we can overcome those obstacles.

So I'm pleased to welcome Jesse Pines here to Brookings. Jesse is the director of the Center for Health Care Innovation and Policy Research in the School of Medicine of George Washington University. He is the principle investigator for urgent matters. That is a program that disseminates information on best practices in emergency care. His latest book is entitled, “Value Based Approaches in Acute and Emergency Care” and it's going to be published in 2016. So I don't know if it's actually out now or --

DR. PINES: Yes.

MR. WEST: -- to be out.

Rob Havasy is the executive director of Continua and also the vice president of the Personal Connected Health Alliance. He works among other things, on the interoperability of medical devices and ways to improve the delivery of health care. He and his team have built a digital platform that enables the center to collect patient generated data and integrate it with enterprise clinical systems.

Lesley Anne Long is the global director of mPowering Frontline Health Workers. She provides strategic leadership and coordinates with health officials in sub-Saharan Africa and in South Asia. And before we were talking, she and her organization are active in 16 different nations around the world, mostly in the developing part. She is a former dean of the faculty of Health and Social Care, so she has a strong record of academic publication in the areas of law and global health. And she's

published many articles on that subject.

So I'm going to start with Jesse. You were on the front lines of health care, literally, in the sense of working in emergency medicine. How are emergency incorporating some of these new technologies in medical treatment?

DR. PINES: All right. First off, thanks for having me. And I think this is a really amazing topic. As a practicing physician, I've seen an amazing transformation of really how we use technology at the point of care. To quote Bob, emergency medicine, which is my clinical area, it's really about bringing patient care to patients where they need it and when they need it in emergency medicine. This could actually be a challenge to care delivery, particularly in remote areas or areas where you may not have expertise, actually, in the hospital, and what I'm going to do is give you a couple of examples of really where technology is actually really helping patients at the front line now. So again, really the challenge is to get the most expert clinician to the bedside as early as possible, particularly when patients have time-critical illness.

To give you one example, the University of Mississippi Medical Center is using telemedicine for that purpose. And what they have is a connected network where their main hub emergency department connects with over 28 different emergency departments across rural Mississippi. So if a patient comes in to one of these rural emergency departments and the clinician has a question about a clinical case, they can actually beam in to the hub emergency department and get the expert opinion of the clinician enabled by technology in a way that the clinician can actually see the patient. There are a lot of things that are important to see about the patient, and that can actually make a decision about whether that patient needs this particular treatments or transfer.

Another great example in this area is called TeleStrokes. Now, stroke care has also been revolutionized recently where really the goal is the early risk stratification and determination whether or not people need clot busting agents such as, it's called TPA. The challenge is, when people come in to these rural hospitals, you may not have the expert neurologists at the bedside. Many emergency departments actually have really great TeleStroke networks where they can beam in to a neurologist and get an expert opinion at the bedside where the neurologist can actually direct the physician to do specific

elements of the physical exam.

And then the third example, the University of Massachusetts Medical Center has a really neat program that actually uses Google Glass where the physician actually wears Google Glass and goes in with the expert toxicologist with them to ask an answer specific questions around poisonings and other toxi-exposures.

So these are just a few examples about how technology is already impacting care at the bedside, but also, you know, I think we're really at the beginning of the revolution here. I mean, there are really so many ways in emergency medicine and many other fields that technology can really help care and I think that we're, you know, really just at the beginning here. And then for my final point, the question is, how can policy changes really facilitate this sort of innovation. So there are many things that are happening now that really do facilitate this, particularly many of the provisions of the Affordable Care Act that promote payment models that move away from fee for service that really promote this sort of innovation that really improves care efficiency. So, you know, it really makes it worthwhile for hospitals to make the investment. In the future I hope that more policies are promulgated that really make this -- really increases the dissemination and the innovation in this area so we can help more of our patients.

MR. WEST: Okay. Thank you, Jesse. And so, Rob, you work on health interoperability issues, among other things. How can we connect all these new devices that are going to be coming online, and what are the best ways to integrate health technology?

MR. HAVASY: We can certainly do it better than we do now, that's for sure. The line from one of the opening remarks that I wrote down that was really important to me was that the lack of semantic interoperability will no longer be tolerated. See? There's somebody else who's on my team here. And that's, unfortunately, where we find ourselves today. Right? About six years ago I was privileged to give a speech over in Brussels, and I was with Dr. George Crooks who's the head of the Scottish NHS and their ambulance service. And he gave a quote that really stuck in my mind. Back then we were talking about the leap to LTE and LTE rollouts. And he said, you know, in my line of work, if we could just figure out how to use all the stuff we already have, we'd be far better off than whatever new innovation is coming down the pipe. And so that's where we find ourselves today.

My organization, when we were founded 10 years ago, we set out not to become a standards organization. We didn't want to become a caricature of something that happens all too often in technology. One of my favorite cartoons does it well. XKCD, where two engineers are sitting around saying, this is ridiculous. There's a dozen standards for this type of device. Somebody needs to unify this mess. And then a year later there's 13 standards for that particular type of device.

And so we set out to take existing standards and work very closely with existing standards organizations to say, you're close. In order to use this for health care, we need to add this. How do we work with you to do that, rather than create something new? If I look around today, I see IoT as a new buzz word. All right? Everybody wants to be an IoT company. There's IoT in the tagline, in the hashtag up there. And so there's about six different IoT standards initiatives that are underway at the moment. And if I could have any say in the matter, I would say, we need to not go down that road again. We need to unify all of these things. And we need to break out of our silos, and perhaps that's the biggest thing in my mind.

When Continua set out, we were a health care standards organization. We wanted to standardize personalized health care devices, those things that patients, that people, take home and use outside of clinic walls. Right? Whether they're activity monitors, scales, blood glucose meters, traditional medical devices nonetheless, but things that people use at home. And it was easy to say back then, well, a blood glucose meter or a blood pressure monitor is a medical device, the way the FDA looks at it, the way a lot of regulators look at it. And then we started to get into things that could be a medical device or it might not be a medical device. Your scale at home, which everyone probably has, which I don't use as often as I should, sometimes it's a medical device, sometimes it's not.

And in an IoT world, the line gets blurred even further. All right? I mentioned one of the conversations we had backstage. An interesting initiative I saw, some students built at MIT was, well, for some chronic diseases or for general fitness and wellness, we'd like people to stand on their scale frequently enough to remind them of their trajectory on their diet or their exercise regimen or whatever they're doing, and people don't do that enough. So what if we brought the scale to them, and what if we weighed them by putting a sensor in the couch or a sensor in the bed or a mat on the floor? Well, does

that now make your bed or your couch or your floor a medical device? So, as we move into this IoT world where everything becomes connected and everything is contributing to health care, everything is contributing to all sorts of other things, and your health care devices are contributing to other parts of your life, we need to knock down the walls between the standards organizations, and we need to knock down the walls between what is and what is not health care, and understand we're all in this together, and get to a world where not just semantic interoperability is no longer tolerated.

But companies that traditionally consider themselves consumer device companies build their technology with sufficient precision and sufficient resolution and sufficient imbedded capabilities that it could be used in health care, even if that wasn't their initial intent. When we get to a world where everything's connected to everything else, that means everything can be used for any particular purpose. And in health care we worry, especially doctors and emergency physicians know this really well, we worry about accuracy and precision. We worry about integrity of data. We worry about consent and privacy and all of those other things. And so to go back an example, right? Maybe the couch manufactures and the floor mat manufactures and the bed manufactures are going to have to start worrying about precision and accuracy and integrity of their data. And I think that's where we really need to start. We need to bring things together.

So, you know, who's going to do that? I don't know. I think it's a push. It's certainly an international push. It's a push from existing regulatory agencies and existing legislative bodies. It's a push from the existing issues. We mentioned some of the standards organizations who have been active so far. In the Continua organization we have worked for years very closely with IEEE. We worked very closely with a number of other standards organizations. We didn't set out to be a standards body, but ITU adopted our standards as one of their technical standards in a telemedicine architecture now, so we became a de facto standards body. But we don't need to create five new ones. We need to take what's out there, we need to all get together, and we need to figure out a way to overcome these basic ideas so that everything that's sending data sends at least enough context, we were talking about context before, too, enough context, enough data about the last calibration, the precision, of all those things so that we know how to use this data. And then I think we can get somewhere. But it's a matter of breaking out of

the silos for sure.

MR. WEST: Okay. Thank you. Now just for the record, I do not want my couch keeping track of my weight, because I do not want to have an adversarial relationship with my couch.

Lesley Anne, you work in 16 sub-Saharan African nations with populations that often have very limited incomes. How can health technology help people in the developing world?

MS. LONG: Well, I'm listening to what is this massive opportunity with 5G and living in a country where 4G is commonplace. And I think, like you, I'm worried my sofa might start colluding with my fridge as I reach for the Coke Zero they'll say, you should not be having Coke Zero for breakfast, although it's great.

I live in a 4G world, but I work in a world that's really characterized mainly by 2G and increasingly by 3G, but that's usually where donors or some governments have made the decision to invest in smart devices for the health workers. So when I was thinking about the way that mobile technology's three, four, and potentially 5G will impact on health care in sub-Saharan Africa, which is primarily where mPowering works through its partners, I was thinking of 9, 10, 11, 12 different ways, but I thought, perhaps a good way to capture it this afternoon is to just tell you a bit of a story about some work we're doing in Nigeria.

MPowering has been set up to really address, how can we end -- prevent all maternal and child deaths? Nearly 6 million children die before their fifth birthday every day in sub-Saharan Africa. More than 300,000 women are dying because of pregnancy and child birth or post-child birth related illnesses and complications. So we were invited by the minister of health in (inaudible) in Nigeria to develop a training program for their midwives and nurses in 20 facilities. So it's about 200 health workers. And the way mPowering works is we use open source content. We use open source learning management systems, and we use an open source delivery system to get training content to health workers.

So we adapted for existing films. We sliced them down into three minute pieces. We wove in narrative, quizzes and questionnaires. We organized it through Moodle and we delivered it through this open delivery system called OppiaMobile which is for Android. That launched about seven

weeks ago with the 200 health workers. I think within the next six months that program will probably have been adapted to reach up to 25,000 health workers. So for a very small investment, using the fact that these facilities already have a tablet to collect patient data, they're now using the same tablet to be able to view this training content.

But what's great for us is it's not just the health workers that are using it. They're beginning to show the videos to the women coming to the clinic. And the women coming to the clinic for their antenatal care visits, and we know it's really hard to get women to go through all four. They usually maybe go for one or two. They're watching the videos and they're saying, I want to come back and watch these videos and I'm going to bring my friends. So we're addressing, through this very simple, mobile-optimized program, refresher training, skills training, community health awareness, improving the number of antenatal care visits, and generally, we hope, through scale-up, through government ownership, for this very modest investment, it cost us about $65,000 to create this program, that we're going to reach thousands and thousands of health workers who themselves deliver services to millions of women. So I think that's a really nice example of what mobile can do. And, of course, there's all the side sharing of content. Once they've downloaded those videos, they can watch them offline. They can share them with Bluetooth. They can be put onto SD cards and put into the really basic Nokia phones. So they can be shared kind of incrementally but also exponentially.

And thinking about your description of the telemedicine, there's this amazing group of women doctors in Pakistan. And they did some research and realized that about 86 percent of women doctors who qualify don't actually practice for all kinds of reasons. So what they've done is they've created an organization called Doctors, and the doctor at home, she is abled by video link to be connected with the nurse or the community health workers in the clinic, and provide real time advice to the nurse with the patient. And there's something about having the doctor there, on video link, adds that kind of authority to the situation, but it also provides confidence to the nurse or the community health worker who, frankly, are often poorly trained, poorly paid, lack confidence, and so what mobile is doing, it's providing them with this access to really vital information that makes them feel more confident, able to do that job better, and builds that confidence in that community and the advice that they're able to share.

MR. WEST: Okay, great. Thank you. So I want to ask a question to everyone on the panel and get each of your views. Each of you have mentioned a number of obstacles, fee-for-service plans, the current payment models, lack of unified technical standards, organizational silos, so it's a two-part question. What do you view as the most important obstacles to moving to this world of connected medicine, and what are the best ways to overcome those obstacles? Jesse, we'll start with you.

DR. PINES: Sure. So, I think the biggest obstacle right now, that I see in emergency medicine, is the ability of different organizations to share information amongst each other, and particularly the interoperability of health information technology. So here at George Washington University, if someone goes to another emergency department and gets a very expensive workup for let's say chest pain or for another serious condition and walks out of that emergency department and then walks into my emergency department a few minutes later, I may not be able to see that that workup just happened and I may just repeat that whole workup all over again. Now, so, interoperability or the ability to share information between health care providers to make sure that everyone has seen all of the tests and treatments that have been provided beforehand, really can improve the efficiency of care and improve the quality of care.

The major barrier right now is that many organizations don't share that information. That's the, sort of, step one. And then the second issue is that technology itself does not really facilitate sharing information across platforms. So we're on one electronic medical record vendor platform, but another health system may be on another platform, and those two platforms may not talk to one another, even if those organizations are able and willing to share that information.

So one of the things that's actually just happened recently, in this area, to try to improve interoperability is sharing information into health information exchanges. In this area it's called CRISP, which is a central resource for health information from hospitals. Not everything is in there, but many hospitals provide information in D.C. and Maryland, so if a patient does come into my emergency department and has recently been seen in another emergency department, I can log in to that system and see that information. But, still, I think we're really just at the beginning of really making interoperability usable. There are still many, many barriers from an information sharing perspective and also a

technology perspective to make sure that systems can talk to one another.

MR. WEST: Okay. Rob, what do you see as the major obstacles and how can we overcome them?

MR. HAVASY: Well, as the interoperability guy, I'm out of ideas now. You just expressed them better than I did. I think I'm going to hone in on one of the words Dr. Pines used here, which is information. When we talk about infrastructure, and 5G is just another generation of infrastructure, right? It's the G. We talk about bandwidth, lower latency, and we're really talking about the movement of data. But what physicians want is information. Right? I'm honing in on that "I" word that you used. And that's where we have a barrier today. We can collect. We have been able to for a long time, to collect far more data about you than we can process into real information and use in decision support. Whether that's supporting decisions that you make about your own care or whether that's what we call clinical decision support, right, guiding some sort of clinical professional towards some sort of therapy or treatment or something else, and that's really where the barrier is today.

One of the things that I find interesting in any of these discussions is that there's always talk about the future, and there's talk about these wonderful things that are happening and can happen to a few people. You know, while Lesley mentioned that, you know, around the planet, the vast majority of people are still struggling with things we've been struggling with for 100 years. And in my line of work, chronic disease management really drives that. Right? It's the diabetes, it's the hypertension, it's the middle aged men like me who don't exercise enough who eat poorly, who are the next generation of high cost patients in the system and I don't need a lot of data to change that. What I need is some information delivered at the right moment to affect my behavior and head this problem off. And to do that, the simplest case, right, most people on this planet, we can save probably the most costs across the most cultures, by getting people to exercise a little more, to eat a little bit better, and sleep a little more regularly, none of which requires, you know, fat mega pipes worth of bandwidth. We need some weight from a scale. We need some, maybe, blood glucose readings from a finger. We need some blood pressure, which is a few kilobits of data. Right? It's a date stamp and a value and a unit and some other metadata around it. But we need some system that can take all of that in, and that becomes a big data

problem. We need a system that can take all of that in, look longitudinally at a person and make personalized recommendations to affect your behavior at the time when those recommendations make sense. Telling me when I'm about to crawl into bed at night that I should eat a salad tomorrow doesn't help. Telling me when I walk into the door at McDonald's that I should eat a salad is very helpful, and very likely to affect my behavior.

So that's the barrier I see now. We both lack the capability to aggregate because of interoperability all of the sort of longitudinal, latitudinal, the wide variety of data we need to make decisions at the right moment in the right context. And even where we get into diseases that we've dealt with for a long time, we lack agreed upon algorithms, agreed upon thresholds, for when is somebody's blood pressure high enough to intervene, when is it high enough to prescribe this versus this? At what point for a given heart failure patient do we say, you've gained too much weight in too short a period of time, we need to adjust your diuretic or call an ambulance or do something. Those are left to individual professionals today and I think maybe I'll get some agreement, maybe not, most of those professionals feel overwhelmed by the data they already have, never mind data from millions of more people and tens of thousands of more data points from those patients. So we need to automate this capture, automate these rules, and that's really the barrier that we're facing right now.

MR. WEST: Okay. Lesley Anne, we'd like to get your view on that. Then we'll open the floor to questions from the audience.

MS. LONG: So there are many barriers that we face working in the sub-Saharan Africa, but I'll just focus very briefly on three. One is affordability, and not just the device, it's the data plan, it's government taxes, it's the cost of charging. The second is consumer barriers, so literacy and digital literacy, and lack of Internet awareness. And then the third, which is really critical given the role of women in decision making about health of families, is the gender gap in phone ownership. And it's between 30 to 40 percent depending on where you look in sub-Saharan Africa, the Middle East, and North Africa. So I think those are issues that are not so much linked to the technology itself, but to the kind of ecosystem around the technology.

MR. WEST: Okay, great. Let's open the floor to questions from the audience. So if you

have a question, raise your hand and give us your name and organization. The gentleman right here. There's a microphone that can come over to you.

MR. GIFFIN: Thank you. It's a great session, great panel. Appreciate it. I'm Bob Griffin from Medtronic and the third leading cause of death in the U.S. is medical error. How can the internet of things address that critical problem?

DR. PINES: If I could address that. So, one of the key problems that we see with today's electronic health records is that – so the government has given a lot of money to hospitals and health systems to buy electronic health records, but a lot of those health records are not particularly usable in a lot of instances at the point of care. To give you an example, a patient may come into my emergency department, let's say it's a complex patient who's had a lot of prior medical care and they give their information to me on a little device that I plug into the computer that brings up a tremendous amount of information. To give you a clinical example, let's say it's a patient who has a spine tumor who's had 12 different MRIs. You know, and from my question is in an emergency position, I want to know, you know, what was the most recent MRI? What's the plan of care? And what medicines is the patient on? And a lot of times the technology doesn't necessarily facilitate getting to that information in a usable way.

And the other example I like to give is, so, when my youngest son was two years old he was able to pick up an iPad and, you know, get around the apps. You know, I think what we need to do is really focus on usability for physicians and for providers at the point of care that can take a lot of the technology that we have and really make it more usable. And I think that by making technology more usable and really sort of reducing the complexity at the point of care, and really focusing providers on the most salient information to make a decision, I think that that can really go a long way to reduce medical errors.

MR. HAVASY: I think I would say the first step would be to not make the problem worse. Right? And I'll give you again an example. In an IoT world where everything is connected to everything, whether you're a device manufacturer or a consumer goods manufacturer, whatever you think you are, you're making a product that's going to be used for many unintended things. Today, for example, we send patients home with heart failure. They have scales. And once in a while a nurse gets a reading that

comes up on the screen that should trigger an action. And usually that action is a phone call. And I worked in a clinic for years and I sat down and I asked why, and they said, well, I don't really know who's standing on the scale. That's a simple problem. Right?

My boss at my last job, got relatively famous in the tech geek world for this. I mean, he had one of the first Withings connected scales, a prototype. And he called them up and was very -- you know, this was a public exchange saying, you're sending phantom weights. Right? You're sending a weight at, like 10:30 in the morning and I'm in my office, so something's wrong with your system. It turned out it was the cleaning woman in his house who would stand on a scale every day when she was cleaning the bathroom. Right? The most simplest piece of any sort of data integrity plan is authentication. Who is this packet of data giving me information about? We haven't even solved that yet. There's not a scale on the market today that can read a footprint and tell me who's standing on it. There's not a blood glucose meter today that can prove that it's not a teenager who gives the thing to their friend because they don't want their parents to yell at them because they know they ate stuff they shouldn't have for lunch.

We have to overcome those basic barriers before we really start connecting a lot of devices so I think that's it. Let's not make the problem worse. Let's realize we're all building things for unintended uses and try and make them as precise and accurate and, again, as robust as possible.

MR. WEST: Other questions? You in the back.

MS. DROBAC: My name is (inaudible).

MR. WEST: Actually, there's a microphone coming up right behind you.

MS. DROBAC: My name is Krista Drobac. I'm with the Alliance for Connected Care. Can you talk about how reimbursement impacts the use of these technologies in health care, or lack thereof, I might say?

DR. PINES: Sure, I can take that on. So the way that health care traditionally has been reimbursed is through a fee for service mechanism where the doctor delivers a service and that service is paid for by the insurer. You know, some of that goes to the provider, and some of that goes to, let's say, the facility where they're working. So in that current environment, there's really very little incentive to

innovate because buying new technology, unless it allows you to see more patients, really doesn't impact your bottom line. Technology, however, in a new world of the Affordable Care Act where organizations are getting bundled payments, capitated payments, other types of alternative payment models, where there'll be more incentive to become efficient, I think organizations are going to be a lot more willing to make the kinds of investments they need to make in order to make things more efficient at the bedside.

MR. HAVASY: I think -- oh, please.

MS. LONG: I've just got a slightly different taken on that from the perspective where we're working that it's very difficult to pay health workers, even where governments want to, and one of the issues in West Africa during the Ebola crisis was it was very difficult to get payments to health workers who were responding to the emergency. So mobile money payments in sub-Sahara Africa makes up, like, 53 percent of mobile money transactions. Mobiles enable payments to be made in a way that overcomes things with inherent landscape difficulties, but also air time and other incentives that can be delivered by mobile encourage health workers to really engage with the technology and use it in their practice.

MR. HAVASY: Yeah, I was actually going to say, from a global perspective, part of the problem is, we'd like to distribute care. And we'd like to get out of the model where there's a doctor in a big hospital with a lot of expensive infrastructure and treat things where we're able to farther out in the communities. And that involves being able to enlist non-traditional health care workers, community health care workers, lots of people, pharmacists, into the system and making sure that they're both connected to send data, but also able to be part of the car team and that reimbursement. Specifically, in the U.S., one of the big things holding us back right now is still the CMS barrier that telemedicine is only for those rurally designated places, when we know for a fact there are a number of use cases like psychology visits, right, where deep in cities there are strong biases against mental health care and people don't go because they know their neighbors will see them going in or out of that building and they'll know what it's for. And so we should be doing telemedicine block by block in some cases, but we can only do it in large rural areas. And there's lots of others, but I'm sure they're discussed in other places.

MR. WEST: Right here on the aisle.

MR. TAVARES: Ricardo Tavares from TechPolis on San Diego, California. An irony is that we're discussing the U.S. reality and the sub-Saharan reality. And it looks to me that in the U.S., the issues raised as the most important ones are IT issues, much more than wireless interface for wireless technology. But in Africa we need 5G in Africa than in the U.S., actually, because you need remote surgery, so you need the most advanced technology in the poorest place for training and for execution of health care because video is very important where you have illiteracy. So it looks like this panel lives with a great contradiction, so I'd like insights on that.

MR. WEST: Lesley Anne, do you want to take that?

MS. LONG: Oh, gosh. I'm not quite sure how to answer that, really, thinking about 5G in sub-Saharan Africa, but the points you're making about the need for it, and the need to be able to reach remote areas and very dispersed populations is what's really driving the thinking behind donor coordination and government ownership and scale up because the approach in sub-Saharan Africa and south Asia has been really characterized by pilotitis or these very small projects that never really change behavior or go to scale. So I don't think it's so much about, is it 5G or 4G, but it's about, how can we create scalable programs and build digital infrastructure that will then take the opportunities of primary health care out to that last model, first model, depending on where you sit.

And I think, you know, there's a lot of funding that goes into the tertiary care level and is building hospitals that have that kind of interoperability in sharing information and so on. But suddenly, and I think the Ebola crisis kind of led this change, there's a real light has been shown on the role of community health workers that volunteer unpaid, and realizing that most people in these countries are never going to see a high level cardiac physician or surgeon. They're going to be talking to a faith-based organization community health worker, an NGO community health worker, and so on. So it's about how do we get crisp, clean information out to them? How do we focus more on health promotion?

You know, we're so far away from the kind of the 5G world that we've been hearing about today. That's not to say that there aren't ways that we can start to tackle those real issues. And as I said, we focus on maternal and child heath, but the non-communicable disease issue is becoming huge in sub-Saharan Africa. It's not just a western problem. I'm not sure if I answered your question.

MR. WEST: Okay. The gentleman over here.

QUESTIONER: My name is (inaudible) from Cisco Systems, and I was wondering if you think that we may have a tension between the way we develop technology and the way we regulate medical devices when it comes to updating technology for being exposed to a dynamic threat environment. In other words, you have the device that gets labeled as a medical device, and anything that is built for a regulated environment is built to be approved and used in a certain way. And that oftentimes makes it difficult to make that device capable of being updated, and yet you're going to connect these devices up and put them into a dynamic threat environment where any other technology that's in that kind of environment to operate well needs to be capable of being updated to handle all the threats that are being thrown at it.

DR. PINES: I think it was exactly your ultrasound example. Right? I'm not touching that with a thousand-foot pole in Washington, D.C. on behalf of my members. It's a well-known problem, right? There's a lot of Windows XP still in hospitals. I guarantee you've run into a Windows XP workstation in the last six months. Right? For that very reason, because it's attached to a medical device and it can't be updated. Yeah, and in an internetworked world, where information can move faster and therefore threats can propagate faster, the ability to react to that is going to be critical.

So I think, as we mentioned earlier, right, this is a combination of technological innovation. It's a combination of regulatory innovation. When everything's a medical device, nothing's a medical device anymore. Right? And that's something that I know, you know, our friends here in Washington and regulatory bodies all around the -- I was just in China and they're just as concerned with privacy and security of medical data as any other country. And I said, I can close my eyes and this argument plays out and I've heard it in Sweden. I've heard it in Denmark. I've heard it in Washington, D.C. I've heard it in China. It's an issue. And it's definitely both a regulatory and a legislative and a technology issue, and it's also an issue with the way we innovate. Right?

People are quite happy to use the, oh, the FDA won't let me excuse rather than building a connected system that they would then have to build a system to manage. Right? So, and oftentimes -- I'm a health IT guy. Right? I can't tell you the number of times in my early career I told doctors, nope,

can't do that. It's HIPAA, when it had nothing to do with HIPAA, but it's a great way to get people off my back. And, you know, I think some manufacturers -- doctors don't read HIPAA. I think some manufacturers use that as an excuse today. To say, oh, the FDA wouldn't let me build an update system for this. Well, of course they will. It's just hard, and they want you to do it thoughtfully and you don't want to spend the money on it, but yeah, it's something we're going to have to address for sure.

MR. WEST: Yes, near the back.

MR. GRAHAM: Thank you very much. My name is John Graham from the Health Technology Forum D.C., and I write a column at Forbes. I think Mr. Havasy might have answered the question, but the question's for Dr. Pines. You gave a vignette of a patient showing up at the emergency department that you know who very recently might have been at another emergency department at another health system and you don't have access to the information. When one talks to doctors one gets two other complaints with that that the non-technology one is, to be blunt, I don't trust other doctors. I don't know the other doctors. And secondly the question of legal liability, relying on information that I had no control over generating and I wonder if you could comment further on that. Thank you.

DR. PINES: Sure. Well, you know, not trusting other physicians and what they've done is not really the technological question. I think as we move on and especially the new generation physicians who are really trained on this new technology I think are going to get to know which information can be trusted and which information can't be trusted. There may be some things like an electrocardiogram that may be important when a patient comes in that has chest pain. I want to know what the electrocardiogram looks like last week. I may be able to log in to that system and see the electrocardiogram. I may be able to call another emergency department and have them use an older technology, a fax machine to fax it over, but regardless, I think the physician really needs to make the judgement at the point of car whether to trust that information. But I think as technology evolves and hopefully gets better and more useable, we'll be able to trust the information more.

MR. WEST: Let me ask a question of the panel. Imagine five years from now and we're having this discussion, which of the problems that we're talking about now do you think will be solved, and which ones do you think we'll still be talking about?

MR. HAVASY: It's always safe in Washington, D.C. to say we'll be still discussing the regulatory issues, and that will evolve slowly, I think. So on both the reimbursement and importantly the question we just had about, will the regulations keep up with the fact that lots of things are now connected in systems. It will be something we'll still be talking about.

DR. PINES: Yeah, I'd agree with that. I think regulation is going to move a lot slower than technology and innovation in technology. I'm hoping that in five years from now that a lot of the issues around interoperability that we're facing now and usability by providers at the point of care will be solved, you know, now that businesses do have -- there is more economic incentive to actually solve those problems. But I think, you know, regulation has to move at the speed of regulation, unfortunately.

MS. LONG: In five years with smartphone ownership, better connectivity, better data sharing, which will drive decision making at some district, regional, and national levels so that will improve decisions that are made about patient care. It will also enable citizens to hold their governments more accountable for the care that they get. I really hope we're not still talking about how difficult it is to collaborate and coordinate, but I have a feeling we may not quite be there where we're all fully interoperably talking to each other.

MR. WEST: The gentleman right here.

MR. RABINOWITZ: Thank you. I'm Dave Rabinowitz. I'm retired. And I have another regulation issue. Right now in the U.S., medical professionals in general are licensed on a state level and can only practice in the states that they're licensed in. I wonder if any action is being taken to sort of change that so that people can do telemedicine efficiently and effectively?

DR. PINES: Sure, from a regulatory perspective I'm not exactly sure what sort of movements are going on right now, but I can tell you, practically, from a telemedicine perspective that, for example, the University of Mississippi is only patients who are seen within Mississippi by physicians who are actually licensed within Mississippi, so the result is a lot of this innovation, particularly in telemedicine, is happening on a regional basis, which is not necessarily a bad thing because, for example, let's say a rural emergency department may want to send a patient to the main hospital in Jackson, Mississippi. They, you know, having a direct connection with the hospital that may take them because they're close

and within the same region, it may actually make sense. But more broadly, I totally agree, especially for, as we start thinking about consultations that may be helpful overseas, across borders in different states. I don't see any other clinical reasons why that shouldn't happen. It's just a regulatory issue.

MR. HAVASY: Procedurally, the way most people are working with it right now is by making that there's a clinician on both ends of the line. Right? The doctors are both restricted by the scope of their license geographically, but they are able to consult any resources they wish, and so a doctor-to-doctor consult can happen across any borders. And that's really how most of the large telemedicine programs are doing it now. We ran one when I was at Partners Health Care and that was exactly what it was. There was always a doctor on the other end to whom the decisions were given who could then either say yes or no, or give it to the patients. And a lot of that is happening. That's why you also see telemedicine happening in private systems, right, in places where – I'm not exactly sure how to say this. You see large companies who overcome large geographic areas who hire physicians to privately care for their workers and where licensing sort of becomes a little less of an issue. You see that particularly in Middle East and Gulf states where there's large oil fields and places like that. We see physicians off the cost of Louisiana where those oil rigs are. You know, you can't really tell exactly who's in Texas, who's in Louisiana, but they're being cared for by a company physician under a company plan and things like that. But generally the physician-to-physician thing gets around most of it.

MR. WEST: Other questions? The gentleman right here.

MR. DAN: So I'm Dan with Medtronic, as well. And thank you for your remarks. I guess these questions weren't geared towards you, Rob, and you already touched on it regarding China and such, but in an increasingly IoT world that is more connected, can we expect regulatory barriers towards that connectivity? And, you know, how can we address those obstacles? Or are they obstacles at all?

MR. HAVASY: Yeah. It's interesting. I think regulatory is a big field when you start getting into -- or a big word when you start getting into international concerns. Right? So some regulators in countries are trying very hard to harmonize, collaborate, and make things work better. The FDA and its counterparts in device regulations seem to work surprisingly well. Right? And are very well connected and seem to do a good job. But there are other regulations that affect an IOT world, right?

There are trade regulations. There are privacy regulations, which in the U.S. is really the domain of the FTC and states. And so it's hard to put a blanket statement out to say, will we see more? Sure. I think we'll see better harmonization between the medical device regulators, but we'll probably see lots of concern by privacy and other regulators.

So I think the focus, or the area that most people are concerned with, the regulatory focus is going to shift, so some will get better, some will get worse, and we'll just work through the problems as they come. I don't know if anyone else has any specialty opinions for anything else, and some of those countries that are desperately willing to push regulatory barriers out of the way to gain access to things they need.

MS. LONG: Well, so, not to be superficial about this, but I've seen the way medical students Nepal and Malawi are now using Facebook to create user groups where they can share information with each other, get advice. They don't have access to textbooks. They don't necessarily have access to the kind of content that we have on our open source platform, so they're just sharing information with each other. We're doing some research. I'm on an advisory board for some research currently in Ghana and Malawi to look at how nurses and midwives and using social media to connect with each other both to kind of provide themselves with a network because they all work in very isolated ways, but actually to share information.

So it sits well under the radar of the kind of regulatory frameworks that you were describing. But people are finding a way to get around it, and I think we're talking as if things are going to be as they are now, but if you look at the way Uber and Airbnb and all these other kind of very disruptive models of business and peer-to-peer connections are being made, I wonder if, quietly, under the radar, people are going to be creating different ways, particularly as we move -- I think it was that you were saying earlier, to sort of looking more at, you know, home care and peer care and family care, which really are the cornerstone of much of the care that happens here in the U.S., and certainly in the U.K., the NHS would just crash if we didn't have home carers.

And so I think there's going to be much more than sort of just patient awareness and patient accountability movements. There's going to be people taking their own care into their own hands,

and using ways that we're not necessarily thinking about today.

MR. WEST: And if I could follow up on that, I mean, we've talked about many of the things that slow innovation, you know, the regulatory process and interoperability and so on, but I wonder, on the other hand, if consumer demand is actually going to speed up change, like especially young people are growing up in the technology world and the social media world, in a crowd-sourcing world. It seems to me, as they're moving to the workforce, they're going to be demanding things from our health care providers and our reimbursement providers. Maybe they will be a way to drive change in the system.

MR. HAVASY: I think that's right, and I'd be remiss if I didn't say this. Right? One of the first quotes I ever heard at a health care conference, connected health conference years ago, was, patients are unencumbered by the regulatory process. And so I think Lesley's actually right, and you're very right with consumers. Right? People are now demanding that their medical devices work like their -- with interfaces as good as their phones, and why can't I go to the hospital and navigate this system as well as I can order a burrito from, you know, Chipotle online? And I think that consumer demand, and with the distribution of data, the distribution of information, the distribution of knowledge through education, people will be doing much of what we consider health care right now on their own, unencumbered by the regulatory process.

DR. PINES: I think a great example, a clinical example, of patients being unencumbered is when people come into the emergency department and have what's called a cellulitis, which is an infection on their leg. So we were sort of battling for a long time to try to get -- be able to take a picture with some sort of a connected phone that was HIPAA compliant and upload that into the electronic health record, but actually an easier way of managing that, what we used to do was draw a line around it and then if it goes outside the line you come back, or if it's getting better than you can stay home. What we do now is actually ask the patient to take a picture with their own iPhone because, you know, it's the patient's own leg. They can take a picture of whatever they want, and actually to take subsequent pictures and actually show the physician when they come in so the patient is actually the holder of the information. So there are many ways that providers are trying to -- and patients are trying to get around a lot of these

issues.

MR. WEST: Any other questions? Yeah, right there on the aisle.

MR. WELCH: I'm Thomas Welch. I used to work at the FDA. There's been a lot of debate, recently, about the national patient identifier, which was prohibited by Congress in 2000, and also the unique device indicator. And I wondered whether the panel might like to address that.

MR. WEST: I guess the answer is no.

DR. PINES: Well, I mean, I think one of those is less controversial than the other one, right? The unique device identifier, that's a technical problem and it almost solves itself I would say, in the world of Internetwork devices, because we had to figure out the IP address, right? And go to IPV6 just to have enough network addresses for things. You know, a MAC address scheme and or some other connected device scheme is going to have to evolve, as well. So once everything is connected, in order -- because of the way networks work, they will have to have a unique ID and that'll solve the problem. Right? Again, we were worried about unique medical device identifiers and everything is going to need a unique identifier, and that problem will work itself out.

The unique patient ID is very much a U.S. issue. And, you know, that is what it is, but it doesn't encumber many of the other countries that I work with and places where I work that are building national scale systems much more quickly and much more cost-effectively because they have a national patient identifier. And I'm not advocating one way or the other, for sure, but I can tell you that in, you know, Scandinavian countries where there's a little more trust and faith in government, and a little more accountability of the government, it's not holding them back and, in fact, I think it's helping them move forward very quickly.

MR. WEST: In fact, when I look around the world, some of the countries that have made the greatest progress on health innovation and integration of data have a national identifier of some sort.

DR. PINES: And as a physician from a clinical perspective, it makes all the sense in the world.

MR. WEST: Okay. I want to thank Jesse, Rob, and Lesley-Anne for sharing your views. And thank you very much for joining us here today.

CERTIFICATE OF NOTARY PUBLIC

I, Carleton J. Anderson, III do hereby certify that the forgoing electronic file when originally transmitted was reduced to text at my direction; that said transcript is a true record of the proceedings therein referenced; that I am neither counsel for, related to, nor employed by any of the parties to the action in which these proceedings were taken; and, furthermore, that I am neither a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

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Expires: November 30, 2016