Remarks During a Panel Discussion at the White House Frontiers Conference at Carnegie Mellon University in Pittsburgh, Pennsylvania

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Ariadne Labs Executive Director Atul Gawande. Well, they tell me, Mr. President, to treat you like any other panel member.

The President. That's exactly right. [*Laughter*]

Dr. Gawande. I'm, like, right, okay. We'll try it, right? So I'm Atul Gawande. I'm a surgeon, I'm a public health researcher, and a staff writer at the New Yorker. I'm the executive director of Ariadne Labs, a health systems innovation center at the Brigham and Women's Hospital and Harvard Chan School of Public Health. I'd like to welcome you. I'm the moderator today for this panel. To my left is a lawyer. [*Laughter*]

I want to start, actually—you challenged us, in your talk and in what you wrote in Wired, to think bigger. So I want to start with each of you, and I'm going to ask you what you think the big opportunity is. And so first is Kaf Dzirasa, M.D., Ph.D., extraordinary—he's a rare bird. He is a psychiatrist, he's a neuroscientist, and he's trained as an engineer as well. He's on the faculty at Duke, and I want you to tell us what you think the big opportunity is for the future.

Duke University Assistant Professor of Psychiatry and Behavioral Sciences Kafui Dzirasa. Yes, I think the big opportunity is for us to begin to think of the brain as an engineered system. So I will give an example of what I mean. Let me—if I look out into the crowd and I say, anyone who's excited of voting in the next few weeks, put your hands up. So let me—there we go.

The President. Come on, everybody. [*Laughter*] Let's get something to vote for.

Dr. Dzirasa. That's right. [*Laughter*] So let me talk about what happened in that.

[*At this point, Dr. Dzirasa made brief remarks, concluding as follows.*]

So as we begin to think about these illnesses, whether it's Alzheimer's or autism, the challenge is, we're talking about a system that evolves so quickly and information is processed in multiple areas to generate behavior. The first time I heard someone describe the brain that way, I was a junior in college at the University of Maryland, Baltimore County. And we had—invited a speaker, and he was one of my childhood heroes, he was a neurosurgeon. He will go unnamed. [*Laughter*]

The President. I know who you're talking—really good surgeon. [*Laughter*]

[*Dr. Dzirasa made additional remarks, concluding as follows.*]

Dr. Dzirasa. And so I decided to pursue an interest in psychiatry, and as I sat there with families who were experiencing some of the same challenges that my family was experiencing, I realized that we just needed a breakthrough in how we think about and how we treat mental illness. That big breakthrough, I think, for me, is going to come through this brain initiative. The—it's the opportunity for engineers to engage in how we think about mental illness, to map out how the brain is processing information in real time, the activity of all of these cells. The promise is that one day we'll have a new form of treatment that becomes—that comes out of reading information from the brain, generating neuroprosthetics, in the same way that individuals are now moving their hands by thinking about it. Can we augment brain function in a way that allows those with mental illness to come out of the shadows and to continue to contribute to this great American system? So——

The President. That's great.

Dr. Gawande. Thank you for that. I'd like to introduce Riccardo Sabatini, who is a Silicon Valley quantum physicist who has turned his training to using machine learning around genomics and health at Human Longevity, Incorporated. I want you to tell us what you think the big opportunity is.

Human Longevity, Inc., Research Scientist Riccardo Sabatini. Yes, so I think one of the most exciting thing that happened in last 20 years is that we digitalized life. We took—we opened up biology to computation. And that happened in the middle of my studies. I'm a quantum physicist. I was working on nanotech for the longest time. And I realized all of a sudden that I could move my expertise, my numerical modeling, on life, on biology, on genomics. Near 2000, as a human species, we started to read our own code. This is a camera moment in science. And you, Mr. President, gave a Medal of Science to the very two people that helped, Francis Collins and Craig Venter. This allowed to take completely different techniques to study how our biology works. It's the hardest problem that we will ever face and that we ever encountered. But we are learning. We are taking AI, we are taking machine learning, quantum mechanics, and we are virtualizing parts of our biology to understand how a specific molecule, a drug, works on just your body, how another molecule can hit your specific cancer, extracting the genome of your cancer. We are learning how to read the weak signals, very, very early stage, to understand if we can predict some pathology that is growing and intervene fast.

And this is a fascinating field, because it's the very field where numerical computation is saving life every day. It's the moment where we can predict and act at the same time. And this—when I saw this opportunity, I think is really—last century was about the atom, the next century is going about—is going to be about biology. Digitalizing allowed me to work in this field. And what I'm excited about is keeping going, virtualizing the human being better and better, understanding better and better, and taking this knowledge, opening up for all the community and all over the world, scaling down the prices, as we did with the genome sequencing, allowing more knowledge, and taking on board linguistics, physicians, physicists, mathematicians. This is the most important problem we have as a species, and we're going to crack it.

The President. That's great.

Dr. Gawande. Fantastic.

Mr. Sabatini. Thank you.

Dr. Gawande. I'd like to introduce Zoë Keating, who is not a scientist.

Patient advocate Zoë Keating. No.

Dr. Gawande. Zoë is, first of all, an amazing San Francisco cellist and composer. She's someone who's had number-one classical recordings. At the same time, she's someone who had a journey with the health care system with her husband, who had a devastating cancer, and has been thinking a lot, as a patient advocate, about what that experience has meant. And so I wanted to ask you, from what you went through, what is the opportunity—what is the big opportunity that you see for the future?

Ms. Keating. Well, I'll tell you the story, but I'll tell you the summary first. And in a nutshell, it's, like, how can we make lives better for patients? How can we ease suffering? How can we end the suffering? That's what it's about. And our story was that my husband, in 2014, was diagnosed with stage-4 lung cancer. And it took 5 months and three different doctors to find it.

[*Ms. Keating continued her remarks, concluding as follows.*]

But if I could just say something else about patients, it's that during our journey, we never had the sense that there was one person keeping track of all the data, that if there was data—and I tried really hard to digitize all my husband's and get it to where it needed to go—how could I—where do I put it? Who do I give it to? Who do I trust? And in this future scenario, I can imagine where I would go into the doctor's office and they would know everything about me. And I would imagine there would be some AI that had done some, like, analysis on my data to, like, pop some things up for the doctor. But still there's a human. No matter how much technology you have, there's a human at the end of it to help a patient through their journey and to keep track of it all and to think about, like, their caregivers, their life, everything. It's all a big package. It's not just patients or the users. So——

Precision Medicine/Cancer Research/Health Care Reform

Dr. Gawande. If I were to tie together—it sounds incredibly disparate, but the story that is coming out from everything you're saying—I'm going to take what you said, Riccardo, about the last century, one step farther. The last century was the century of the molecule. We were trying to—the power of reductionism—boil it down to the most small possible part: the atom, the gene, the neuron. Give me the drug, the device, the superspecialist. And that provided enormous good.

But in this century, what they're all describing is, now we're trying to figure out how do they all fit together. How do the neurons fit together to create the kinds of behaviors that you're to solve in mental illness? How do they fit—the genes network can fit together in epigenetics to account for the health and disease of the future that we all may face? And Zoë is describing a superhighway of information and science that is plugging into the patient through a bike path called the doctor's office.

And trying to make a system that can actually bring it all together really is a completely different kind of science from the last century. It's surrounding these problems. Who—with people come from incredibly different perspectives. Now, Kaf, you're all of them in one. We normally might bring a psychiatrist and an engineer and a neuroscientist together. [*Laughter*] And maybe—but it really isn't the age of the hero scientist anymore.

And so I want to ask you: What do we have to reinvent about the way we do science to make all of this possible, genuinely, scientifically, with real innovation?

The President. Well, first of all, I want to thank the panelists, especially Zoë's, because of the story you're telling. Although, Kaf, it sounds like you were also inspired in part because of very personal experiences. At the end of the day, they're people who count and who we want to enhance their lives. And so being able to bring it down from 40,000 feet down to what you're experiencing while you're waiting on the phone to help somebody you love so deeply, I think, is a good reminder of why we do this.

As you say, Atul, what we've been calling this Precision Medicine Initiative is really: how do we stitch together systems that can maximize the potential of the research that a Kaf or a Riccardo are doing and end up with Zoë's husband getting better treatment? And a couple of things that we've tried to do that I think are helping.

Number one, is to make sure that the data that is being generated by genomic sequencing, as its price comes down, is better integrated and better shared, which is going to require us rethinking research models.

In the past, what's happened is, is that if a researcher wants to look into cancer, they get some samples from an arrangement, maybe, with a teaching university close by, and they're plugging away, somewhat in isolation. And what we now have is the opportunity to—as we discover, particularly, that what we think—used to think of as cancer might turn out to be 20

different types of cancer—we're now in a position where we can actually generate a huge database. And as a consequence, not only identify some of the specific features of that cancer, not only identify what kinds of genetic variants might make you more predisposed to that cancer, but we're also breaking down those silos in such a way where we can accelerate research. Not everybody has to have one small sample. Now, potentially, we've got a million people who are contributing to a database that somebody like a Kaf or a Riccardo can work off of.

And what that allows us to do in developing cures is, over time, as Riccardo said, to identify, first of all, do you have a predisposition towards a particular disease, and can we intervene more quickly before you develop it? Second, can we develop better cures, interventions, as Kaf said. But third, are we also in a position to get this information to patients sooner to empower them so that they can be in charge of their own health? Because part of our goal here is to shift from what is really a disease care system to an actual health care system.

So that's one big chunk of the initiative. And just to be more specific, part of what we're doing with the Precision Medicine Initiative is to get a bunch of collaborators to start digitalizing, pooling, and sharing their data. Within the VA, we've got half a million folks who sign up and are contributing their genetic samples.

We now have more and more institutions that are coming together. And as a consequence, our hope is, is that if you are a cancer researcher in any particular cancer, you're going to have a big data set that you can start working off of. And by the way, we're being very intentional about making sure that we're reaching out to communities that sometimes are forgotten—whether it's African American communities, women—so that we can really pinpoint what works for who.

Dr. Gawande. Can I try pushing on some of that?

The President. Just one last thing——

Dr. Gawande. All right.

The President. ——I want to say, though, because it goes to what Zoë said about systems. Even as we're doing all this cool stuff to come up with greater cures, what we're also having to do is try to figure out what are the incentives—the perverse incentives—that are set up in the health care system that prevent it from reaching a patient earlier. So I'll just give two quick examples.

The first is what you were talking about in terms of your individual patient data. We're trying to promote the notion, number one, that this data belongs to you, the patient, as opposed to the institution that is treating you. Because once you understand that it's yours and you have agency in this process, it means that as you're looking for different treatment options, as you're consulting with different doctors, you're able to be a more effective advocate without having to constantly fill out paperwork and so forth. So that's important.

And one of the things that we've discovered is, is that even the software where your individual patient data is stored, because it's a commercial enterprise oftentimes, is non—it's not interoperable, it's not sharable in an easy form. And so we've actually been trying to get some of the major providers to start working together so that it makes it easier for somebody like Zoë, if she's moving from system to system.

The second this is—and, Atul, you've written about this—to the extent that we are reimbursing doctors and hospitals and other providers based on outcomes rather than discrete services that are being provided, we can start incentivizing the kind of holistic system thinking in health care—rather than you come in, you get a test, then you've got to go to another place to do this, and then you've got to go to another thing to do that, and then maybe the surgeon hasn't talked—spoken to the primary care physician and you don't have the outpatient coordination that would make sure that you're not coming back into the hospital.

And one of the things that we've been trying to do with the Affordable Care Act, Obamacare, that hasn't gotten as much attention as just providing people insurance is to make sure that we're pushing, we're nudging the system more and more to do that.

So that was a long answer—[*laughter*]—but it's a big topic. The good news is, is that I think we've identified the pathways where we can start making real progress.

Cybersecurity/Privacy of Health Records

Dr. Gawande. I want to live in your world. I want to live in the world where——

The President. I'm only going to be here for 4 more months. So—[*laughter*]. Three and a half.

Dr. Gawande. ——in a world where I get to own—I have my genomic information, I have my medical records, I have—everything about me belongs to me, and it's easy to access, and I can bring it to the doctors that I need it to get to.

The second level, you announced an initiative today, the All of Us Research Initiative, where you would be able to, A, get that data and then share it with researchers so that they can learn more from you, trusting that that data is safe. I had worked in the Clinton administration, and I got notified that my background records, my clearance records were hacked, right? If you can hack all of my background records now, suppose you can hack my genetic information, all of my electronic records, my mental health information and more. And being able to trust—so we're in this world where the system—having system science only works if it's transparent and information is widely available. And yet we're in deep fear about what happens with information and making it widely available.

I'd love to hear what you have to think about that. And I'm going to jump to Riccardo and think in a variety of worlds that you've been in, how do we trust that this research is in the right hands?

The President. I'll be very quick on this. This is going to be a ongoing problem that we have across disciplines. It's not just in health care. As Riccardo said, our lives become digitalized. It means that how we provide security for that information—whether it's financial, health, you name it—is going to be challenging.

Now, the good news is that we are making real progress in understanding the architecture that we have to build across sectors, private and public, in order for—to make this work. In fact, our outstanding president of Pitt has been working with our cybersecurity committee to really crack some of these problems. And we've put some guidelines for the private sector and providers to assure best practices on cybersecurity. But it is going to be something that will be increasingly challenging.

Here's the only thing I would say though. The opportunities to hack your information will be just as great or greater in a poorly integrated, broken-down health care system as it will be in a highly integrated, effective health care system. So I think it's important for us not to overstate the dangers of—the very real dangers of cybersecurity and ensuring the privacy of our health records. We don't want to so overstate it that that ends up becoming a significant impediment to us making the system work better. All right?

Dr. Gawande. Are there technological solutions, Riccardo, to this problem of privacy?

Mr. Sabatini. Yes. So we started to—one of the questions we started about a year ago is exactly, can we identify someone from his own genome? So we started to build a class of algorithm to predict and extract information from your genes, some common traits: your height,

your eye color, your skin color, the structure of your face. Every single model has its own limitations, sometimes for the lack of data, sometimes because the data is not only in your genes.

But what we learned is that using them collectively, we can go a long way to really identify a person from his genome. So this is something that we have to face, is a digital asset that is one of the most complicated ways to be handled. We want to publish it, we want to share it, but it's still something—there is some concern about identity and security.

[*Mr. Sabatini continued his remarks, concluding as follows.*]

So we need to remove a fear and allow people to engage more in their own health and in their own data. There are technologies to keep them safe and to keep them secure. The one thing that is very important is overcoming this barrier of knowing yourself, which I think is the most—is the hardest hurdle to scale up the databases. Security—there are the best people working on it across the border, both in the scientific domain and governmental domain. But this should not be a limitation to access your own information and feel comfortable to own your own information and feel comfortable to share it with governmental infrastructure and with companies that are implement the security right.

Technological Innovation/Health Care Reform/Accuracy of Online Information/Climate Change

Dr. Gawande. At the center of this, I think, is a question about optimism and pessimism about whether we can solve these problems. And I think I would like to ask a question of all of you about our values, the scientific values of a scientific orientation. And behind that orientation is a fundamental belief: We have an allegiance to the idea that the way you discover, the way you explain nature, the way you describe the world, the way you intervene in the world is through factual observation and through testing. And there's a certain sense of—it's an orientation, it's a way of being that we're describing. It's an openness, it's an inquisitiveness, it's curiosity. It's a willingness to acknowledge good arguments and recognize ones that are bad and that haven't tested out.

And that orientation feels like, at times—on the one hand, it's been the most powerful, collective enterprise in human history, the scientific community. And at other times, it feels embattled. And I wonder why. Why does it seem under fire when we're—you mentioned, President Obama, that in certain areas like climate change or around nutrition or around other parts of medical care, we have enormously fraught debates? And it feels at this moment almost like we're not just debating what it means to be a scientist, but what it means to be a citizen.

What do you take away, Kaf and Zoë, about where we are, and why are we under fire, and how do we get past this?

Dr. Dzirasa. I think, in a lot of ways, science, the outcome changes perspective, right? So when science is useful, we don't have people arguing about whether polio vaccines are great or not, right? And so I think there are a lot of areas in medicine where we face this challenge. I actually think debate is very healthy for science. Right? I think contentious debate can actually be very helpful for science, in the same way our country was set up in way that healthy, constructive debate can be extremely useful.

I think what we want to do, especially as neuroscientists, I think we're at a place where we need to draw as many people in as possible and have healthy, constructive debates about how we get the outcomes we want.

[*Dr. Dzirasa continued his remarks, concluding as follows.*]

So we're at a place now where we're going to have to bring in other disciplines to know how to handle that data. I sat with a high school kid last night, Gabe, and it was pretty clear to me that the people who were going to solve this challenge of the brain are probably in, like, seventh or eighth grade right now. Right? And so how do we create an ecosystem where all those different perspectives can come in. The utility is, when all those different perspectives come in, there has to be contentious debate, right? But I think the solutions that will come out of it are what will move people's perspective on the usefulness of science.

Dr. Gawande. Zoë, what do you think about the constructive debate you hear, how we get to the more constructive debate, and enough optimism that we want to actually put funding into the kind of work that Kaf is talking about?

Ms. Keating. Well, I think of just making it broader. I was really inspired this morning by a lot of the speakers on the health track, and one of them was Steven Keating, who's not related to me at all—another Keating—and I was really struck how—he was a Ph.D. student, and he was doing 3–D printing. And he wanted to study his brain tumor, because he had a brain tumor. But in order to study his tumor, he had to become a medical student in order to get some of the tumor so he could study it.

And that seemed really—like, wow, that's limiting. Think of, like, all these amazing people we have in our country who are doing things, and increasingly, people are doing things outside of institutions. And I feel like that's where solutions are going to come from. Like, I think that we should also look at Silicon Valley. I was thinking about patients and how the whole patient issue I was having is kind of like a user-experience problem that somebody might tackle at a software startup, and maybe we should approach these things from different perspectives that way.

And I think that's part of this trust—you were talking about trust in data—that somehow expanding, bringing in voices, figuring out how people can contribute data, how we can all just be more involved will be a way towards making trust. The same thing is true with government. So—[*laughter*].

The President. No, absolutely. Well, I'll just pick up on a couple of themes. Any scientific revolution is, by definition, contesting the status quo. And we're going through a period in which our knowledge is expanding very quickly. It is going to have a wide range of ramifications and you've got a whole bunch of legacy systems that are going to be affected. So if self-driving cars are pervasive, a huge percentage of the American population right now makes its living, and oftentimes a pretty good living, driving. And so, understandably, people are going to be concerned about what does this mean. The—we've heard of the controversies around Uber versus those who have taxi medallions, but it's actually driverless Uber that is going to be even more challenging.

The same is true in the health care field. One of the things that you discover is this Rube Goldberg contraption that grew up over the last 50 years or 60 years, in terms of our health care system, is there's all kinds of economics that are embedded in every aspect of it. So it's not surprising, then, that when we passed the Affordable Care Act, that there are going to be people who push back not just because they really want to make it work and they've got some legitimate, factual critiques of it, but because people's pocketbooks may be threatened.

You—and, Zoë, you just used one example, which was the enormous controversy we had when we said that we should phase out certain types of insurance that, on their face, look really cheap, until you have a tumor and it turns out that they don't cover you. And that very low-cost insurance, sort of the equivalent of the bare-bones insurance you have to get for driving, but when you get in an accident, it turns out, doesn't do anything to fix your car, but obviously, much more is at stake here.

We still have debates today where people will say, you know, people's—aren't having the choices that they used to have. Well, the choices, in some cases, that they used to have were choices to get insurance that weren't going to cover them during a catastrophe.

So I think that the way I would like to see us operate—and we're not there at the moment, and it will never be perfect—is, yes, significant debate, contentious debate, but where we are still operating on the same basic platform, basic rules about how do we determine what's true and what's not. And one of the ironies, I think, of the Internet has been the degree to which it's bringing us unprecedented knowledge, but everything on the Internet looks like it might be true. [*Laughter*] And so in this political season, we've seen just—you just say stuff. [*Laughter*] And so everything suddenly becomes contested. That I do not think is good for our democracy, and it's certainly not good for science or progress or government or fixing systems. We've got to be able to agree on certain baseline facts.

If you want to argue with me about how to deal with climate change, that's a legitimate argument. Some people might argue it's unrealistic to think that we're going to be able to fix this so we should just start adapting to the oceans being 6 feet higher. You might want to suggest to me that it's got to be a market-based solution and it's all going to come through innovation, regulation is not going to help, we need a huge—I'm happy to have those arguments. But what you can't do is argue with me that we've had over the last 10, 15 years, each year is the hottest year ever, or that the glaciers are melting and Greenland is melting. You can't argue with me about that because I can see it, and we're recording it.

And in the same way around health, I think any good scientist or doctor would not presume to suggest that the sum total of our knowledge is all contained in our current medical schools, and there may be holistic medicines or alternative medicines that are remarkable, but we also should be able to test them. And you can't just assert that this works and more conventional therapies don't work and not be subject to that kind of testing regimen.

So that's where I think we have to move our conversation generally if we're going to have the kind of debate that Kaf talked about.

Accuracy of Online Information/News Media/Scientific Research

Dr. Gawande. So how do we move our conversation in that way, right? There was a time when scientists were arguing about climate change and reasonably so.

The President. Right.

Dr. Gawande. So how do we set up frameworks where we say, this is our time period where we're going to collect facts, and at the end of the day, we will accept the consensus of fact? Right? How do we do that in our current political enterprise?

The President. If I had the perfect answer to that, then I'd run for President. [*Laughter*] No, I just—look, this takes us a little bit far afield, but I do think that it's relevant to the scientific community, it's relevant to our democracy, citizenship. We're going to have to rebuild, within this Wild, Wild West of information flow, some sort of curating function that people agree to.

I use the analogy in politics: It used to be, there were three television stations and Walter Cronkite is on there and not everybody agreed. And there were always outliers who thought that it was all propaganda and we didn't really land on the Moon and Elvis is still alive and so forth. [*Laughter*] But generally, that was in the papers that you bought at the supermarket right as you were checking out. And generally, people trusted a basic body of information.

It wasn't always as democratic as it should have been. And Zoë is exactly right that, for example, on something like climate change, we've actually been doing some interesting initiatives

where we're essentially deputizing citizens with hand-held technologies to start recording information that then gets pooled. They're becoming scientists without getting the Ph.D. And we can do that in a lot of other fields as well.

But there has to be, I think, some sort of way in which we can sort through information that passes some basic truthiness tests—[*laughter*]—and those that we have to discard because they just don't have any basis in anything that's actually happening in the world.

And that's hard to do, but I think it's going to be necessary, it's going to be possible. I think the answer is obviously not censorship, but it's creating places where people can say, this is reliable and I'm still able to argue about—safely, about facts and what we should do about it while still not just making stuff up.

Technological Innovation/Science, Technology, Engineering, and Math Education/Distinction Between Government and Private Sector

Dr. Gawande. I think you're focusing on the idea of places where the scientific orientation can be that ethos is protected is really important. Science is always probable knowledge. It's never nailed down. But we're at CMU, we're at University of Pittsburgh, because they are places that hold those values of a scientific orientation. There are places that live like that online, in patient communities. There are places that are professional societies that make it happen.

It's crucial that it also happen in government and it also happen in the private sector. And I guess my final question would be, for any and all of us, what's the most important thing we can make sure that we do to keep that scientific orientation, that optimism, and that striving for the big opportunity going? That we can keep these values as part of the places where we are, whether they're in the virtual world or in our institutions. And maybe, I'll let you have the last word, so I'll start on that end, if that's okay, Zoë.

Ms. Keating. Well, I really feel like this—it's just this huge opportunity and this way for, if people feel like they can contribute, that then they will trust things. They will trust institutions, they will trust governments, if they feel that they have a voice. And it's our job to figure out how can we make this thing the President was talking about—how can we make the system that allows people to contribute, but it's somehow vetted so that all that knowledge can be shared, because we need all hands on deck. So—[*laughter*].

Dr. Gawande. And a chance for people to participate in the science itself.

Ms. Keating. Yes, a chance for people to participate. And that goes—that's beyond health care, that's across the board. And I feel like that's a huge challenge for our time. Right now, just how can we do that so that we can really—because we need everybody's help in everything that's coming for us.

Dr. Gawande. Riccardo.

Mr. Sabatini. Yes, the one thing that—the fight is a little bit unfair because magic has always answers, the bogus things that you find around. There's always strong answers. There is the cure of cancer, but it's closed in a closet somewhere. While science cannot state those strong answers, because it's a constantly evolving field, and it wouldn't be fair.

But we have a cool story that sometimes we don't say enough. When we describe how the brain works, when we describe the majesty of what it means watching inside your genes and how the proteins flow, and the molecules, and when I explain these stories and I make them human, and I explain cases—stories of patients and people that access their health and they really got incredible advancements on that. When we nail the story right, then we engage the young people, the vast majority of the population.

We tend to fight these bogus messages. But on one side, it means we are failing. We are failing to tell the amazing advancements that we are doing in the right stories, beating fake stories with great realities. And this is a challenge that we have to do. And I'm engaging as much as possible, explaining the excitement that there is in the time in history when we have access to things that we were never even dreaming 15 years ago.

This is the story that we have to tell outside these doors. You are some of the smartest people in this country. You have to be advocates of how amazing things we're doing, without giving strong solutions, but—and fake results, but telling that there are the best people chasing this dream and we're going to crack it. It is our duty, making people feel confident that this is the right story to follow.

Dr. Dzirasa. Yes, I'm honored that you chose to sit on this panel, because I think health is the real truth teller and the real equalizer. When you think about this country, by 2050, we'll be spending about a trillion dollars a year on Alzheimer's. If, Lord willing, we get over 85, half of us will have Alzheimer's. One out of every 48 boys in this country are born with autism now. And so it's the real truth teller. Right? It is the real common enemy that all of us, as Americans, as scientists, as educators have. Right?

And the reason I'm optimistic is because I fundamentally believe there is a 7-year-old sitting in a classroom somewhere that will take all of these investments and all of this work that we've made and transform things for my family. Right? The challenge for me is that I would love to see an America in which, whether that 7-year-old kid is sitting in a school in Detroit or Baltimore or Gentry High School in the Mississippi Delta, that they will also have the opportunity for their ideas to bubble up and be nurtured. Because, at the end of the day, that—the solution to that common enemy that we all face might be sitting in that classroom right now.

The President. That's great. Well, I'm going to steal some ideas from what my other panelists have already said.

First of all, Zoë's point about opening up systems so that people understand them and don't just feel like cogs in that system, but rather, have agency in that system, I think, is critically important.

So what we've been trying to do across the board—and we're not even close to being there yet—is to use technology as a way to do exactly what you are talking about. Whether it's releasing big data—and the easiest example, I think, for the general public to think about is all the apps that now give us the weather over our phones, and those are all generated from inside government, but it—what used to be closed data now we let out there. Well, it turns out that we've got huge data sets on all kinds of stuff. And the more we're opening that up and allowing businesses, individuals, to work with that information, I think, the more they feel empowered. And that makes a huge difference.

The second thing that I want to emphasize is, the most important curator to be able to sort through what's true and false and sustain that—those scientific values you talk about is the human brain, and making sure that our kids are getting that ability to analyze and do that sorting early. And so part of the reason why we've been emphasizing STEM education is not because we don't value the humanities—and I was a political science and English major, and I've probably learned more from reading novels than textbooks—but it's—what it does do is, it helps everyone as citizens, even if you don't become a doctor or a scientist or a physicist, it helps you evaluate information in a way that allows you to make good decisions in your own life, but also allows you to participate in the country as a whole.

And so we want everybody—we're putting a special emphasis on girls, young people of color, who so often are underrepresented in the STEM fields—we want to make sure they feel a

confidence about so much of the technology and information revolution and science that is transforming their lives all around them. And we want them to be creators of science, not just consumers of it. So I think that's very important.

The final thing I'll say is that government will never run the way Silicon Valley runs because, by definition, democracy is messy. This is a big, diverse country with a lot of interests and a lot of disparate points of view. And part of government's job, by the way, is dealing with problems that nobody else wants to deal with.

So sometimes, I talk to CEOs, they come in and they start, kind of, telling me about leadership, and here's how we do things. [*Laughter*]. And I say, well, if all I was doing was making a widget—[*laughter*]—or producing an app, and I didn't have to worry about whether poor people could afford the widget, or I didn't have to worry about whether the app had some unintended consequences—setting aside my Syria and Yemen portfolio—[*laughter*]—then I think those suggestions are terrific. [*Laughter*] But if—which isn't the—that's not, by the way, to say that there aren't huge efficiencies and improvements that have to be made.

But the reason I say this is, sometimes you get, I think—in the scientific community, the tech community, the entrepreneurial community—the sense of we just have to blow up the system or create this parallel society and culture because Government is inherently wrecked. No, it's not inherently wrecked; it's just Government has to care for, for example, veterans who come home. That's not on your balance sheet, that's on our collective balance sheet, because we have a sacred duty to take care of those veterans. And that's hard, and it's messy, and we're building off legacy systems that we can't just blow up.

We've been pushing very hard in the area of medicine to have the FDA reimagine how it does regulations in the genetic space so that it's different from how they might deal with a mechanical prosthetic. But I don't want to just blow up the FDA, because part of Government's job is to make sure that snake oil and stuff that could hurt you isn't out on—out there on the market being advertised on a daily basis.

So there are going to be some inherent balances that have to be taken in, and there are equities that are complicated in Government. And I guess the reason I'm saying this is, I don't want this audience of people who are accustomed to things happening faster and smoother in their narrow fields to somehow get discouraged and say, I'm just not going to deal with Government. Because, at the end of the day, if you're not willing to do what Kaf said earlier, which is just get in the arena and wrestle with this stuff and argue with people who may not agree with you and tolerate sometimes not perfect outcomes, but better outcomes, then the space to continue scientific progress isn't going to be there.

And what gives me confidence is that I've met a lot of people as President of the United States, and the American people fundamentally are good, they're decent, and they're smart, and they just don't have time to follow everything. The more we empower them, the more we bring them in and include them, I have no doubt that we're going to be able to make enormous strides. And the audience here, I think, is representative of the amazing possibilities that we confront. All right?

Dr. Gawande. Well, let's thank the panel. And I'd also like to thank the President for having the Frontiers Conference. I think you have set an expectation which can apply to any President in the future of any party that you can be a President for science and health and that we can live up to those values. So thank you.

NOTE: The President spoke at approximately 2:05 p.m. in the Wiegand Gym at the Jared L. Cohon University Center. In his remarks, he referred to Patrick Gallagher, chancellor, University

of Pittsburgh. Mr. Sabatini referred to J. Craig Venter, founder, chairman, and chief executive officer, J. Craig Venter Institute. Ms. Keating referred to Steven Keating, research affiliate, Mediated Matter.

Categories: Addresses and Remarks : White House Frontiers Conference, panel discussion at Carnegie Mellon University in Pittsburgh, PA.

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